PROJECT MANUAL

Greenbrier State Park - Charge Station

Washington County, Maryland
South Mountain Recreation Area
21843 National Pike
Boonsboro, MD 21713

For the Department of Natural Resources

Z|S Project Number - 2015
DGS Project Number - P-052-200-002
Classification Code "E"

BID AND CONSTRUCTION DOCUMENTS SUBMISSION

Date of Documents: 23 August 2021

STATE OF MARYLAND

DEPARTMENT OF GENERAL SERVICES
Atif Chaudhry, Secretary
301 West Preston Street, Room 1405
Baltimore, MD 21201

BOARD OF PUBLIC WORKS
Wes Moore, Governor
Brooke E. Lierman, Comptroller
Dereck E. Davis, Treasurer

MINORITY BUSINESS ENTERPRISES ARE ENCOURAGED TO RESPOND TO THIS SOLICITIATION

Mechanical/Electrical Engineer: James Posey Associates
Civil Engineer: A. Morton Thomas and Associates, Inc.
Landscape Architect: Floura Teeter Landscape Architects
Structural Engineer: Albrecht Engineering, Inc.
Geotechnical Engineer: Schnabel Engineering

ZIGER | SNEAD ARCHITECTS

1006 Morton Street
Baltimore, Maryland 21201
410.576.9131
zigersnead.com

TABLE OF CONTENTS

(Not Used)

DIVISION 31 - EARTHWORK

DIVISION 32 - EXTERIOR IMPROVEMENTS

DIVISION 33 - UTILITIES

APPENDICES

END OF SECTION

LIST OF DRAWINGS

GENERAL

G.000	COVER SHEET
G.110	CODE ANALYSIS AND LIFE SAFETY PLAN

CIVIL

C.001	CIVIL/SITE GENERAL NOTES AND INFORMATION
GI.501	SOIL BORING LOGS
VF.101	EXISTING CONDITIONS PLAN
CD.101	SITE DEMOLITION PLAN
CE.101	EROSION CONTROL PLAN STAGE 1
CE.102	EROSION CONTROL PLAN STAGE 2
CE.103	EROSION CONTROL PLAN STAGE 3
CE.104	EROSION CONTROL PLAN STAGE 4
CE.501	EROSION AND SEDIMENT CONTROL NOTES
CE.502	EROSION AND SEDIMENT CONTROL NOTES
CE.503	EROSION AND SEDIMENT CONTROL DETAILS
CG.101	SITE GRADING AND DRAINAGE PLAN
CG.201	STORM DRAINAGE PROFILES
CG.401	SITE GRADING AND DRAINAGE PLAN
CG.402	SITE GRADING AND DRAINAGE PLAN
CS.101	SITE IMPROVEMENTS PLAN
CS.102	NEW MAIN ENTRY GATE PLAN
CS.501	SITE DETAILS
CS.502	SITE DETAILS
CS.503	SITE DETAILS
CS.504	SITE DETAILS
CS.505	SITE DETAILS
CW.101	STORMWATER MANAGEMENT PLAN
CW.401	SWM #1 ENLARGED PLAN
CW.402	SWM #2 ENLARGED PLAN
CW.403	SWM #2 PROFILE AND SECTION
CW.404	SWM #3 ENLARGED PLAN
CW.501	SWM NOTES AND DETAILS
CW.502	SWM NOTES AND DETAILS

LN.101	NATURAL RESOURCE INVENTORY
LF.101	TREE PROTECTION PLAN
LF.102	TREE PROTECTION NOTES & DETAILS

LANDSCAPE

LS.100	OVERALL LANDSCAPE PLAN
LS.200	LANDSCAPE DETAILS

STRUCTURAL

S.001	STRUCTURAL NOTES
S.100	STRUCTURAL PLANS
S.101	STRUCTURAL DETAILS
S.102	STRUCTURAL DETAILS

ARCHITECTURAL

AR. 000	ARCHITECTURAL SYMBOLS, MATERIALS, & ABBREVIATIONS
AR.001	PROJECT STANDARDS AND MOUNTING SCHEDULE
AD.100	DEMOLITION PLANS - REGISTRATION STATION
AS.000	SITE PLAN - NEW CONSTRUCTION
A.010	CONSTRUCTION TYPES SCHEDULE
A.011	CONSTRUCTION TYPES SCHEDULE - PARTITION DETAILS
A.100	FLOOR PLAN & RCP - REGISTRATION STATION
A.101	ROOF & ATTIC PLANS - REGISTRATION STATION
A.102	PLANS & RCP - CHARGE STATION
A.300	EXTERIOR ELEVATIONS - REGISTRATION STATION
A.301	BUILDING SECTIONS - REGISTRATION STATION
A.302	ELEVATIONS & SECTIONS - CHARGE STATION
A.400	WALL SECTIONS - REGISTRATION STATION
A.401	WALL SECTIONS - REGISTRATION STATION
A.410	WALL SECTIONS & DETAILS - CHARGE STATION
A.500	REGISTRATION STATION DETAILS
A.501	REGISTRATION STATION DETAILS
A.502	REGISTRATION STATION DETAILS
A.510	CHARGE STATION DETAILS
A.520	FIREWOOD STORAGE DETAILS - ADD ALTERNATE
A.700	INTERIOR ELEVATIONS

A.800	INTERIOR DETAILS
A.900	DOOR & WINDOW SCHEDULES, AND TYPICAL DETAILS

MECHANICAL

M-001	SYMBOLS AND ABBREVIATIONS
M.100	FLOOR PLANS - DEMOLITION AND NEW WORK
M.500	MECHANICAL DETAILS & DIAGRAMS
M.600	MECHANICAL SCHEDULES

PLUMBING

P.100	FLOOR PLANS - PLUMBING - DEMOLITION AND NEW WORK
P.500	PLUMBIND DETAILS & DIAGRAMS
P.600	PLUMBING SCHEDULES

ELECTRICAL

E.001	SYMBOLS AND ABBREVIATIONS
E.002	SITE PLAN - DEMOLITION
E.003	SITE PLAN - NEW YORK
ED.100	FLOOR PLANS - ELECTIRCAL -D EMOLITION
E.100	FLOOR PLANS - ELECTRICAL - LIGHTING
E.101	FLOOR PLANS - POWER - NEW WORK
E.500	DETAILS AND DIAGRAMS
E.501	DETAILS AND DIAGRAMS
E.601	SCHEDULES

SECTION 01 1000

SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Project information.
2. Work covered by Contract Documents.
3. Owner-furnished products.
4. Access to Site.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and Drawing conventions.

B. Related Requirements:
1. Section 01 5000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 DEFINITIONS

A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

A. Project Identification: Greenbrier State Park Charge Station.
1. Project Location: 21843 National Pike, Boonsboro, MD, 21713.

B. Owner: Department of Natural Resources.

C. Architect: Ziger Snead Architects.

D. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.
1. See Section 01 3100 "Project Management and Coordination." for requirements for using web-based Project software.

1.5 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:
   1. Renovation of the existing camper registration and surrounding site, as well as construction of two charge stations and other Work indicated in the Contract Documents.

B. Type of Contract:
   1. Project will be constructed under a single prime contract.

1.6 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.

B. Owner-Furnished Products
   1. Ice Maker (2) at rear porch.

1.7 ACCESS TO SITE

A. General: Contractor shall have full use of Project Site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.8 COORDINATION WITH OCCUPANTS

A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
   1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
   2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
   3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
   4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.9 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.
   1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to between 8:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
   1. Weekend Hours: By Request Only.
   2. Early Morning Hours: Prior to 8:00 AM by request only.
   3. Hours for Utility Shutdowns: By Request Only.

C. 8Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
   1. Notify Owner not less than two days in advance of proposed disruptive operations.
   2. Obtain Owner's written permission before proceeding with disruptive operations.

D. Smoking and Controlled Substance Restrictions: Use of tobacco products , alcoholic beverages, and other controlled substances on Owner's property is not permitted.

E. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

F. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
   1. Maintain list of approved screened personnel with Owner's representative.

1.10 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
   1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
   2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
   1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
   2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawingsand published as part of the U.S. National CAD Standard.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 1000

SECTION 01 2300

ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
   1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
   2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
   1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Stone Site Walls
   1. Base Bid: No stone site walls to be constructed.
   2. Alternate: As indicated on Drawings
      a. Construct dry-stacked stone wall between entry lane and sidewalk as indicated on Drawings.
      b. Construct stone-clad masonry site walls as indicated on Drawings.

B. Alternate No. 2: Site Paving
   1. Base Bid: Exposed Aggregate concrete paving at all site paving locations.
   2. Alternate: As indicated on Drawings.
      a. Provide Unit Paving as specified in Section 32 1400, and as indicated on Drawings.

C. Alternate No. 3: Firewood Storage
   1. Base Bid: Do not construct firewood storage units.
   2. Alternate: Provide firewood storage units as indicated on Drawings.

D. Alternate No. 4: Hard-wiring at entry gate.
   1. Base Bid: as indicated on Drawing:
      a. Provide solar-powered entry gate with key pad and associated site modifications.
   2. Alternate: Provide hard-wired electrical connection:
      a. Extend wiring within buried conduit from Camper Registration building and along entry drive, approximately 1,700 linear feet.

END OF SECTION 01 2300

SECTION 01 2500

SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:
   1. Section 01 6000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
   1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
   2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Substitution Request Form: Use facsimile of form provided in Project Manual.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
      b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
      d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
   a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
   b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions. Submittals for substitution are after award only.

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
   1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
      a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
      b. Requested substitution provides sustainable design characteristics that specified product provided.

c. Substitution request is fully documented and properly submitted.
d. Requested substitution will not adversely affect Contractor's construction schedule.
e. Requested substitution has received necessary approvals of authorities having jurisdiction.
f. Requested substitution is compatible with other portions of the Work.
g. Requested substitution has been coordinated with other portions of the Work.
h. Requested substitution provides specified warranty.
i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
j. Only one request for substitution for each product per contractor will be considered. When substitution is not accepted, provide specified product.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Requested substitution provides sustainable design characteristics that specified product provided.
e. Substitution request is fully documented and properly submitted.
f. Requested substitution will not adversely affect Contractor's construction schedule.
g. Requested substitution has received necessary approvals of authorities having jurisdiction.
h. Requested substitution is compatible with other portions of the Work.
i. Requested substitution has been coordinated with other portions of the Work.
j. Requested substitution provides specified warranty.
k. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2500

SECTION 01 2600

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:
1. Section 01 2500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
2. Section 01 3100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work. Contractor will review said changes and indicate if these will result in a change in the contract sum or contract time and will provide additional information about these changes for review by Architect and Owner.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.

2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
   a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   c. Include costs of labor and supervision directly attributable to the change.

d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 2500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701 or form acceptable to the Owner and Architect..

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2600

SECTION 01 3100

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
   1. General coordination procedures.
   2. Coordination drawings.
   3. Requests for Information (RFIs).
   4. Digital project management procedures.
   5. Web-based Project management software package.
   6. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:
   1. Section 01 3200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
   2. Section 01 7300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   3. Section 01 7700 "Closeout Procedures" for coordinating closeout of the Contract.
   4. Section 01 9113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.

2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in each built facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Cooridnate use of temporary utilities to minimize waste.

1.6 COORDINATION DOCUMENTATION

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Show the relationship of components shown on separate shop drawings.
2. Indicate required installation sequences.

B. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
   1. File Preparation Format:
      a. Same digital data software program, version, and operating system as original Drawings.
   2. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
      a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
   3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
      a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
      b. Contractor shall execute a data licensing agreement in the form of AIA Document C106 or an Agreement form acceptable to Owner and Architect.

1.7 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
   1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
   2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
   1. Project name.
   2. Owner name.
   3. Owner's Project number.
   4. Name of Architect.
   5. Architect's Project number.
   6. Date.
   7. Name of Contractor.
   8. RFI number, numbered sequentially.
   9. RFI subject.
   10. Specification Section number and title and related paragraphs, as appropriate.
   11. Drawing number and detail references, as appropriate.
   12. Field dimensions and conditions, as appropriate.
   13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   14. Contractor's signature.
   15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
      a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
   1. The following Contractor-generated RFIs will be returned without action:
      a. Requests for approval of submittals.
      b. Requests for approval of substitutions.
      c. Requests for approval of Contractor's means and methods.
      d. Requests for coordination information already indicated in the Contract Documents.
      e. Requests for adjustments in the Contract Time or the Contract Sum.
      f. Requests for interpretation of Architect's actions on submittals.
      g. Incomplete RFIs or inaccurately prepared RFIs.
   2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
   3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 2600 "Contract Modification Procedures."
      a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Construction Manager in writing within 10 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
   1. Project name.
   2. Name and address of Contractor.
   3. Name and address of Architect.
   4. RFI number, including RFIs that were returned without action or withdrawn.
   5. RFI description.
   6. Date the RFI was submitted.
   7. Date Architect's response was received.
   8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
   9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.
   1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
   2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
   3. Contractor shall execute a data licensing agreement in the form of AIA Document C106 Digital Data Licensing Agreement or an Agreement form acceptable to Owner and Architect.
      a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of AIA Document C106 or anAgreement acceptable to Owner and Architect.

4. The following digital data files will be furnished for each appropriate discipline:
   a. Floor plans.
   b. Reflected ceiling plans.

B. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
1. Web-based Project management software includes, at a minimum, the following features:
   a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
   b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
   c. Document workflow planning, allowing customization of workflow between project entities.
   d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
   e. Track status of each Project communication in real time, and log time and date when responses are provided.
   f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
   g. Processing and tracking of payment applications.
   h. Processing and tracking of contract modifications.
   i. Creating and distributing meeting minutes.
   j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
   k. Management of construction progress photographs.
   l. Mobile device compatibility, including smartphones and tablets.
2. Provide up to ten Project management software user licenses for use of Owner, Owner's Commissioning Authority, Architect, and Architect's consultants. Provide eight hours of software training at Architect's office for web-based Project software users.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
4. Provide the following web-based Project software packages under their current published licensing agreements:
   a. Newforma, Inc.
   b. Procore Technologies, Inc.
   c. Autodesk: Constructware
   d. Meridian Systems; Prolog.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
    a. Responsibilities and personnel assignments.
    b. Tentative construction schedule.
    c. Phasing.
    d. Critical work sequencing and long lead items.
    e. Designation of key personnel and their duties.
    f. Lines of communications.
    g. Use of web-based Project software.
    h. Procedures for processing field decisions and Change Orders.
    i. Procedures for RFIs.
    j. Procedures for testing and inspecting.
    k. Procedures for processing Applications for Payment.
    l. Distribution of the Contract Documents.
    m. Submittal procedures.
    n. Sustainable design requirements.
    o. Preparation of Record Documents.
    p. Use of the premises and existing building.
    q. Work restrictions.
    r. Working hours.
    s. Owner's occupancy requirements.
    t. Responsibility for temporary facilities and controls.
    u. Procedures for moisture and mold control.
    v. Procedures for disruptions and shutdowns.
    w. Construction waste management and recycling.
    x. Parking availability.
    y. Office, work, and storage areas.
    z. Equipment deliveries and priorities.
    aa. First aid.
    bb. Security.
    cc. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, and Owner's Commissioning Authority of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    a. Contract Documents.
    b. Options.
    c. Related RFIs.
    d. Related Change Orders.
    e. Purchases.
    f. Deliveries.
    g. Submittals.
    h. Sustainable design requirements.
    i. Review of mockups.
    j. Possible conflicts.
    k. Compatibility requirements.
    l. Time schedules.
    m. Weather limitations.
    n. Manufacturer's written instructions.
    o. Warranty requirements.
    p. Compatibility of materials.
    q. Acceptability of substrates.
    r. Temporary facilities and controls.
    s. Space and access limitations.
    t. Regulations of authorities having jurisdiction.
    u. Testing and inspecting requirements.
    v. Installation procedures.
    w. Coordination with other work.
    x. Required performance results.
    y. Protection of adjacent work.
    z. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    a. Preparation of Record Documents.
    b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    c. Procedures for completing and archiving web-based Project software site data files.
    d. Submittal of written warranties.
    e. Requirements for completing sustainable design documentation.

f. Requirements for preparing operations and maintenance data.
g. Requirements for delivery of material samples, attic stock, and spare parts.
h. Requirements for demonstration and training.
i. Preparation of Contractor's punch list.
j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
k. Submittal procedures.
l. Coordination of separate contracts.
m. Owner's partial occupancy requirements.
n. Installation of Owner's furniture, fixtures, and equipment.
o. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at regular intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      1) Review schedule for next period.
   b. Review present and future needs of each entity present, including the following:
      1) Interface requirements.
      2) Sequence of operations.
      3) Status of submittals.
      4) Status of sustainable design documentation.
      5) Deliveries.
      6) Off-site fabrication.
      7) Access.
      8) Site use.
      9) Temporary facilities and controls.
      10) Progress cleaning.
      11) Quality and work standards.
      12) Status of correction of deficient items.
      13) Field observations.
      14) Status of RFIs.
      15) Status of Proposal Requests.
      16) Pending changes.
      17) Status of Change Orders.
      18) Pending claims and disputes.
      19) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
   b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
   c. Review present and future needs of each contractor present, including the following:
      1) Interface requirements.
      2) Sequence of operations.
      3) Resolution of BIM component conflicts.
      4) Status of submittals.
      5) Deliveries.
      6) Off-site fabrication.
      7) Access.
      8) Site use.
      9) Temporary facilities and controls.
      10) Work hours.
      11) Hazards and risks.
      12) Progress cleaning.
      13) Quality and work standards.
      14) Status of RFIs.
      15) Proposal Requests.
      16) Change Orders.
      17) Pending changes.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3100

SECTION 01 3200

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Startup construction schedule.
   2. Contractor's Construction Schedule.
   3. Construction schedule updating reports.
   4. Daily construction reports.
   5. Material location reports.
   6. Site condition reports.
   7. Unusual event reports.

B. Related Requirements:
   1. Section 01 3300 "Submittal Procedures" for submitting schedules and reports.
   2. Section 01 4000 "Quality Requirements" for schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
   1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
   2. Predecessor Activity: An activity that precedes another activity in the network.
   3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.
   1. Float time belongs to Owner.
   2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
   3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:
   1. Working electronic copy of schedule file.
   2. PDF electronic file.

B. Startup construction schedule.
   1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
   1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
   1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
   2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
   3. Total Float Report: List of activities sorted in ascending order of total float.
   4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at monthly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Unusual Event Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 3100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including interim milestones.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL,

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

B. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 3300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.

4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
5. Commissioning Time: Include no fewer than 15 days for commissioning.
6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 1000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
2. Work Restrictions: Show the effect of the following items on the schedule:
   a. Coordination with existing construction.
   b. Limitations of continued occupancies.
   c. Uninterruptible services.
   d. Partial occupancy before Substantial Completion.
   e. Use-of-premises restrictions.
   f. Provisions for future construction.
   g. Seasonal variations.
   h. Environmental control.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Final Completion percentage for each activity.

H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

I. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
   1. Post copies in Project meeting rooms and temporary field offices.
   2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.8 CPM SCHEDULE REQUIREMENTS

A. Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 14 days of date established for commencement of the Work. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
   1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 60 days after date established for commencement of the Work.
      a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
   2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
   3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

   4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
   1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
      a. Preparation and processing of submittals.
      b. Mobilization and demobilization.
      c. Purchase of materials.
      d. Delivery.
      e. Fabrication.
      f. Utility interruptions.
      g. Installation.
      h. Work by Owner that may affect or be affected by Contractor's activities.
      i. Testing and inspection.
      j. Commissioning.
      k. Punch list and Final Completion.
      l. Activities occurring following Final Completion.
   2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.

3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, sustainable design documentation, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
    a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
    b. Total cost assigned to activities shall equal the total Contract Sum.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
    a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.

b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.9 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3200

SECTION 01 3233

PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Preconstruction photographs.
   2. Periodic construction photographs.
   3. Final Completion construction photographs.

B. Related Requirements:
   1. Section 01 7700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
   2. Section 01 7900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
   3. Section 02 4116 "Structure Demolition" for photographic documentation before building demolition operations commence.
   4. Section 02 4119 "Selective Demolition" for photographic documentation before selective demolition operations commence.
   5. Section 31 1000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.
   1. Submit photos on CD-ROM or thumb-drive. Include copy of key plan indicating each photograph's location and direction.
   2. Identification: Provide the following information with each image description in file metadata tag:
      a. Name of Project.
      b. Name and contact information for photographer.
      c. Name of Architect.
      d. Name of Contractor.
      e. Date photograph was taken.
      f. Description of location, vantage point, and direction.
      g. Unique sequential identifier keyed to accompanying key plan.

1.4 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

1.5 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.

B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

C. Metadata: Record accurate date and time from camera.

D. File Names: Name media files with date and sequential numbering suffix.

1.6 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs with maximum depth of field and in focus.
   1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
   1. Flag construction limits before taking construction photographs.
   2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
   3. Take 20 photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
   4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Periodic Construction Photographs: Take 50 photographs weekly . Select vantage points to show status of construction and progress since last photographs were taken.

E. Final Completion Construction Photographs: Take 50 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

F. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
   1. Three days' notice will be given, where feasible.
   2. In emergency situations, take additional photographs within 24 hours of request.

3. Circumstances that could require additional photographs include, but are not limited to, the following:
   a. Special events planned at Project site.
   b. Immediate follow-up when on-site events result in construction damage or losses.
   c. Photographs shall be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
   d. Substantial Completion of a major phase or component of the Work.
   e. Extra record photographs at time of final acceptance.
   f. Owner's request for special publicity photographs.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3233

SECTION 01 3300

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:
1. Section 01 3100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
2. Section 01 4000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
3. Section 01 7700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
4. Section 01 7823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
5. Section 01 7839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
6. Section 01 7900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. File Transfer Protocol: Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
   1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
   2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
   3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
      a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
   4. Format: Arrange the following information in a tabular format:
      a. Scheduled date for first submittal.
      b. Specification Section number and title.
      c. Submittal Category: Action; informational.
      d. Name of subcontractor.
      e. Description of the Work covered.
      f. Scheduled date for Architect's final release or approval.
      g. Scheduled date of fabrication.

1.5 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:
   1. Project name.
   2. Date.
   3. Name and address of Architect.
   4. Name of Contractor.
   5. Name of firm or entity that prepared submittal.
   6. Names of subcontractor, manufacturer, and supplier.
   7. Category and type of submittal.
   8. Submittal purpose and description.
   9. Number and title of Specification Section,
   10. Specification paragraph paragraph number or drawing designation and generic name for each of multiple items.
   11. Drawing number and detail references, as appropriate.
   12. Indication of full or partial submittal.
   13. Related physical samples submitted directly.
   14. Location(s) where product is to be installed, as appropriate.
   15. Transmittal number, numbered consecutively.
   16. Submittal and transmittal distribution record.
   17. Other necessary identification.

18. Remarks.
19. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
   a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
   a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 10 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 10 working days for review of each resubmittal.

4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 15 working days for initial review of each submittal.
5. Architect will advise Contractor when a submittal being processed must be delayed for coordination.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect'saction stamp.

1.7 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
    a. Wiring diagrams that show factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.

f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
3. Submit Shop Drawings in the following format:
   a. PDF Electronic file.
4. BIM Incorporation: Develop and incorporate Shop Drawing files into Building Information Model established for Project.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
   a. Project name and submittal number.
   b. Generic description of Sample.
   c. Product name and name of manufacturer.
   d. Sample source.
   e. Number and title of applicable Specification Section.
   f. Specification paragraph number and generic name of each item.
3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
   2. Manufacturer and product name, and model number if applicable.
   3. Number and name of room or space.
   4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:
   1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.

   2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
   3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
   4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
   5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
   6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:
   1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
   2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
   3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
   4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
    1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
    1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. BIM Incorporation: Incorporate delegated-design drawing and data files into BIM established for Project.
    1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.

1.9 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
    1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ARCHITECT'S ACTION

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architectwill forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will discard submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3300

SECTION 01 4000

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
   1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.
   1. Mockups are used for one or more of the following:
      a. Verify selections made under Sample submittals.

b. Demonstrate aesthetic effects.
c. Demonstrate the qualities of products and workmanship.
d. Demonstrate successful installation of interfaces between components and systems.
e. Perform preconstruction testing to determine system performance.

2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 ACTION SUBMITTALS

A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be desgined or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.7 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
   1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
   2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Entity responsible for performing tests and inspections.
   3. Description of test and inspection.
   4. Identification of applicable standards.
   5. Identification of test and inspection methods.
   6. Number of tests and inspections required.
   7. Time schedule or time span for tests and inspections.

8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.8 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.9 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.10 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
   1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
   1. Contractor's responsibilities, including the following:
      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
      c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
      d. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
      e. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
   2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups of size indicated.
   2. Build mockups in location indicated or, if not indicated, as directed by Architect.
   3. Notify Architectseven days in advance of dates and times when mockups will be constructed.
   4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
   5. Demonstrate the proposed range of aesthetic effects and workmanship.
   6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
      a. Allow seven days for initial review and each re-review of each mockup.
   7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

   8. Demolish and remove mockups when directed unless otherwise indicated.

1.11 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.

   2. Payment for these services will be made from testing and inspection allowances specified in Section 01 2100 "Allowances," as authorized by Change Orders.
   3. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
   1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

   2. Engage a qualified testing agency to perform quality-control services.
      a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
   3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
   4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
   5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
   6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
   1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
   2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
   3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
   4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
   5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
   6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 3300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   1. Access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.
   3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
   4. Facilities for storage and field curing of test samples.
   5. Delivery of samples to testing agencies.
   6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
   7. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
   1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.12 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Conducted by a qualified special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
   1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
   2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.

3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 7300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 4000

SECTION 01 4200

REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
   1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
   1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.
   1. AABC - Associated Air Balance Council; www.aabc.com.
   2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
   3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
   4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
   5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
   6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
   7. ABMA - American Boiler Manufacturers Association; www.abma.com.
   8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
   9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
   10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
   11. AF&PA - American Forest & Paper Association; www.afandpa.org.
   12. AGA - American Gas Association; www.aga.org.
   13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
   14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
   15. AI - Asphalt Institute; www.asphaltinstitute.org.
   16. AIA - American Institute of Architects (The); www.aia.org.
   17. AISC - American Institute of Steel Construction; www.aisc.org.
   18. AISI - American Iron and Steel Institute; www.steel.org.
   19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
   20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
   21. ANSI - American National Standards Institute; www.ansi.org.
   22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
   23. APA - APA - The Engineered Wood Association; www.apawood.org.
   24. APA - Architectural Precast Association; www.archprecast.org.
   25. API - American Petroleum Institute; www.api.org.
   26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
   27. ARI - American Refrigeration Institute; (See AHRI).
   28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.

29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
34. ASSP - American Society of Safety Professionals (The); www.assp.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AVIXA - Audiovisual and Integrated Experience Association; (Formerly: Infocomm International); www.soundandcommunications.com.
38. AWEA - American Wind Energy Association; www.awea.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
50. CDA - Copper Development Association; www.copper.org.
51. CE - Conformite Europeenne; www.ec.europa.eu/growth/single-market/ce-marking.
52. CEA - Canadian Electricity Association; www.electricity.ca.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.compositepanel.org.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - CSA Group; www.csa-group.org.
65. CSI - Construction Specifications Institute (The); www.csiresources.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTA - Consumer Technology Association; www.cta.tech.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.coolingtechnology.org.
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHA - Decorative Hardwoods Association; (Formerly: Hardwood Plywood & Veneer Association); www.decorativehardwoods.org.
72. DHI - Door and Hardware Institute; www.dhi.org.
73. ECA - Electronic Components Association; (See ECIA).
74. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
75. ECIA - Electronic Components Industry Association; www.ecianow.org.
76. EIA - Electronic Industries Alliance; (See TIA).
77. EIMA - EIFS Industry Members Association; www.eima.com.

78. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
79. EOS/ESD Association; (Electrostatic Discharge Association); www.esda.org.
80. ESTA - Entertainment Services and Technology Association; (See PLASA).
81. ETL - Intertek (See Intertek); www.intertek.com.
82. EVO - Efficiency Valuation Organization; www.evo-world.org.
83. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
84. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
85. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
86. FM Approvals - FM Approvals LLC; www.fmglobal.com.
87. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
88. FRSA - Florida Roofing, Sheet Metal Contractors Association, Inc.; www.floridaroof.com.
89. FSA - Fluid Sealing Association; www.fluidsealing.com.
90. FSC - Forest Stewardship Council U.S.; www.fscus.org.
91. GA - Gypsum Association; www.gypsum.org.
92. GANA - Glass Association of North America; (See NGA).
93. GS - Green Seal; www.greenseal.org.
94. HI - Hydraulic Institute; www.pumps.org.
95. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
96. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
97. HPVA - Hardwood Plywood & Veneer Association; (See DHA).
98. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
99. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
100. IAS - International Accreditation Service; www.iasonline.org.
101. ICBO - International Conference of Building Officials; (See ICC).
102. ICC - International Code Council; www.iccsafe.org.
103. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
104. ICPA - International Cast Polymer Association; www.theicpa.com.
105. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
106. IEC - International Electrotechnical Commission; www.iec.ch.
107. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
108. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
109. IESNA - Illuminating Engineering Society of North America; (See IES).
110. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
111. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
112. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
113. II - Infocomm International; (See AVIXA).
114. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
115. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
116. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
117. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
118. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
119. ISO - International Organization for Standardization; www.iso.org.
120. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
121. ITU - International Telecommunication Union; www.itu.int.
122. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
123. LMA - Laminating Materials Association; (See CPA).
124. LPI - Lightning Protection Institute; www.lightning.org.
125. MBMA - Metal Building Manufacturers Association; www.mbma.com.
126. MCA - Metal Construction Association; www.metalconstruction.org.

127. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
128. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
129. MHIA - Material Handling Industry of America; www.mhia.org.
130. MIA - Marble Institute of America; (See NSI).
131. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
132. MPI - Master Painters Institute; www.paintinfo.com.
133. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
134. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
135. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
136. NADCA - National Air Duct Cleaners Association; www.nadca.com.
137. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
138. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
139. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
140. NBI - New Buildings Institute; www.newbuildings.org.
141. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
142. NCMA - National Concrete Masonry Association; www.ncma.org.
143. NEBB - National Environmental Balancing Bureau; www.nebb.org.
144. NECA - National Electrical Contractors Association; www.necanet.org.
145. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
146. NEMA - National Electrical Manufacturers Association; www.nema.org.
147. NETA - InterNational Electrical Testing Association; www.netaworld.org.
148. NFHS - National Federation of State High School Associations; www.nfhs.org.
149. NFPA - National Fire Protection Association; www.nfpa.org.
150. NFPA - NFPA International; (See NFPA).
151. NFRC - National Fenestration Rating Council; www.nfrc.org.
152. NGA - National Glass Association (The); (Formerly: Glass Association of North America); www.glass.org.
153. NHLA - National Hardwood Lumber Association; www.nhla.com.
154. NLGA - National Lumber Grades Authority; www.nlga.org.
155. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
156. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
157. NRCA - National Roofing Contractors Association; www.nrca.net.
158. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
159. NSF - NSF International; www.nsf.org.
160. NSI - National Stone Institute; (Formerly: Marble Institute of America); www.naturalstoneinstitute.org.
161. NSPE - National Society of Professional Engineers; www.nspe.org.
162. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
163. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
164. NWFA - National Wood Flooring Association; www.nwfa.org.
165. NWRA - National Waste & Recycling Association; www.wasterecycling.org
166. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
167. PDI - Plumbing & Drainage Institute; www.pdionline.org.
168. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
169. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
170. RFCI - Resilient Floor Covering Institute; www.rfci.com.
171. RIS - Redwood Inspection Service; www.redwoodinspection.com.
172. SAE - SAE International; www.sae.org.
173. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
174. SDI - Steel Deck Institute; www.sdi.org.
175. SDI - Steel Door Institute; www.steeldoor.org.
176. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.

177. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
178. SIA - Security Industry Association; www.siaonline.org.
179. SJI - Steel Joist Institute; www.steeljoist.org.
180. SMA - Screen Manufacturers Association; www.smainfo.org.
181. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
182. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
183. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
184. SPIB - Southern Pine Inspection Bureau; www.spib.org.
185. SPRI - Single Ply Roofing Industry; www.spri.org.
186. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
187. SSINA - Specialty Steel Industry of North America; www.ssina.com.
188. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
189. STI - Steel Tank Institute; www.steeltank.com.
190. SWI - Steel Window Institute; www.steelwindows.com.
191. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
192. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
193. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
194. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
195. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
196. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
197. TMS - The Masonry Society; www.masonrysociety.org.
198. TPI - Truss Plate Institute; www.tpinst.org.
199. TPI - Turfgrass Producers International; www.turfgrasssod.org.
200. TRI - Tile Roofing Institute; www.tileroofing.org.
201. UL - Underwriters Laboratories Inc.; www.ul.com.
202. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
203. USAV - USA Volleyball; www.usavolleyball.org.
204. USGBC - U.S. Green Building Council; www.usgbc.org.
205. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
206. WA - Wallcoverings Association; www.wallcoverings.org.
207. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
208. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
209. WDMA - Window & Door Manufacturers Association; www.wdma.com.
210. WI - Woodwork Institute; www.wicnet.org.
211. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
   1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
   2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
   3. ICC - International Code Council; www.iccsafe.org.
   4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
   1. COE - Army Corps of Engineers; www.usace.army.mil.
   2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
   3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
   4. DOD - Department of Defense; www.quicksearch.dla.mil.
   5. DOE - Department of Energy; www.energy.gov.

6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.govinfo.gov.
2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
   a. Available from Defense Standardization Program; www.dsp.dla.mil.
   b. Available from General Services Administration; www.gsa.gov.
   c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS; California Department of Health Services; (See CDPH).
4. CDPH; California Department of Public Health; Indoor Air Quality Program;www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservice.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 4200

SECTION 01 5000

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:
1. Section 01 1000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to,Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

D. Erosion and Sedimentation-control plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

E. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

F. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
   1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
   2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
   3. Indicate methods to be used to avoid trapping water in finished work.

G. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
   1. Locations of dust-control partitions at each phase of work.
   2. HVAC system isolation schematic drawing.
   3. Location of proposed air-filtration system discharge.
   4. Waste-handling procedures.
   5. Other dust-control measures.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.

B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

C. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

D. Floor Protection Paper: Heavy duty, durable, non-staining paper for floor protection.

2.2 TEMPORARY FACILITIES

A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
   1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
   2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
   3. Drinking water and private toilet.
   4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
   5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. Electronic Communication Service
   1. Provide Internet Service: Broadband modem, router and ISP, equipped with hardware firewall at each computer.
   2. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing and spam protection in a combined application.

D. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
   1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 01 7700 "Closeout Procedures."

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
1. Locate facilities to limit site disturbance as specified in Section 01 1000 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.
1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
   1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
   1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
   2. Install lighting for Project identification sign.

I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment l for each field office.
   1. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

J. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:
   1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.

   2. Utilize designated area within existing building for temporary field offices.

3. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Section 31 2000 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.

4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Section 32 1216 "Asphalt Paving."

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: Provide temporary parking areas for construction personnel.

F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
   a. Provide temporary, directional signs for construction personnel and visitors.
3. Maintain and touch up signs, so they are legible at all times.

H. Waste Disposal Facilities: Comply with requirements specified in Section 01 7419 "Construction Waste Management and Disposal."

I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
   1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
   1. Comply with work restrictions specified in Section 01 1000 "Summary."
   2. Retain first "Temporary Erosion and Sedimentation Control" paragraph below when requirements for temporary erosion and sedimentation control are covered in Section 31 1000 "Site Clearing." Retain option for LEED-NC Prerequisite SS-1.

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
   1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
   2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
   3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
   4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
   1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.

2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

L. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
1. Construct dustproof partitions with gypsum wallboard, with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.

2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.
   a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.
3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
5. Protect air-handling equipment.
6. Provide walk-off mats at each entrance through temporary partition.

M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
   1. Protect porous materials from water damage.
   2. Protect stored and installed material from flowing or standing water.
   3. Keep porous and organic materials from coming into prolonged contact with concrete.
   4. Remove standing water from decks.
   5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
   1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
   2. Keep interior spaces reasonably clean and protected from water damage.
   3. Periodically collect and remove waste containing cellulose or other organic matter.
   4. Discard or replace water-damaged material.
   5. Do not install material that is wet.
   6. Discard and replace stored or installed material that begins to grow mold.
   7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
   1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
   2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
   3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
      a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
      b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
      c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

   2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
   3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 7700 "Closeout Procedures."

END OF SECTION 01 5000

SECTION 015639

TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Related Requirements:

1. Section 311000 "Site Clearing" for removing existing trees and shrubs.

1.3 DEFINITIONS

A. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape at a height 54 inches above the ground line for trees with caliper of 8 inches or greater as measured at a height of 12 inches above the ground.

B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:

a. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
b. Arborist's responsibilities.
c. Quality-control program.
d. Coordination of Work and equipment movement with the locations of protection zones.
e. Trenching by hand or with air spade within protection zones.

f. Field quality control.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
2. Detail fabrication and assembly of protection-zone fencing and signage.
3. Indicate extent of trenching by hand or with air spade within protection zones.

C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For arborist and tree service firm.

B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

E. Quality-control program.

1.7 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA.

B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.8 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Moving or parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Soil: Planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

1. Mixture: Well-blended mix of two parts stockpiled soil to one part planting soil.
2. Planting Soil: Planting soil as specified in Section 329113 "Soil Preparation"

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

C. Protection-Zone Fencing: Fencing fixed in position and as shown on the Drawings.

D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:

1. Size and Text: As shown on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Tie a 1-inch blue vinyl tape around each tree trunk at 54 inches above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

3.3 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zone before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

1. Chain-Link Fencing: Install to comply with ASTM F567 and with manufacturer's written instructions.
2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner as indicated on the approved Forest Conservation Plan.

C. Maintain protection zones free of weeds and trash.

D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "Earth Moving" unless otherwise indicated.

B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as shown on Drawings and as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Cut Ends: Do not paint cut root ends.
3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
4. Cover exposed roots with burlap and water regularly.
5. Backfill as soon as possible according to requirements in Section 312000 "Earth Moving."

B. Root Pruning at Edge of Protection Zone: Prune tree roots flush with the edge of the protection zone by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.6 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.7 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.8 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Trees: Remove and replace trees indicated to remain that are more than 66 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Small Trees: Provide new trees of same size and species as those being replaced for each tree that measures 6 inches or smaller in caliper size.
2. Large Trees: Provide one new tree(s) of 6-inch caliper size for each tree being replaced that measures more than 6 inches in caliper size.

    a. Species: As selected by Architect.

3. Plant and maintain new trees as specified in Section 329300 "Plants."

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 015639

SECTION 01 6000

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:
1. Section 01 1000 "Summary" for Contractor requirements related to Owner-furnished products.
2. Section 01 2300 "Alternates" for products selected under an alternate.
3. Section 01 2500 "Substitution Procedures" for requests for substitutions.
4. Section 01 4200 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

1.4 ACTION SUBMITTALS

A. Comparable Product Requestsl: An action submittal requesting consideration of a comparable product, including the following information:
   1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
   2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
   3. Architect's Action: If necessary, architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of additional information or documentation, whichever is later.
      a. Form of Approval: As specified in Section 01 3300 "Submittal Procedures."
      b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 3300 "Submittal Procedures."

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
   1. Resolution of Compatibility Disputes between Multiple Contractors:
      a. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
   1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
   2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
      a. Name of product and manufacturer.

b. Model and serial number.
c. Capacity.
d. Speed.
e. Ratings.

3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:
1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 7700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
    a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.

B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
    a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
    a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
    a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
    a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
    a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 2500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
    1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 2500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

E. Provide products complete with accessories, trim, finish, safety guards and other devices and details needed for complete installation for intended use and effect.

F. Products, which, by nature of their application, are likely to be needed at a later date for maintenance and repair or replacement work, shall be current models for which replacement parts are available.

G. Product selection shall be done in accordance with the following requirements:
    1. Standards, Codes and Regulations: Select from among products that are in compliance with the project requirements, as well as with construction standards, all applicable codes and regulations and sustainable design requirements.

2. Perfomance Requirements: Provide products that comply with specific performances indicated and are recommended by the manufacturer (in published product literature or by individual certification) for the application indicated.
3. Prescriptive Requirments: Provide products that have been produced in accordance with prescriptive requirements, using specified ingredients and components and complying with specified requirements for mixing, fabricating, curing, finishing, testing and other operations in the manufacturing process.
4. VOC Reduction: The contractor will commit to avoiding the use of VOC in the following materials:
    a. Interior Paints and Coatings: The VOC limits of newly applied interior paints and coatings meet one of the following requirements:
        1) 100% of installed products meet California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectrual Coatings, or South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011, for VOC Content.
        2) At minimum 90%, by volume, meet the California Department of Public Health (CDPH) Standard Method v1.1-2010 for VOC emissions.
        3) Applicable national VOC content regulations or conduct testing of VOC content in accordance with ASTM D2369-10; ISO 11890, part 1; ASTM D6556-03; or ISO 11890-2.
    b. Interior Adhesives & Sealants: The VOC limits of newly applied interior adhesives and sealants meet one of the following requirements:
        1) 100% of installed products meet South Coast Air Quality Management District (SCAQMD) Rule 1168 for VOC content. Volatile organic compound (VOC) limits correspond to an effective date of July 1, 2005 and rule amendment date of January 7, 2005.
        2) At minimum 90%, by volume, meet the California Department of Public Health (CDPH) Standard Method v1.1-2010 for VOC emissions.
        3) Applicable national VOC content regulations or conduct testing of VOC content in accordance with ASTM D2369-10; ISO 11890, part 1; ASTM D6886-03; or ISO 11890-2.
    c. Flooring: The VOC emissions of all newly installed interior flooring must meet all limits set by the following, as applicable-
        1) California Department of Public Health (CDPH) Standard Method v1.1-2010.
    d. Insulation: The VOC emissions of all newly installed interior thermal and acousticinsulation must meet all limits set by the following, as applicable -
        1) California Department of Public Health (CDPH) Standard Method v1.1-2010.
    e. Furniture & Furnishings: The VOC emissions of at least 95% (by cost) of all newly purchased interior furniture and furnishings within the project scope must meet all limits set by the following, as applicable-
        1) ANSI/BIFMA e3-2011 Furniture Sustainability Standard sections 7.6.1 and 7.6.2, tested in accordance with ANSI/BIFMA Standard Method M7.1-2011.
5. Avoidance of toxic materials: The Contractor will commit to not using the following toxic and hazardous materials:
    a. Asbestos: No products containing asbestos.
    b. Lead:
        1) Products containing lead content, including older or flux containing not more than 0.25 percent lead in wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures, and 0.20% for solder or flux used in plumbing for water intended for human consumption.
        2) Not more than 100 ppm (by weight) added lead in all other building materials.
    c. Mercury:
        1) No new mercury containing thermometer, switches and electrical relays.
        2) II lamps compliant with the low-mercury limits.

3) Illuminated exit signs only use Light-Emitting Diode (LED) or Light-Emitting Capacitor (LEC) lamps.
4) No mercury vapor or probe-start halide high intensity discharge lamps.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Submittal Requirements: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 6000

SECTION 01 7300

EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering and surveying.
   3. Installation of the Work.
   4. Cutting and patching.
   5. Coordination of Owner's portion of the Work.
   6. Coordination of Owner-installed products.
   7. Progress cleaning.
   8. Starting and adjusting.
   9. Protection of installed construction.

B. Related Requirements:
   1. Section 01 1000 "Summary" for limits on use of Project site.
   2. Section 01 3300 "Submittal Procedures" for submitting surveys.
   3. Section 01 7700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
   4. Section 02 4119 "Selective Demolition" for demolition and removal of selected portions of the building.
   5. Section 07 8413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 PREINSTALLATION MEETINGS

A. Cutting and Patching Conference: Conduct conference at Project site.

1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
   a. Contractor's superintendent.
   b. Trade supervisor responsible for cutting operations.
   c. Trade supervisor(s) responsible for patching of each type of substrate.
   d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.

C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
   a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.6 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.7 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
   a. Primary operational systems and equipment.
   b. Fire separation assemblies.
   c. Air or smoke barriers.
   d. Fire-suppression systems.
   e. Plumbing piping systems.
   f. Mechanical systems piping and ducts.
   g. Control systems.
   h. Communication systems.
   i. Fire-detection and -alarm systems.
   j. Conveying systems.
   k. Electrical wiring systems.
   l. Operating systems of special construction.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
   a. Water, moisture, or vapor barriers.
   b. Membranes and flashings.
   c. Exterior curtain-wall construction.
   d. Sprayed fire-resistive material.
   e. Equipment supports.
   f. Piping, ductwork, vessels, and equipment.
   g. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.
   1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
   1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
   1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
   1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
   2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
   3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
   1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
   2. List of detrimental conditions, including substrates.
   3. List of unacceptable installation tolerances.
   4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 01 3100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:
1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
   1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
   2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
   1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
   2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
   3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
   1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

   2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb, and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
   4. Maintain minimum headroom clearance of [96 inches] <Insert dimension> in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

J. Repair or remove and replace damaged, defective, or nonconforming Work.
   1. Comply with Section 01 7700 "Closeout Procedures" for repairing or removing and replacing defective Work.

K. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 01 1000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
   5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
   6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
   2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
      a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
      b. Restore damaged pipe covering to its original condition.
   3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
      a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel .

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel .
1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
   a. Use containers intended for holding waste materials of type to be stored.
4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 7419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 9113 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 4000 "Quality Requirements."

3.10 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 7300

SECTION 01 7419

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Salvaging nonhazardous demolition and construction waste.
   2. Recycling nonhazardous demolition and construction waste.
   3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:
   1. Section 02 4116 "Structure Demolition" for disposition of waste resulting from demolition of buildings, structures, and site improvements.
   2. Section 31 1000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner’s property.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
   1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report.Include the following information:
   1. Material category.
   2. Generation point of waste.
   3. Total quantity of waste by weight or volume.
   4. Quantity of waste salvaged, both estimated and actual by weight or volume .
   5. Quantity of waste recycled, both estimated and actual by weight or volume.
   6. Total quantity of waste recovered (salvaged plus recycled) by weight or volume.
   7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Qualification Data: For waste management coordinator and refrigerant recovery technician.

H. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements.

B. Refrigerant Recovery Technician Qualifications:certified by EPA-approved certification program.

C. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

D. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 01 3100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
   1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
   2. Review requirements for documenting quantities of each type of waste and its disposition.
   3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
   4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
   5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
   1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
   2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
   3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
   4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
   5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
   6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
   1. Comply with operation, termination, and removal requirements in Section 01 5000 "Temporary Facilities and Controls."

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
   1. Distribute waste management plan to everyone concerned within three days of submittal return.
   2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
   2. Comply with Section 01 5000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
   3. Store items in a secure area until installation.
   4. Protect items from damage during transport and storage.
   5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area designated by Owner.

5. Protect items from damage during transport and storage.

D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

F. Plumbing Fixtures: Separate by type and size.

G. Lighting Fixtures: Separate lamps by type and protect from breakage.

H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
    a. Inspect containers and bins for contamination and remove contaminated materials if found.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
1. Pulverize concrete to maximum 4-inch size.

C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
1. Pulverize masonry to maximum 4-inch size.
2. Clean and stack undamaged, whole masonry units on wood pallets.

D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

E. Metals: Separate metals by type.
   1. Structural Steel: Stack members according to size, type of member, and length.
   2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

F. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

G. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

H. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

I. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.

J. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
   1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

K. Carpet Tile: Remove debris, trash, and adhesive.
   1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

L. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.

M. Conduit: Reduce conduit to straight lengths and store by material and size.

N. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   2. Polystyrene Packaging: Separate and bag materials.
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:
   1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
   2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
      a. Comply with requirements in Section 32 9300 "Plants" for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
   1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
      a. Comply with requirements in Section 32 9300 "Plants" for use of clean ground gypsum board as inorganic soil amendment.

D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

END OF SECTION 01 7419

SECTION 01 7700

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
   1. Substantial Completion procedures.
   2. Final completion procedures.
   3. Warranties.
   4. Final cleaning.

B. Related Requirements:
   1. Section 01 3233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
   2. Section 01 7823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
   3. Section 01 7839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   4. Section 01 7900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
   3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
      a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
   5. Submit testing, adjusting, and balancing records.
   6. Submit sustainable design submittals not previously submitted.
   7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Advise Owner of pending insurance changeover requirements.
   2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   3. Complete startup and testing of systems and equipment.
   4. Perform preventive maintenance on equipment used prior to Substantial Completion.
   5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 7900 "Demonstration and Training."
   6. Advise Owner of changeover in utility services.
   7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
   8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   9. Complete final cleaning requirements.

10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
   1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
   2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
   1. Submit a final Application for Payment in accordance with Section 01 2900 "Payment Procedures."
   2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Submit pest-control final inspection report.
   5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
   1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
   1. Organize list of spaces in sequential order, starting with exterior areas first , listed by room or space number.
   2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
   3. Include the following information at the top of each page:
      a. Project name.
      b. Date.
      c. Name of Architect.
      d. Name of Contractor.
      e. Page number.
   4. Submit list of incomplete items in the following format:

a. PDF Electronic File: Architect will return annotated file.
b. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
1. Submit on digital media acceptable to Architect.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
a. Clean Project site, yard and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 01 5000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 01 7419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 01 7300 "Execution" before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

a. Do not paint over"UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 7700

SECTION 01 7823

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory manuals.
   2. Emergency manuals.
   3. Systems and equipment operation manuals.
   4. Systems and equipment maintenance manuals.
   5. Product maintenance manuals.

B. Related Requirements:
   1. Section 01 3300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
   2. Section 01 9113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
   1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
   2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:
   1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
   1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

E. Comply with Section 01 7700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
   1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
   2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
   1. Title page.
   2. Table of contents.
   3. Manual contents.

B. Title Page: Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name and contact information for Contractor.
   6. Name and contact information for Construction Manager.
   7. Name and contact information for Architect.
   8. Name and contact information for Commissioning Authority.
   9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
   10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
   1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
   2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
   3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:
   1. Type of emergency.
   2. Emergency instructions.
   3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
   1. Fire.
   2. Flood.
   3. Gas leak.
   4. Water leak.
   5. Power failure.
   6. Water outage.
   7. System, subsystem, or equipment failure.
   8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:
   1. Instructions on stopping.
   2. Shutdown instructions for each type of emergency.
   3. Operating instructions for conditions outside normal operating limits.
   4. Required sequences for electric or electronic systems.
   5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
   1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
   2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
   1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
   2. Performance and design criteria if Contractor has delegated design responsibility.
   3. Operating standards.
   4. Operating procedures.
   5. Operating logs.
   6. Wiring diagrams.
   7. Control diagrams.
   8. Piped system diagrams.
   9. Precautions against improper use.
   10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:
   1. Product name and model number. Use designations for products indicated on Contract Documents.
   2. Manufacturer's name.
   3. Equipment identification with serial number of each component.
   4. Equipment function.
   5. Operating characteristics.
   6. Limiting conditions.
   7. Performance curves.
   8. Engineering data and tests.
   9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:
   1. Startup procedures.
   2. Equipment or system break-in procedures.
   3. Routine and normal operating instructions.
   4. Regulation and control procedures.
   5. Instructions on stopping.
   6. Normal shutdown instructions.
   7. Seasonal and weekend operating instructions.

8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.

6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:
1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.

3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 7823

SECTION 01 7839

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
   1. Record Drawings.
   2. Record specifications.
   3. Record Product Data.
   4. Miscellaneous record submittals.

B. Related Requirements:
   1. Section 01 7300 "Execution" for final property survey.
   2. Section 01 7700 "Closeout Procedures" for general closeout procedures.
   3. Section 01 7823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit copies of Record Drawings as follows:
      a. Initial Submittal:
         1) Submit Record Digital Data Files and one set(s) of plots.
         2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
      b. Final Submittal:
         1) Submit PDF electronic files of scanned Record Prints and three set(s) of file prints.
         2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
   1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
   1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Accurately record information in an acceptable drawing technique.
      c. Record data as soon as possible after obtaining it.
      d. Record and check the markup before enclosing concealed installations.
      e. Cross-reference record prints to corresponding photographic documentation.
   2. Content: Types of items requiring marking include, but are not limited to, the following:
      a. Dimensional changes to Drawings.
      b. Revisions to details shown on Drawings.
      c. Depths of foundations.
      d. Locations and depths of underground utilities.
      e. Revisions to routing of piping and conduits.
      f. Revisions to electrical circuitry.
      g. Actual equipment locations.
      h. Duct size and routing.
      i. Locations of concealed internal utilities.
      j. Changes made by Change Order or Construction Change Directive.
      k. Changes made following Architect's written orders.
      l. Details not on the original Contract Drawings.
      m. Field records for variable and concealed conditions.
      n. Record information on the Work that is shown only schematically.
   3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
   4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
   5. Mark important additional information that was either shown schematically or omitted from original Drawings.
   6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
   1. Format: Annotated PDF electronic file with comment function enabled.
   2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
   3. Refer instances of uncertainty to Architect for resolution.
   4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
      a. See Section 01 3100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
      b. Architect will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
   1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
   2. Format: Annotated PDF electronic file with comment function enabled.
   3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
   4. Identification: As follows:
      a. Project name.
      b. Date.
      c. Designation "PROJECT RECORD DRAWINGS."
      d. Name of Architect.
      e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

   2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
   3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.

B. Format: Submit record specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

   3.

C. Format: Submit Record Product Data as annotated PDF electronic file.
   1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.
   1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 7839

SECTION 01 7900

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
   1. Instruction in operation and maintenance of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.
   3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
   1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For facilitator instructor and videographer.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
   1. Identification: On each copy, provide an applied label with the following information:
      a. Name of Project.
      b. Name and address of videographer.
      c. Name of Architect.
      d. Name of Construction Manager.
      e. Name of Contractor.
      f. Date of video recording.

2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
4. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 01 7823 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 4000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 3100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.7 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
   1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
      a. System, subsystem, and equipment descriptions.
      b. Performance and design criteria if Contractor is delegated design responsibility.
      c. Operating standards.
      d. Regulatory requirements.
      e. Equipment function.
      f. Operating characteristics.
      g. Limiting conditions.
      h. Performance curves.
   2. Documentation: Review the following items in detail:
      a. Emergency manuals.
      b. Systems and equipment operation manuals.
      c. Systems and equipment maintenance manuals.
      d. Product maintenance manuals.
      e. Project Record Documents.
      f. Identification systems.
      g. Warranties and bonds.
      h. Maintenance service agreements and similar continuing commitments.
   3. Emergencies: Include the following, as applicable:
      a. Instructions on meaning of warnings, trouble indications, and error messages.
      b. Instructions on stopping.
      c. Shutdown instructions for each type of emergency.
      d. Operating instructions for conditions outside of normal operating limits.
      e. Sequences for electric or electronic systems.
      f. Special operating instructions and procedures.
   4. Operations: Include the following, as applicable:
      a. Startup procedures.
      b. Equipment or system break-in procedures.
      c. Routine and normal operating instructions.
      d. Regulation and control procedures.
      e. Control sequences.
      f. Safety procedures.
      g. Instructions on stopping.
      h. Normal shutdown instructions.
      i. Operating procedures for emergencies.
      j. Operating procedures for system, subsystem, or equipment failure.
      k. Seasonal and weekend operating instructions.
      l. Required sequences for electric or electronic systems.
      m. Special operating instructions and procedures.
   5. Adjustments: Include the following:
      a. Alignments.
      b. Checking adjustments.
      c. Noise and vibration adjustments.
      d. Economy and efficiency adjustments.
   6. Troubleshooting: Include the following:
      a. Diagnostic instructions.
      b. Test and inspection procedures.
   7. Maintenance: Include the following:
      a. Inspection procedures.
      b. Types of cleaning agents to be used and methods of cleaning.
      c. List of cleaning agents and methods of cleaning detrimental to product.

d. Procedures for routine cleaning.
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

1.8 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 7823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
   2. Owner will furnish an instructor to describe Owner's operational philosophy.
   3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner, through Construction Manager, with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
   1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD modewith vibration reduction technology.
   1. Submit video recordings on CD-ROM or thumb drive.
   2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
   3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
   4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
      a. Name of Contractor/Installer.
      b. Business address.
      c. Business phone number.
      d. Point of contact.
      e. Email address.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
   1. Film training session(s) in segments not to exceed 15 minutes.
      a. Produce segments to present a single significant piece of equipment per segment.
      b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
      c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
   1. Furnish additional portable lighting as required.

E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 7900

SECTION 02 4116

STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Demolition and removal of buildings and site improvements.
2. Disconnecting, capping or sealing, and removing site utilities.
3. Salvaging items for reuse by Owner.

B. Related Requirements:
1. Section 01 1000 "Summary" for use of the premises and phasing requirements.
2. Section 01 3200 "Construction Progress Documentation" for preconstruction photographs taken before building demolition.
3. Section 02 4119 "Selective Demolition" for partial demolition of buildings, structures, and site improvements.
4. Section 31 1000 "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store. Include fasteners or brackets needed for reattachment elsewhere.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be demolished.
2. Review structural load limitations of existing structures.
3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review and finalize protection requirements.

5. Review procedures for noise control and dust control.
6. Review procedures for protection of adjacent buildings.
7. Review items to be salvaged and returned to Owner.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building.

C. Schedule of Building Demolition Activities: Indicate the following:
1. Detailed sequence of demolition work, with starting and ending dates for each activity.
2. Temporary interruption of utility services.
3. Shutoff and capping or re-routing of utility services.

D. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 01 3233 "Photographic Documentation." Submit before the Work begins.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work.

2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. On-site storage or sale of removed items or materials is not permitted.

1.10 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations or operations of adjacent occupied buildings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 31 2000 "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

E. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations. Comply with Section 01 3233 "Photographic Documentation."

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

B. Salvaged Items: Comply with the following:
   1. Clean salvaged items of dirt and demolition debris.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to storage area designated by Owner.
   5. Protect items from damage during transport and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.
   1. Owner will arrange to shut off utilities when requested by Contractor.
   2. Arrange to shut off utilities with utility companies.
   3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
   4. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
   5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
   1. Strengthen or add new supports when required during progress of demolition.

C. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.
   1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
   2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
      a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 01 5000 "Temporary Facilities and Controls."
   1. Protect adjacent buildings and facilities from damage due to demolition activities.
   2. Protect existing site improvements, appurtenances, and landscaping to remain.

3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

E. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL

A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
2. Maintain fire watch during and for at least <4> hours after flame-cutting operations.
3. Maintain adequate ventilation when using cutting torches.
4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.

2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

C. Explosives: Use of explosives is not permitted.

3.6 DEMOLITION BY MECHANICAL MEANS

A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.

C. Salvage: Items to be removed and salvaged are indicated on Drawings.

D. Below-Grade Construction: Demolish foundation walls and other below-grade construction.
   1. Remove below-grade construction, including basements, foundation walls, and footings, to depths indicated.

E. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within Insert dimension outside footprint indicated for new construction. Abandon utilities outside this area.
   1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Section 31 2000 "Earth Moving."

F. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.

3.7 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.8 REPAIRS

A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction. and recycle or dispose of them according to Section 01 7419 "Construction Waste Management and Disposal."
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.10 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.
   1. Clean roadways of debris caused by debris transport.

END OF SECTION 02 4116

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Foundation walls.
3. Slabs-on-grade.

B. Related Sections include the following:

1. Division 2 Section "Earthwork".
2. Division 2 Section "Portland Cement Concrete Pavement".

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement in accordance with ACI 315 “Details and Detailing of Concrete Reinforcement”. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified design professional, detailing fabrication, assembly, and support of formwork.

1. Shoring and Re-shoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

E. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Waterstops.
6. Curing compounds.
7. Bonding agents.
8. Adhesives.
9. Vapor barriers.
10. Repair materials.

F. Field quality-control test and inspection reports.

G. LEED Submittals.
1. LEED Materials Certification Form. Information to be supplied for this Form shall include:
   a. The percentages of pre-consumer and/or post-consumer recycled content in the supplied products.
   b. Indication of whether the raw materials have been extracted, harvested, or recovered, and the final product has been manufactured within 500 miles of the project site
2. VOC Reporting Form: For all installed products and materials, provide VOC content in grams/liter or lbs/gallon.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing and inspections indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

D. Codes and Standards: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
3. ACI 347, “Guide to Formwork of Concrete”.
4. ACI 315, “Details and Detailing of Concrete Reinforcement”.

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

F. Mock-ups: Cast concrete panels to demonstrate typical joints, surface finish, texture, floor treatments, and standard or workmanship

1. Build panel approximately 200 square feet for slab on grade and 100 square feet for formed surfaces as directed by the Architect.

G. Preconstruction Meeting:

1. At least 35 days prior to start of the concrete construction schedule, the Contractor shall conduct a meeting to review the proposed mix designs and to discuss the required methods and procedures to achieve the required concrete construction.

2. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the meeting, including but not limited to:
   a. Contractor’s superintendent
   b. Laboratory responsible for the concrete mix design
   c. Laboratory responsible for field quality control
   d. Concrete subcontractor
   e. Engineer of Record

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
   1. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Use form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Use exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

    a. High-density overlay, Class 1 or better.
    b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
    c. Structural 1, B-B or better; mill oiled and edge sealed.
    d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Form Liners: Use for surfaces with architectural patterns exposed to view.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1-1/2 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, galvanized.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, galvanized.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Epoxy repair Coating: Liquid, two-part, compatible with reinforcement coating and complying with ASTM A 775.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II.
2. Fly Ash: ASTM C 618, Class F.
3. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
4. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag cement.
5. Silica Fume: ASTM C 1240, amorphous silica.

B. Normal-Weight Aggregates: ASTM C 33. Provide aggregates from a single source.

1. Coarse-Aggregate: Well-graded crushed stone or washed gravel with maximum aggregate size of 1-1/2 inches nominal for foundations and 3/4 inch for topping slab.
2. Fine Aggregate: Well-graded, washed, natural or manufactured sand free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94 and potable.

2.6 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Accelerating Admixture: ASTM C 494, Type C.
4. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
5. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
6. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
7. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
8. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

2.7 WATERSTOPS

A. Flexible PVC Waterstops: For embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufacturers:

   a. Greenstreak.
   b. Progress Unlimited, Inc.
   c. Williams Products, Inc.

2. Profile: Ribbed, dumbbell with center bulb
3. Dimensions: 9 inches by 3/8 inch thick; non-tapered.

B. Extrudable swelling waterstop: One component, polyurethane-based, bentonite-free for adhesive bonding to concrete.

1. Manufacturers:

   a. Greenstreak.
   b. Sika Corporation
   c. Williams Products, Inc.

2. Profile: rectangular or trapezoidal strip
3. Dimensions: 3/4 inch by 1 inch thick

2.8 VAPOR BARRIERS

A. Polyolefin Geomembrane

1. Provide a 15 mil thick polyolefin geomembrane manufactured from ISO certified virgin resins under foundation slabs and on walls over polymeric waterproofing membrane conforming to ASTM E 1745, Class A.
   a. Permeance rating, ASTM E 96: 0.012 perms or lower.
   b. Puncture resistance, ASTM E 1745: minimum 2200 grams.
   c. Tensile strength, ASTM E 1745: minimum 50.0 lbf/in.
   d. Use a high density polyethylene tape with a minimum width of 4”.

2.9 CURING MATERIALS

A. Evaporation Retarder

1. Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
2. Products

a. Axim Concrete Technologies; Cimfilm.
b. Burke by Edoco; BurkeFilm.
c. ChemMasters; Spray-Film.
d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
e. Dayton Superior Corporation; Sure Film.
f. Euclid Chemical Company (The); Eucobar.
g. Kaufman Products, Inc.; Vapor Aid.
h. Lambert Corporation; Lambco Skin.
i. L&M Construction Chemicals, Inc.; E-Con.
j. MBT Protection and Repair, Div. of ChemRex; Confilm.
k. Meadows, W. R., Inc.; Sealtight Evapre.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
n. Sika Corporation, Inc.; SikaFilm.
o. Symons Corporation, a Dayton Superior Company; Finishing Aid.
p. Unitex; Pro-Film.
q. US Mix Products Company; US Spec Monofilm ER.
r. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yard when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Curing Compound: Clear, waterborne, membrane-forming compound conforming to ASTM C 309, Type 1, Class B, dissipating.

1. Products:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. Burke by Edoco; Aqua Resin Cure.
c. ChemMasters; Safe-Cure Clear.
d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; W.B. Resin Cure.
e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
f. Euclid Chemical Company (The); Kurez DR VOX.
g. Kaufman Products, Inc.; Thinfilm 420.
h. Lambert Corporation; Aqua Kure-Clear.
i. L&M Construction Chemicals, Inc.; L&M Cure R.
j. Meadows, W. R., Inc.; 1100 Clear.
k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
l. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
m. Tamms Industries, Inc.; Horncure WB 30.

n. US Mix Products Company; US Spec Maxcure Resin Clear.

2.10 RELATED MATERIALS

A. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

C. Reglets: Fabricate reglets of not less than 0.0217-inch- thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

D. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.11 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301. The proposed mix designs shall be accompanied by complete standard deviation analysis or trial mixture data.

B. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

C. The proposed mix design shall identify the amount of water to be withheld for addition at the project site.

D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

E. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.12 CONCRETE MIXTURES FOR STRUCTURAL ELEMENTS

A. Minimum Compressive Strength: As noted on the Drawings.

B. Maximum Water-Cementitious Materials Ratio: As noted on the Drawings.

C. Slump Limit: 5 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture.

D. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

2.13 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

B. Perform cutting and bending in the shop to the greatest extent possible. Bend steel cold. Do not bend or straighten bars in a manner that will injure the material. Do not bend bars in the field except to correct minor errors or damage in shipment or handling, or to make shipment of certain bars practicable.

C. Furnish reinforcing bars in full lengths as shown on the Contract Documents. Do not splice bars unless specifically approved by the Architect.

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete:

1. Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
2. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing:

1. Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M.
2. Mix concrete materials in appropriate drum-type batch machine mixer.

3. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
4. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.

C. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces.

F. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
Install keyways, reglets, recesses, and the like, for easy removal.

G. Do not use rust-stained steel form-facing material.

H. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

I. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

J. Chamfer exterior corners and edges of permanently exposed concrete, unless otherwise specified.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

L. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

M. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

N. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

B. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

C. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

E. Install dovetail anchor slots in concrete structures as indicated.

F. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by the Architect.

3.3 VAPOR BARRIERS

A. Polyolefin Geomembrane

1. Deliver and store in accordance with manufacturer’s recommendations.
2. Prepare subgrade in accordance with geotechnical requirements and manufacturer’s recommendations.
3. Place, protect, and repair vapor barriers according to ASTM E 1643 and manufacturer's written instructions.
4. Lap joints 6 inches and seal with manufacturer's recommended tape. Seal all penetrations and block-outs per manufacturer’s instructions.

B. Granular Course: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.

1. Place and compact a 1/2-inch- thick layer of fine-graded granular material over granular fill.

3.4 STEEL REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practices presented in "Placing Reinforcing Bars".

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
1. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
2. Do not tack weld crossing reinforcing bars.
3. Reinforcing steel in the bottom of slabs resting on earth may be supported by concrete, brick, or mortar blocks. Do not use stones, clay bricks, wood blocks, or pieces of broken concrete to support reinforcing steel.

D. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints

1. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by the Architect.
2. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
3. Do not continue reinforcement through sides of strip placements of slabs on grade.
4. Keyed joints are used in walls and floors and between walls and slabs or footings. Form keyed joints as indicated.

    a. Embed keys at least 1-1/2 inches into concrete.
    b. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
    c. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
    d. Space vertical joints in walls every 20 feet.
    e. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
    f. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints in Slabs-on-Grade

1. After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

2. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
3. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
4. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

D. Doweled Joints

1. Install dowel bars and support assemblies at joints where indicated.
2. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.6 WATERSTOPS

A. Flexible PVC Waterstops:

1. Install in construction joints and at other joints indicated to form a continuous diaphragm.
2. Install in longest lengths practicable.
3. Support and protect exposed waterstops during progress of the Work.
4. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Swelling Waterstop:

1. Install only in locations noted “swelling waterstop”.
2. Install according to manufacturer’s instructions.

3.7 CONCRETE PLACEMENT

A. General

1. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Provide temporary protective covering of adjacent surfaces to guard against spattering during placement.
2. Comply with ACI 304 “Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete”.
3. Do not add water to concrete during delivery, at Project site, or during placement unless approved by the Architect.
4. Before test sampling and placing concrete, water may be added at Project site up to the amount specified in the mix proportions, subject to limitations of ACI 301. Do not add water to concrete after adding high-range water-reducing admixtures to mixture and do not exceed the specified w/cm ratio.
5. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
6. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

7. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 and ACI 309 “Guide for Consolidation of Concrete”.

    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

8. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
9. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
10. Maintain reinforcement in position on chairs during concrete placement.
11. Screed slab surfaces with a straightedge and strike off to correct elevations.
12. Slope surfaces uniformly to drains where required.
13. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
14. Do not further disturb slab surfaces before starting finishing operations.

B. Cold-Weather Placement:

1. Comply with ACI 306.1 and as follows: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average air temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
4. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

C. Hot-Weather Placement

1. Comply with ACI 305.1 and as follows: Protect from hot weather conditions which can impair the quality and strength of concrete.

    a. Maintain concrete temperature below 90 deg F at time of placement.
    b. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
    c. Using liquid nitrogen to cool concrete at Contractor's option.
    d. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete.
    e. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

A. Rough-Formed Finish:

1. As-cast concrete texture imparted by form-facing material.

2. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
3. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish

1. As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
2. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
3. Apply to concrete surfaces exposed to public view or that are to receive direct applied coating or covering material such as waterproofing, paint, or other similar system.

C. Rubbed Finish

1. Apply the following to smooth-formed finished concrete where exposed to view:
2. Smooth-Rubbed Finish
   a. Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
   b. Do not apply cement grout other than that created by the rubbing process
3. Grout-Cleaned Finish
   a. Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes.
   b. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water.
   c. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces.
   d. Scrub grout into voids and remove excess grout.
   e. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
4. Cork-Floated Finish
   a. Wet concrete surfaces and apply a stiff grout.
   b. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water.
   c. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces.
   d. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

A. General

1. Comply with recommendations of ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

2. After screeding, consolidating, and leveling concrete slabs, do not work surface or begin floating until all bleed water had disappeared.

B. Float finish: Apply a float finish to slabs not exposed to view and exterior concrete to receive broom finish.

C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

D. Trowel Finish: Apply to interior slab surfaces that are exposed to view and slab surfaces to receive carpet, ceramic tile, paint, or other thin coating system.
1. Immediately after float finish, begin trowelling operation using a power-driven trowel to uniform texture and appearance.
2. Apply fine broom finish after trowelling to surfaces that will receive tile on mortar bed and where required by the waterproofing manufacturer.

E. Slip-Resistive Finish
1. Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps.
2. Apply according to manufacturer's written instructions and as follows:
a. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in 1 or 2 applications. Tamp aggregate flush with surface, but do not force below surface.
b. After broadcasting and tamping, apply float finish.
c. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

F. Sealers, Hardeners, and Densifiers: Apply a coat of the specified compound to exposed interior concrete floors where indicated. Apply and cure in accordance with the manufacturer’s instructions.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Curbs

1. Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.11 CONCRETE PROTECTING AND CURING

A. General

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.
2. Start initial curing right after finishing, and keep continuously moist for at least 7 days. Begin final curing immediately after initial curing and continue for at least 7 days. Use

sun shades, wind breaks, and evaporation retardant when necessary in accordance with ACI 308 recommendations.

B. Evaporation Retarder

1. Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations.
2. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms.
2. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces

1. Begin curing immediately after finishing concrete.
2. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
3. Cure concrete surfaces to receive floor coverings or floor treatments by moist-curing, moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering.
4. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

a. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

1) Water.
2) Continuous water-fog spray.
3) Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers

b. Moisture-Retaining-Cover Curing

1) Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
2) Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

c. Curing Compound

1) Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3) After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

d. Curing and Sealing Compound:

1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete

1. Repair and patch defective areas as approved by the Architect.
2. Remove and replace concrete that cannot be repaired and patched to the Architect’s approval.

B. Patching Mortar

1. Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces

1. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
2. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension, to a depth not less than 1 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
3. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
4. Repair defects on formed surfaces not exposed to view that affect concrete's durability and structural performance as determined by the Architect.
5. Apply smooth-formed finish to concrete where exposed to view.

D. Repairing Unformed Surfaces

1. Surface defects include crazing, cracks wider than 0.01” or which penetrate to reinforcement regardless of width, spalls, pop-outs, honeycombs, rock pockets, voids and other objectionable conditions.
2. Repair defects on unformed surfaces that affect concrete's durability and structural performance as determined by the Architect, by cutting out defective area to sound concrete. Make edges of cuts perpendicular to concrete surface. Clean, dampen with

water, and brush-coat holes and voids with bonding agent. Fill and compact with fresh concrete to match existing before bonding agent has dried.

3. Repair isolated random cracks with the specified crack sealer following manufacturer's instructions.

4. Correct high and low areas that do not meet the tolerance criteria specified for floor flatness and levelness.
   a. Correct high areas by grinding after concrete has cured at least 14 days.
   b. Correct low areas by cutting out and replacing with fresh concrete. Underlayment compound or repair topping may be used when approved by the Architect.

3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Inspections:

1. Steel reinforcement placement.
2. Headed bolts and studs and other embedded items.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.

C. Concrete Tests

1. Contractor shall provide space and source of electrical power on the project site for facilities to be used for initial curing of concrete test specimens as required by ASTM C 31 for the use of the Testing Agency.

2. Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

   a. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
   b. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump

   a. ASTM C 143/C 143M; one test at point of delivery for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   b. Perform additional tests when concrete consistency appears to change.

4. Air Content

a. ASTM C 231; pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature:

a. ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

6. Unit Weight

a. ASTM C 138; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

7. Compression Test Specimens: ASTM C 31/C 31M.

a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
b. Cast and field cure sets of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C 39/C 39M

a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
b. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
c. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
d. Test results shall be reported in writing to the Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

9. Nondestructive Testing

a. Impact hammer, sonoscope, or other nondestructive device may be permitted by the Architect but will not be used as sole basis for approval or rejection of concrete.

D. Additional Tests

1. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by the Architect.

2. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by the Architect.
3. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
4. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 033000

SECTION 04 2200

UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry-joint reinforcement.
5. Ties and Anchors
6. Embedded flashing.
7. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:
1. Steel lintels in unit masonry.
2. Steel shelf angles for supporting unit masonry.
3. Cavity wall insulation

C. Related Requirements:
1. Section 033000 "Cast-in-Place Concrete" for installing dovetail slots for masonry anchors.
2. Section 05 5000 "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.

3. Section 07 6200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating post-consumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Projectc and cost for each regional material.

C. Shop Drawings: For the following:
1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

D. Samples for Initial Selection:
1. Colored mortar.
2. Weep holes/cavity vents.

E. Samples for Verification: For each type and color of the following:
1. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:
1. Masonry units.
a. Include data on material properties material test reports substantiating compliance with requirements.

b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Build mockup of typical wall area as shown on Drawings.
   2. Build mockups for typical exterior wall in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.
      a. Include a sealant-filled joint at least 16 inches long in exterior wall mockup.
      b. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
   3. Protect accepted mockups from the elements with weather-resistant membrane.
   4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
      a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
      b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
   1. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C1314.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
   1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

A. <Double click to insert sustainable design text for regional materials.>

B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide square-edged units for outside corners unless otherwise indicated.
      a. <Double click here to find, evaluate, and insert list of manufacturers and products.>
   3. <Double click here to find, evaluate, and insert list of manufacturers and products.>

C. CMUs: ASTM C90.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
   2. Density Classification: Lightweight unless otherwise indicated.
   3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.
   4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
   5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.
   6. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
   1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Capital Materials Corporation; Flamingo Color Masonry Cement.
      b. Essroc, Italcementi Group;
      c. Lehigh Cement Company

E. Mortar Cement: ASTM C1329/C1329M.
   1. Products: Subject to compliance with requirements, provide one of the following, or approved equal:
      a. Lafarge North America Inc; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.
      b. Manufacturers not listed but who do offer products that comply with the requirements of this section will be considered as substitute manufacturers, subject to the conditions specified in Division 1 Section Product Substitution Procedures.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
   1. Products: Subject to compliance with requirements, provide one of the following, or approved equal:
      a. Davis Colors: True Tone Mortar Colors.
      b. Lanxess Corporation: Barferrox Iron Oxide Pigments.
      c. Solomon Colors, Inc.: SGS Mortar Colors.

G. Colored Cement Products: Packaged blend made from portland cement and hydrated limemasonry cement or mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
   1. Colored Portland Cement-Lime Mix:
      a. Products: Subject to compliance with requirements, provide one of the following, or approved equal:
         1) Capital Materials Corporation: Riverton Portland Cement Lime Custom Color
         2) Holcim (US) Inc: Rainbow Mortamix Custom Color Cement/Lime.
         3) Lafarge North America, Inc.: Eaglebond Portland & Lime.
   2. Colored Masonry Cement:
      a. Products: Subject to compliance with requirements, provide one of the following, or approved equal:
         1) Capital Materials Corporation: Flamingo Color Masonry Cement.
         2) Holcim (US) Inc: Rainbow Mortamix Custom Color Masonry Cement
         3) Lafarge North America, Inc.: Lehigh Custom Color Masonry Cement
   3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.

4. Pigments shall not exceed 10 percent of portland cement by weight.
5. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.

H. Aggregate for Mortar: ASTM C144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

I. Aggregate for Grout: ASTM C404.

J. Epoxy Pointing Mortar: ASTM C395, epoxy-resin-based material formulated for use as pointing mortar for glazed or pre-faced masonry units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.

K. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
a. Euclid Chemical Company: Accelguard 80
b. Grace Construction Products Applied Technologies: Morset

L. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.
1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.187-inch diameter.
4. Wire Size for Cross Rods: 0.187-inch diameter.
5. Spacing of Cross Rods: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

2.7 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
   1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.
   2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
   3. Stainless Steel Wire: ASTM A580/A580M, Type 304.
   4. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.
   5. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
   6. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
   7. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Partition Top Anchors: 0.105-inch- thick metal plate with a 3/8-inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

D. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated bent to configuration indicated.
   1. Corrosion Protection: Hot-dip galvanized to comply with ASTMA 153/A153M.

2.8 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
   1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
   2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
   3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) Cheney Flashing Company
         2) Hohmann & Barnard, Inc.
         3) Keystone Flashing Company, Inc.
         4) Sandell Manufacturing Co, Inc.
   4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
   5. Fabricate through-wall flashing with drip edge where indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
   6. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
   7. Fabricate metal drip edges for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam sheds water.

8. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
9. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
10. Provide stainless steel end dams at all flashing terminations.

B. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 6200 "Sheet Metal Flashing and Trim."

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

D. Termination Bars for Flexible Flashing: Stainless-steel sheet 0.019 inch by 1-1/2 inches with a 3/8 inch sealant flange at top.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime or mortar cement mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.
3. For mortar parge coats, use Type S or Type N.
4. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; and for other applications where another type is not indicated, use Type S.
5. For interior nonload-bearing partitions, use Type N.

D. Pigmented Mortar: Use colored cement product.
   1. Pigments shall not exceed 10 percent of portland cement by weight.
   2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
   3. Mix to match Architect's sample.
   4. Application: Use pigmented mortar for exposed mortar joints with the following units:
      a. Decorative CMUs.
      b. Pre-faced CMUs.
      c. Cast-stone trim units.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
   1. Mix to match Architect's sample.
   2. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:
      a. Decorative CMUs.
      b. Pre-faced CMUs.
      c. Cast-stone trim units.

F. Grout for Unit Masonry: Comply with ASTM C476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
   2. Proportion grout in accordance with ASTM C476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
   3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.

G. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.
   1. Application: Use epoxy pointing mortar for exposed mortar joints with pre-faced CMUs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.
   4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
   3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
   4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 8443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
   1. Bed face shells in mortar and make head joints of depth equal to bed joints.
   2. Bed webs in mortar in all courses of piers, columns, and pilasters.
   3. Bed webs in mortar in grouted masonry, including starting course on footings.
   4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Wet joint surfaces thoroughly before applying mortar.
3. Rake out mortar joints for pointing with sealant.

D. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.

E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

F. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

G. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:
   1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
   2. Install preformed control-joint gaskets designed to fit standard sash block.
   3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
   4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide concrete or masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 FLASHING

A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.

B. Install flashing as follows unless otherwise indicated:
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
   2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
   3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 9200 "Joint Sealants" for application indicated.
   4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 9200 "Joint Sealants" for application indicated.
   5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
   6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
   7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.11 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

   2. Limit height of vertical grout pours to not more than 60 inches.

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

I. Prism Test: For each type of construction provided, according to ASTM C1314 at 7 days and at 28 days.

3.13 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.14 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches in each dimension.

2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 2000 "Earth Moving."

3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 2200

04 4000

STONE VENEER - SITE WALL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Veneer stone for site walls.

1.2 RELATED SECTIONS

A. Section 31 10 00 - Site Clearing.

B. Section 31 20 00 - Earth Moving; Excavation and preparation.

1.3 REFERENCES

A. ASTM C 97 - Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.

B. ASTM C 170 - Standard Test Method for Compressive Strength of Dimension Stone

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

B. Installer Qualifications: Firm with documented experience of at least two projects of similar construction and scope. Include brief description of each project and name and phone number of owner's representative knowledgeable in each listed project. Other verifiable experience may be accepted in lieu of the above at the discretion of the Architect.

C. Mock-Up: Install a mock-up using acceptable products and manufacturer approved installation methods.
   1. Maintain mock-up during construction for workmanship comparison.
      a. Remove and legally dispose of mock-up when no longer required.
      b. Incorporate mock-up into final construction upon Architect's approval.
   2. Obtain Architect's acceptance of finish color, texture and pattern, and workmanship standard.

D. Pre-Construction Meeting: Prior to commencement of stone installation, conduct a meeting at the site with the stone materials supplier, the stone installer, and the Contractor to review the retaining wall requirements. Notify the Owner and the Architect at least 3 days in advance of the time of the meeting.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation (as applicable).

B. Prevent excessive mud, fluid concrete, or other deleterious materials from coming in contact with and affixing to stone materials.

1.7 PROJECT CONDITIONS

A. Do not place backfill when subgrade is wet or frozen.

B. Do not place backfill during wet or freezing weather that prevents conformance with specified compaction requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Tri-State Stone & Building Supply, Inc., which is located at: 8200 Seven Locks Rd.; Bethesda, MD 20817; ASD Tel: 301-365-2100; Fax: 301-365-5524; Email: joeporto@carderock.com; Web: https://www.carderock.com

B. Substitutions: Not permitted.

2.2 VENEER STONE

A. Carderock Veneer Stone: Mica-schist quartzite veneer stone for use in walls with setting beds of 4 to 6 inches.
   1. Depth: 4 to 6 inches .
   2. Height: 6 inches to 12 inches .
   3. Length: Random lengths up to 60 inches. Lengths shall match patterns on existing park building.
   4. Texture: Somewhat irregular in shape, many pieces with reasonably square edges for corners.
   5. Grade: Provide stone that matches existing park building.
   6. Color Range: Full color range; various shades of blues, browns, grays and greens. Match color pallet of existing park building
   7. Material shall conform to the following properties:
      a. Specific gravity of 2.75 when tested in accordance with ASTM C 97.
      b. Minimum density of 170 lbs/cubic ft when tested in accordance with ASTM C 97.
      c. Minimum compressive strength of 13,100 average psi when tested in accordance with ASTM C 170.

2.3 ACCESSORY MATERIALS

A. Crushed Limestone Fill: Granular limestone fill graded as follows:
   1. 100 to 75 percent passing a 2-inch sieve.
   2. 100 to 75 percent passing a 3/4-inch sieve.
   3. 100 to 20 percent passing a No. 4 sieve.
   4. 0 to 60 percent passing a No. 40 sieve.
   5. 0 to 35 percent passing a No. 200 sieve.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify substrate is level, smooth, and capable of supporting stone imposed loads.

C. Verify grades, contours and elevations of substrate are correct.

D. Verify substrate base supporting stone has been properly compacted.

E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly debris, roots, branches and extraneous materials prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's instructions.

3.4 INSTALLATION - VENEER STONE

A. Do not begin installation until backing structure is plumb, bearing surfaces are level and substrates are clean and properly prepared.

B. Coordinate placement of reinforcement, anchors and accessories, flashings and other moisture control products supplied by other sections.

C. Clean all built-in items of loose rust, ice, mud, or other foreign matter before incorporating into the wall. All ferrous metal built into the wall shall be primed or galvanized.

D. If required, provide temporary bracing during installation of masonry work. Maintain bracing in place until building structure provides permanent support.

E. Install veneer stone and mortar in accordance with ACI 530.1/ASCE 6/TMS 602 Specifications for Masonry Structures.

F. Maintain masonry courses to uniform dimension(s). Form vertical and horizontal joints of uniform thickness.

G. Pattern Bond:
1. Match patterns of stonework on the existing park building.
2. Lay stone with the bedface, splitface or weather edge exposed. Take care to avoid a concentration of any one color to any one wall surface.
3. Maintain an approximate 1/2 inch joint, as stone allows.
4. If a dry stack installation is desired, stone is to be laid tight to one another, as the stone will naturally allow.
5. Do not use stacked vertical joints.
6. Lay out work in advance and distribute color range of stone uniformly over total work area.

H. Anchoring: Tie stone to backing as required by the applicable Building Code. As a minimum tie stone to backing with metal ties as follows:
1. Provide minimum one tie per 2 square feet of wall surface area.
2. Maximum spacing between adjacent ties shall be 16 inches vertically and 32 inches o.c. horizontally.
3. Ties shall be imbedded in horizontal joints to a 2 inch minimum depth.
4. Provide additional ties at openings within 12 inches of opening.

I. Joining Work: Where fresh masonry joints partially set masonry.
   1. Remove loose stone and mortar.
   2. Clean and lightly wet surface of set masonry.
   3. To avoid a horizontal run of masonry rack back 1/2 inch the length of stone in each course.
   4. Toothing is not permitted.

J. Joints:
   1. Lay stone with an approximate 1/2 inch mortar joint, as stone allows.
   2. Tool joints when "thumb-print" hard with a round jointer slightly larger than the width of the joint.
   3. Trowel-point or concave tool exterior joints below grade.
   4. Flush cut joints to be finished with a soft brush only.
   5. Retempering or mortar is not permitted.
   6. Use non-corrosive stone shims as required to maintain uniform joint thickness.

K. Control and Expansion Joints: Keep joints open and free of debris. Coordinate control joint in accordance with Section 07 90 00 - Joint Protection.

L. Sealant Recesses: Provide open joint 3/4 inch deep and 1/4 inch wide, where masonry meets doors, windows and other exterior openings. Coordinate sealant joints in accordance with Section 07 90 00 - Joint Protection.

M. Cutting And Fitting: Cut and fit for chases, pipes, conduit, sleeves, grounds, and other penetrations and adjacent materials

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Protect adjacent work areas and finish surfaces from damage during product installation.

C. Cover the top of unfinished stone masonry work to protect it from the weather.

D. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials from stone without damage to the stonework.

E. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.

F. Adjust or reset any materials disturbed by successive operations.

G. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 CLEANING

A. Clean exposed faces to remove dirt and stains which may be on units after erection and completion of joint treatments.

B. Wash and rinse in accordance with stone supplier's instruction.

C. Do not use cleaning materials or processes which could change the character of the exposed finishes.

END OF SECTION

SECTION 04 4313

STONE MASONRY VENEER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Stone masonry anchored to wood framing and sheathing.
2. Stone masonry adhered to unit masonry backup.

B. Related Requirements:
1. Section 04 2000 "Unit Masonry" for concealed flashing horizontal joint reinforcement andveneer anchors.
2. Section 07 6200 "Sheet Metal Flashing and Trim" for flashing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each variety of stone, stone accessory, and manufactured product.

B. Samples for Initial Selection: For colored mortar and other items involving color selection.

C. Samples for Verification:
1. For each stone type indicated. Include at least two Samples in each set and show the full range of color and other visual characteristics in completed Work.
2. For each color of mortar required. Label Samples to indicate types and amounts of pigments used.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters.

B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
1. Build mockup of typical wall area as shown on Drawings.

2. Build mockups for typical exterior wall in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.
   a. Include a sealant-filled joint at least 16 inches long in mockup.
   b. Include through-wall flashing installed for a 24-inch length in corner of mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit stone masonry above half of flashing).
   c. Include wood studs, sheathing, veneer anchors, flashing, and weep holes in exterior masonry-veneer wall mockup.
3. Protect accepted mockups from the elements with weather-resistant membrane.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Sealant Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 07 9200 "Joint Sealants," Samples of materials that will contact or affect joint sealants.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

C. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, in a dry location, or in covered weatherproof dispensing silos.

D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

A. Protection of Stone Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed stone masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining stone masonry face.
   1. Protect base of walls from rain-splashed mud and mortar splatter using coverings spread on the ground and over the wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at end of each day to prevent rain from splashing mortar and dirt on completed stone masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace stone masonry damaged by frost or freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1.9 COORDINATION

A. Advise installers of adjacent Work about specific requirements for placement of reinforcement, veneer anchors, flashing, and similar items to be built into stone masonry.

B. Coordinate locations of dovetail slots installed in concrete that are to receive stone anchors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from single quarry, whether specified in this Section or in another Section of the Specifications, with resources to provide materials of consistent quality in appearance and physical properties.

B. Rough stone veneer is to match existing stone to be salvaged during demolition, believed to be Carderock Quartzite Field Stone. Confirm stone type, texture and size prior to construction. Maryland veneer stone to be supplied by one of the following or approved equal:
1. Tri-State Stone Co - Bethesda, MD.
2. Luck Stone, Sterling, VA.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious component from single manufacturer and each aggregate from single source or producer.

2.2 QUARTZ-BASED STONE

A. Material Standard: Comply with ASTM C616/C616M , Classification III Quartzite.

B. Varieties and Sources: Subject to compliance with requirements, provide the following:
1. Match existing stone to be salvaged and to remain. Confirm stone type and sizing.
2. Color range: gray-green-blue with variations to brown, beige, mustard to rose. Colors should match, as close as possible, existing stone color on adjacent stone walls of buildings. Color shall match all approved samples..

3. Surface finish: match existing - cleft or split-face finish. Natural strata faces with quarry range of textural variations, varying in thickness, height and length.
4. Sizes: Roughly rectangular size range as close as possible to existing adjacent stone walls.
5. Grade/quality: uniform in color range and quality.
6. Shape and Pattern: match exsiting - coursed and roughly in thin horizontal "ledge" fashion, rectangular, with no stone laid vertically.

C. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; natural color or white cement may be used as required to produce mortar color indicated.
1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cementcomplying with ASTM C 150, Type I or III, and hydrated lyme complying with ASTM C 207.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Colored Portland Cement-Lime Mix
1) Glen-Gery Corporation; Color Mortar Blend
2) Lafarge Corporation; Centurion Colorbond PL
3) Lehigh Portland Cement Co.; Lehigh Custom Color Portland/Lime
4) Riverton Corporation; Riverton Cement Lime Custom Color

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in stone masonry mortar.

E. Aggregate: ASTM C144 and as follows:
1. For pointing mortar, use aggregate graded with 100 percent passing No. 16 sieve.
2. White Aggregates: Natural white sand or ground white stone.
3. Colored Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.
a. Match existing building mortar color.
b. Match Architect's sample.

F. Water: Potable.

2.4 VENEER ANCHORS

A. Materials:
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M; with ASTM A153/A153M, Class B-2.

2. Stainless Steel Wire: ASTM A580/A580M, Type 304.
3. Hot-Dip Galvanized-Steel Sheet: ASTM A1008/A1008M, cold-rolled, carbon-steel sheet, hot-dip galvanized after fabrication to comply with ASTM A153/A153M, Class B-2.

4. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

B. Size: Sufficient to extend at least halfway, but not less than 1-1/2 inches, through stone masonry and with at least a 5/8-inch cover on exterior face.

C. Wire Veneer Anchors: Wire ties formed from W1.7 or 0.148-inch- diameter, hot-dip galvanized steel wire.
1. Ties are bent in the form of loops with legs not less than 15 inches in length and with last 2 inches bent at 90 degrees.
2. Ties are bent in the form of rectangular loops with ends bent downward for inserting into eyes projecting from masonry joint reinforcement specified in Section 04 2000 "Unit Masonry."
3. Ties are bent in the form of triangular loops designed to be attached to masonry joint reinforcement specified in Section 04 2000 "Unit Masonry" with vertical wires passing through ties and through eyes projecting from masonry joint reinforcement.

D. Corrugated-Metal Veneer Anchors: Not less than 0.060-inch- thick by 7/8-inch- wide hot-dip galvanized steel sheet with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch.

E. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate wire ties from 0.187-inch- diameter, hot-dip galvanized-steel wire unless otherwise indicated.
3. Fabricate wire connector sections from 0.187-inch- diameter, hot-dip galvanized-steel wire.
4. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.

F. Adjustable, Screw-Attached Veneer Anchors: Units consisting of a wire tie section and a metal anchor section for attachment over sheathing to wood or metal studs, and as follows:
1. Anchor Section: Sheet metal plate, 1-1/4 inches wide by 6 inches long, with screw holes in top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 3-5/8 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie.

2.5 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Cementitious Dampproofing: Cementitious formulation recommended by ILI and nonstaining to stone, compatible with joint sealants, and noncorrosive to veneer anchors and attachments.

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Provide one of the following configurations:
a. Strips, full depth of cavity and 10 inches wide, with dovetail-shaped notches 7 inches deep that prevent mesh from being clogged with mortar droppings.

2.6 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar and grout stains, efflorescence, and other new construction stains from stone masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by cleaner manufacturer and stone producer.

2.7 FABRICATION

A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.
   1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
   2. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."

B. Split stone to produce pieces of thickness, size, and shape indicated, including details on Drawings and pattern specified in "Setting Stone Masonry" Article.
   1. Shape stone specified to be laid in three-course, random range ashlar pattern with split beds.

C. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.

D. Cut and drill sinkages and holes in stone for anchors and supports.

E. Carefully inspect stone at quarry or fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units before shipment.
   1. Clean sawed backs of stone to remove rust stains and iron particles.

F. Thickness of Stone: Provide thickness indicated, but not less than the following:
   1. Thickness: 4 inches plus or minus 1/4 inch. Thickness does not include projection of pitched faces.

G. Finish exposed stone faces and edges to comply with requirements indicated for finish and to match approved samples, existing conditions, and mockups.

2.8 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
   1. Do not use calcium chloride.
   2. Use portland cement-lime masonry cement or mortar cement mortar unless otherwise indicated.
   3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

4. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches required consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Stone Masonry: Comply with ASTM C270, Proportion Specification.
1. Mortar for Setting Stone: Type S.
2. Mortar for Pointing Stone: Type N.

D. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary.
1. Mix to match Architect's sample and to match existing conditions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces indicated to receive stone masonry, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone masonry.

B. Examine substrate to verify that dovetail slots, inserts, reinforcement, veneer anchors, flashing, and other items installed in substrates and required for or extending into stone masonry are correctly installed.

C. Examine wall framing, sheathing, and weather-resistant sheathing paper to verify that stud locations are suitable for spacing of veneer anchors and that installation will result in a weatherproof covering.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Accurately mark stud centerlines on face of weather-resistant sheathing paper before beginning stone installation.

B. Coat concrete and unit masonry backup with asphalt dampproofing.

C. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 INSTALLATION OF STONE MASONRY

A. Perform necessary field cutting and trimming as stone is set.
   1. Use power saws to cut stone that is fabricated with saw-cut surfaces. Cut lines straight and true, with edges eased slightly to prevent snipping.
   2. Use hammer and chisel to split stone that is fabricated with split surfaces. Make edges straight and true, matching similar surfaces that were shop or quarry fabricated.
   3. Pitch face at field-split edges as needed to match stones that are not field split.

B. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.

C. Arrange stones with color and size variations uniformly dispersed for an evenly blended appearance. Match existing stone pattern.

D. Install supports, fasteners, and other attachments indicated or necessary to secure stone masonry in place.

E. Set stone accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.

F. Install steel lintels where indicated. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

G. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any. Lay walls with joints not less than 1/4 inch 3/8 inch at narrowest points or more than 5/8 inch at widest points.

H. Provide sealant joints of widths and at locations indicated.
   1. Keep sealant joints free of mortar and other rigid materials.
   2. Sealant joints are specified in Section 07 9200 "Joint Sealants."

I. Install metal expansion strips in sealant joints at locations indicated. Build flanges of expansion strips into masonry by embedding in mortar between stone masonry and backup wythe. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.

J. Install embedded flashing at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
   1. At stud-framed walls, extend flashing through stone masonry, up sheathing face at least 8 inches, and behind weather barrier.
   2. At multiwythe masonry walls, including cavity walls, extend flashing through stone masonry, turned up a minimum of 8 inches, and extend into or through inner wythe to comply with requirements in Section 04 2000 "Unit Masonry."
   3. At lintels and shelf angles, extend flashing full length of angles but not less than 6 inches into masonry at each end.
   4. At sills, extend flashing not less than 4 inches at ends.
   5. At ends of head and sill flashing, turn up not less than 2 inches to form end dams.

6. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 9200 "Joint Sealants" for application indicated.
7. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 9200 "Joint Sealants" for application indicated.

8. Install metal drip edges beneath flexible flashing at exterior wall face. Stop flexible flashing 1/2 inch back from exterior wall face and adhere flexible flashing to top of metal drip edge.
9. Cut flexible flashing flush with wall face after completing masonry wall construction.

3.4 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.

B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.

C. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet or 3/4 inch in 40 feet or more.

D. Measure variation from level, plumb, and position shown in plan as a variation of the average plane of each stone face from level, plumb, or dimensioned plane.

E. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.

F. Variation in Plane between Adjacent Stones: Do not exceed one-half of tolerance specified for thickness of stone.

3.5 INSTALLATION OF ANCHORED STONE MASONRY

A. Anchor stone masonry to stud framing with adjustable, screw-attached veneer anchors unless otherwise indicated. Fasten anchors through sheathing to framing with two screws.

B. Embed veneer anchors in mortar joints of stone masonry at least halfway, but not less than 1-1/2 inches, through stone masonry and with at least a 5/8-inch cover on exterior face.
   1. Install continuous wire reinforcement in horizontal joints and attach to seismic veneer anchors as stone is set.

C. Space anchors not more than 16 inches o.c. vertically and 24 inches o.c. horizontally. Install additional anchors within 12 inches of openings, sealant joints, and perimeter at intervals not exceeding 12 inches.

D. Space anchors not more than 18 inches o.c. vertically and 32 inches o.c. horizontally, with not less than one anchor per 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings, sealant joints, and perimeter at intervals not exceeding 12 inches.

E. Set stone in full bed of mortar with full head joints unless otherwise indicated. Build anchors into mortar joints as stone is set.

F. Provide 1-inch cavity between stone masonry and backup construction unless otherwise indicated. Keep cavity free of mortar droppings and debris.
   1. Slope beds toward cavity to minimize mortar protrusions into cavity.
   2. Do not attempt to trowel or remove mortar fins protruding into cavity.

3.6 INSTALLATION OF ADHERED STONE MASONRY VENEER

Retain first two paragraphs below for installation over wood or metal framing. Revise both if not using sheathing.

A. Install flashing over sheathing and behind building paper or wrap by fastening through sheathing into framing.

Delete last paragraph above and retain first paragraph below for installation over masonry or concrete.

For adhered veneer installed directly over masonry without lath, delete last two paragraphs above and retain both "masonry backup" options in first paragraph below; otherwise, retain both "scratch coat" options below.

B. Coat backs of stone units and face of masonry backup with cement-paste bond coat, then butter both surfaces with setting mortar. Use sufficient setting mortar, so a slight excess will be forced out the edges of stone units as they are set. Tap units into place, completely filling space between units and masonry backup.

Raking out joints to depth of 3/4 inch (19 mm) allows for two layers of pointing mortar approximately 3/8 inch (10 mm) deep.

3.7 POINTING

A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch deep until a uniform depth is formed.

B. Point stone joints by placing and compacting pointing mortar in layers of not more than 3/8 inch deep. Compact each layer thoroughly and allow to it become thumbprint hard before applying next layer.

C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:
   1. Joint Profile: To match existing.

3.8 ADJUSTING AND CLEANING

A. Remove and replace stone masonry of the following description:
   1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
   2. Defective joints.
   3. Stone masonry not matching approved samples and mockups.

4. Stone masonry not complying with other requirements indicated.

B. Replace in a manner that results in stone masonry matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before cleaning stone masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.

4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
5. Clean stone masonry by bucket and brush hand-cleaning method described in BIA Technical Note No. 20, Revised II, using job-mixed detergent solution.

6. Clean stone masonry with proprietary acidic cleaner applied according to manufacturer's written instructions.

7. Clean limestone masonry to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.9 EXCESS MATERIALS AND WASTE

A. Excess Stone: Stack excess stone where directed by Owner for Owner's use.

B. Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
1. Crush masonry waste to less than 4 inches in greatest dimension.
2. Mix masonry waste with at least 2 parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 2000 "Earth Moving."

3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other waste, and legally dispose of off Owner's property.

END OF SECTION 04 4313.13

SECTION 05 5000

METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Steel framing and supports for countertops.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Metal bollards.
4. Metal downspout boots.
5. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:
1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:
1. Section 04 2000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Fasteners.
2. Metal downspout boots.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
1. Steel framing and supports for countertops.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Metal bollards.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

B. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Research Reports: For post-installed anchors.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.

D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.

E. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.2 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
   1. Provide stainless steel fasteners for fastening stainless steel.
   2. Provide bronze fasteners for fastening bronze.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.

D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.

E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
   1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

H. Post-Installed Anchors: Torque-controlled expansion anchors.
   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

   2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.3 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 09 9113 "Exterior Painting."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
   1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.

D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

H. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

I. Concrete: Comply with requirements in Section 03 3000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete.

2.4 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
   1. Fabricate units from slotted channel framing where indicated.
   2. Furnish inserts for units installed after concrete is placed.

C. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
   1. Provide bearing plates welded to beams where indicated.
   2. Drill or punch girders and plates for field-bolted connections where indicated.

D. aGalvanize miscellaneous framing and supports where indicated.

2.6 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.
   1. Cap bollards with 1/4-inch- thick, steel plate with flat top.

B. Fabricate sleeves for bollard anchorage from steel or stainless steel [pipe] [or] [tubing] with 1/4-inch-thick, steel plate welded to bottom of sleeve.

C. Prime steel bollards with zinc-rich primer.

2.7 METAL DOWNSPOUT BOOTS

A. Source Limitations: Obtain downspout boots from single source from single manufacturer.

B. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
   1. Outlet: Vertical, to discharge into pipe.

C. Prime cast-iron downspout boots with zinc-rich primer.

2.8 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize bearing and leveling plates.

2.9 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
   1. Shop prime with primers specified in Section 09 9113 "Exterior Painting" unless indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
   1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   3. Items Indicated to Receive Primers Specified in Section 09 9600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
   5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.11 ALUMINUM FINISHES

A. As-Fabricated Finish: AA-M12.

B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLATION OF BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 REPAIRS

A. Touchup Painting:
   1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
      a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
   2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 9113 "Exterior Painting."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 5000

SECTION 06 1000

MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Framing with dimension lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking, cants, and nailers.
4. Wood furring and grounds.
5. Wood sleepers.
6. Plywood backing panels.

B. Related Requirements:
1. Section 06 1600 "Sheathing" for sheathing, subflooring, and underlayment.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating post-consumer and preconsumer recycled conent and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
3. Chain-of-Custody Certificates: For certified wood products, include statement of costs.
4. Chain-of-Custody Qualification Data: For manufacturer and vendor.
5. Product Data: For adhesives and sealants indicating compliance with General Emissions evaluation and VOC content requirements.
6. Product Data: For composite wood products indicating compliance with Composite Wood Evlauation.
7. Building Product Disclosure Requirements: To encourage the use of building products that are working to minimize their environmental and health impacts, preference will be given to products with publicly available information:
    a. Environmental product Declarations:
    b. Material Ingredients: Documentation demonstrating chemical inventory of the product to at least 0.1% (1000 ppm).

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:
1. Preservative-treated wood.
2. Fire-retardant-treated wood.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

B. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accreddited certification body and is a certifed participant in AWI's Quality Certification Program.

C. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.

   3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

   2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
   1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat items indicated on Drawings, and the following:
   1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
   3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
   4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
   5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
   1. Treatment shall not promote corrosion of metal fasteners.
   2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
   3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.

   4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664, and design value adjustment factors shall be calculated according to ASTM D6841. For enclosed roof framing, framing in attic spaces, and where high-temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
   1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat items indicated on Drawings, and the following:
   1. Framing for raised platforms.
   2. Concealed blocking.
   3. Roof framing and blocking.
   4. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
   5. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade of any of the following species:
   1. Hem-fir (north); NLGA.
   2. Mixed southern pine or southern pine; SPIB.

3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
6. Northern species; NLGA.

B. Other Framing: No. 1 grade of any of the following species:
1. Hem-fir (north); NLGA.
2. Southern pine; SPIB.
3. Douglas fir-larch; WCLIB or WWPA.
4. Southern pine or mixed southern pine; SPIB.
5. Spruce-pine-fir; NLGA.
6. Douglas fir-south; WWPA.
7. Hem-fir; WCLIB or WWPA.
8. Douglas fir-larch (north); NLGA.
9. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. Joists and Rafters: Select Structural grade of any of the following species:
1. Southern Pine; SPIB
2. Douglas Fir-larch; WWPA

D. Beams and Posts:No. 1 grade of any of the following species:
1. Southern Pine; SPIB
2. Douglas Fir-larch; WWPA
3. Hem Fir; WCLIB or WWPA
4. Spruce Pine Fir; NLGA

2.5 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:
1. Hem-fir (north); NLGA.
2. Mixed southern pine or southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
6. Western woods; WCLIB or WWPA.
7. Northern species; NLGA.

C. Concealed Boards: 15 percent maximum moisture content of any of the following species and grades:
1. Mixed southern pine or southern pine, No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C , fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Screws for Fastening to Metal Framing: ASTM C1002, length as recommended by screw manufacturer for material being fastened.

D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC308 as appropriate for the substrate.
   1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
   2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.8 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cleveland Steel Specialty Co.
   2. KC Metals Products, Inc.
   3. Phoenix Metal Products, Inc.
   4. Simpson Strong-Tie Co., Inc.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
   1. Use for interior locations unless otherwise indicated.

2.9 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
   1. Basis of Design: Subject to compliance with requirements, provide Titebond Original wood glue by Franklin International or a comparable product.

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber orrubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

C. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
   2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.

3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.

4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILER

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 INSTALLATION OF WOOD FURRING

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring horizontally and vertically at 24 inches o.c.

C. Furring to Receive Gypsum Board: Install 1-by-3-inch nominal- size furring vertically at o.c.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 1053

SECTION 06 1600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Wall sheathing.
2. Roof sheathing.
3. Composite nail base insulated roof sheathing.
4. Subflooring.
5. Sheathing joint and penetration treatment.

B. Related Requirements:
1. Section 06 1053 "Miscellaneous Rough Carpentry" for plywood backing panels.
2. Section 07 2500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

B. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
3. Chain-of-Custody Certificates: For certified wood products, Include statement of costs.
4. Chain-of-Custody Qualification Data: For manufacturer and vendor.

5. Product Data: For composite wood products indicating compliance with Composite Wood Evaluation.
6. Product Data: For adhesives and sealants indicating compliance with General Emissions evaluation and VOC content requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:
   1. Wood-preservative-treated plywood.
   2. Fire-retardant-treated plywood.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications:
   1. For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

   2. For testing and inspecting agency providing tests and inspections related to air-barrier and water-resistant glass-mat gypsum sheathing: an independent agency, qualified according to ASTM E329 for testing indicated, and certified by Air Barrier Association of America, Inc.

B. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body and is a certified participant in AWI's Quality Certification Program.

C. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

D. Mockups: install sheathing in mockups of assemblies specified in other Sections that are indicated to receive products specified in this Section. Use materials and installation methods specified in this section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. Additional Low-emitting requirements - Adhesives and Sealants:
   1. VOC Content Requirements for Wet Applied Products: All adhesives and sealants wetapplied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, amended October 26, 2017, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.
   2. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.
   3. Do not use adhesives that contain urea formaldehyde.

C. Low-emitting requirements - Composite Wood:
   1. Composite Wood Evaluation - Composite wood, as defined by the California Air Resources Board, Airborne Toxic Measure to Reduce Formaldehyde Emissions from Composite Wood Products Regulation, shall be documented to have low formaldehyde emissions which meet the California Air Resources Board ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins.

D. Certified Wood: Wood shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-00 and FSC STD-40-004.

E. Sustainability Requirements:
   1. Provide products with the maximum amount possible of post-consumer and pre-consumer recycled content.
   2. Provide products manufactured and extracted within 100 miles of the project site whenever possible.

2.2 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
   1. Use treatment that does not promote corrosion of metal fasteners.
   2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
   3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.

   4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D5516 and design value adjustment factors shall be calculated according to ASTM D6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F shall be not less than span ratings specified.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat plywood indicated on Drawings, and the following:
   1. Roof and wall sheathing within 48 inches of fire walls.
   2. Roof sheathing.

2.5 WALL SHEATHING

A. Plywood Sheathing: Either DOC PS 1 or DOC PS 2, Exterior sheathing.
   1. Span Rating: Not less than 32/16.
   2. Nominal Thickness: Not less than 1/2 inch

2.6 ROOF SHEATHING

A. Plywood Sheathing: Either DOC PS 1 or DOC PS 2, Exterior sheathing.
   1. Span Rating: Not less than 48/24.
   2. Nominal Thickness: Not less than 3/4 inch.

2.7 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING

A. Vented, Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: ASTM C1289, Type II, Class 1, with DOC PS 2, Exposure 1 oriented strand board adhered to spacers on one face.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
      a. Atlas Roofing Corporation.
      b. Cornell Corporation.
      c. Hunter Panels.
      d. Johns Mansville; Berkshire Hathaway, Inc.
      e. Rmax, Inc.
   2. Polyisocyanurate-Foam Thickness: 1 inch.
   3. Oriented-Strand-Board Nominal Thickness: 7/16 inch.
   4. Spacers: Wood furring strips or blocks not less than 3/4 inch thick and spaced not more than 16 inches o.c.

2.8 SUBFLOORING AND UNDERLAYMENT

A. Plywood Subflooring: Either DOC PS 1 or DOC PS 2, single-floor panels or sheathing.
   1. Span Rating: Not less than 48/24.
   2. Nominal Thickness: Not less than 3/4 inch .

2.9 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
   1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C1002.
   2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

2.10 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
   2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
   3. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:
   1. Subflooring:
      a. Screw to framing.
      b. Space panels 1/8 inch apart at edges and ends.
   2. Wall and Roof Sheathing:
      a. Screw to framing.

b. Space panels 1/8 inch apart at edges and ends.

END OF SECTION 06 1600

SECTION 06 2013

EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Exterior wood trim.
2. Exterior frames and jambs.
3. Exterior sills and subsills.
4. Wood siding.

B. Related Requirements:
1. Section 06 1053 "Miscellaneous Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

B. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating post-consumer and pre-consumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harves, or recover for each raw material. Include distance to PRoject and cost for each regional material.
3. Chain-of-Custody Certificates: For certified wood products, include statement of costs.
4. Chain-of-Custody Qualification Data: For manufacturer and vendor.
5.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

E. Samples for Verification:
1. For each species and cut of lumber and panel products, with half of exposed surface finished; 50 sq. in. for lumber and 8 by 10 inches for panels.

1.4 INFORMATIONAL SUBMITTALS

A. Compliance Certificates:
   1. For lumber that is not marked with grade stamp.
   2. For preservative-treated wood that is not marked with treatment-quality mark.

B. Sample Warranties: For manufacturer's warranties.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.
   1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
   2. Provide for air circulation around stacks and under coverings.

1.6 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
   1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
   2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

B. Softwood Plywood: DOC PS 1.

C. Hardboard: ANSI A135.4.

2.2 EXTERIOR TRIM

A. Lumber Trim for Painted Finish:

1. Species and Grade: Redwood; RIS Clear.
2. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA Grade A.
3. Species and Grade: Northern white cedar; NeLMA or NLGA 1 Common.
4. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.

5. Finger Jointing: Not allowed.
6. Face Surface: Surfaced (smooth).
7. Factory Priming: Factory coated on both faces and all edges is acceptable, with exterior primer compatible with topcoats specified. Prime all field-cut edges.

B. Primed Hardboard Trim: ANSI A135.6, primed with manufacturer's standard exterior primer. Recommended by manufacturer for exterior use.

2.3 EXTERIOR FRAMES AND JAMBS

A. Vertical Trim for Painted Finish at Windows and Doors:
1. Species and Grade: Redwood; RIS Clear.
2. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA Grade A.
3. Species and Grade: Northern white cedar; NeLMA or NLGA 1 Common.

Maximum moisture content for seasoned or kiln-dried, board-size lumber varies depending on species, grade, and grading agency. See the Evaluations.

4. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.

Allowing finger-jointed material may be inadvisable, because some mills do not use exterior-type glue.

5. Finger Jointing: Not allowed.
6. Face Surface: Surfaced (smooth).

B. Priming: Factory coated on both faces and all edges is acceptable, with exterior primer compatible with topcoats specified. Prime all field-cut edges.

2.4 EXTERIOR SILLS AND SUBSILLS

A. Horizontal Trim for Painted Finish at Windows, Doors and where indicated above stone subsill.
1. The following species are acceptable in this application:
   a. African Mahogany.
   b. Honduras Mahogany.
   c. Teak.
   d. All-heart Redwood.
   e. All-heard Western Red Cedar.

2.5 LUMBER SIDING

A. Provide kiln-dried lumber siding complying with DOC PS 20, factory coated with exterior primer compatible with topcoats specified.
1. Species and Grade: Redwood; RIS Clear.
2. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA Grade A.
3. Species and Grade: Northern white cedar; NeLMA or NLGA 1 Common.

B. Pattern: Bevel-edge, also known as beadboard, smooth-faced tongue and groove, as indicated in Drawings.

2.6 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.
   1. For redwood, provide stainless steel fasteners.
   2. For prefinished items, provide matching prefinished aluminum fasteners where face fastening is required.
   3. For applications not otherwise indicated, provide stainless steel fasteners.

B. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.

C. Flashing: Comply with requirements in Section 07 6200 "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.

2.7 FABRICATION

A. Back out or kerf backs of standing and running trim wider than 5 inches, except members with ends exposed in finished work.

B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed.
   1. Cut to required lengths and prime ends.
   2. Comply with requirements in Section 09 9113 "Exterior Painting."

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials.
1. Use concealed shims where necessary for alignment.
2. Scribe and cut exterior finish carpentry to fit adjoining work.
3. Refinish and seal cuts as recommended by manufacturer.
4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
5. Coordinate exterior finish carpentry with materials and systems in or adjacent to it.
6. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.4 INSTALLATION OF STANDING AND RUNNING TRIM

A. Install flat-grain lumber with bark side exposed to weather.

B. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary.
1. Use scarf joints for end-to-end joints.
2. Stagger end joints in adjacent and related members.

C. Fit exterior joints to exclude water.
1. Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint.
2. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

D. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3.5 INSTALLATION OF SIDING

A. Install siding to comply with manufacturer's written instructions and warranty requirements.

B. Flashing: Install metal flashing as indicated on Drawings and as recommended by siding manufacturer.

C. Finish: Apply finish within two weeks of installation.

3.6 ADJUSTING

A. Replace exterior finish carpentry that is damaged or does not comply with requirements.
1. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

B. Adjust joinery for uniform appearance.

3.7 CLEANING

A. Clean exterior finish carpentry on exposed and semiexposed surfaces.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

3.8 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
   1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 06 2013

SECTION 06 4023

INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Interior standing and running trim.
2. Interior frames and jambs.
3. Wood furring, blocking, shims, and hanging strips for installing interior architectural woodwork items that are not concealed within other construction.
4. Shop priming of interior architectural woodwork.
5. Shop finishing of interior architectural woodwork.

B. Related Requirements:
1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.

1.3 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:
1. Wood-Preservative Treatment:
a. Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
b. Indicate type of preservative used and net amount of preservative retained.
c. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.
2. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

3. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating post-consumer and pre-consumer recycled content and cost.Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harves, or recover for each raw material. Include distance to PRoject and cost for each regional material.
2. Chain-of-Custody Certificates: For certified wood products, include statement of costs.
3. Chain-of-Custody Qualification Data: For manufacturer and vendor.
4. Product Data: For adhesives and sealants, paints and coatings, and insulation products indicating compliance with General Emissions evaluation.

C. Shop Drawings for interior architectural woodwork:
1. Include the following:
   a. Dimensioned plans, elevations, and sections.
   b. Attachment details.
2. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.

3. For paneling, show location of paneling, large-scale details, attachment devices, and other components. Include dimensioned plans and elevations.
4. Apply AWI Quality Certification Program label to Shop Drawings.

D. Samples for Initial Selection: For each type of shop-applied exposed finish.
1. Size:
   a. Panel Products: 12 inches by 12 inches.

E. Samples for Verification: For the following:
1. Lumber for Transparent Finish: Not less than 5 inches wide by 24 inches long, for each species and cut, finished on one side and one edge.
2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished interior architectural woodwork.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For architectural woodwork manufacturer and Installer.

B. Product Certificates: For the following:
1. Composite wood and agrifiber products.
2. Adhesives.

C. Evaluation Reports: For preservative-treated and fire-retardant-treated wood materials, from ICC-ES.

D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.8 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
   1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.
   2. Installer Qualifications: Manufacturer of products and Licensed participant in AWI's Quality Certification Program.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Build mockups of typical interior architectural woodwork as shown on Drawings.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Architectural Woodwork Standards, Section 2.

B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.

C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
   1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
   1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where interior architectural woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.11 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Frames: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
   1. Smoke- and Draft-Control Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.2 ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
   1. Provide [labels] [and] [certificates] from [AWI] [WI] certification program indicating that woodwork[and installation] complies with requirements of grades specified.

   2. The Contract Documents contain requirements that are more stringent than the Architectural Woodwork Standards. Comply with Contract Documents and Architectural Woodwork Standards.

B. Low-emitting requirements - Interior Products
   1. General Emissions Evaluation: Interior products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010, using the applicable exposure scenario.

C. Additional Low-emitting requiremnts - Paints and Coatings:
   1. VOC Content Requirements for Wet Applied Products: All paints and coatings wetapplied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective February 5, 2016.

2. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.
3. Show compliance with VOC limits as detailed in Section 01 8116 “VOC Limits”

D. Additional Low-emitting requirements - Adhesives and Sealants:
1. VOC Content Requirements for Wet Applied Products: All adhesives and sealants wetapplied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, amended October 26, 2017, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.
2. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.
3. Do not use adhesives that contain urea formaldehyde.

E. Additional Low-emitting requirements - Thermal and Acoustic Insulation
1. Free of formaldehyde: insulation manufactured with 100 percent acrylic binders and no formaldehyde.

F. Low-emitting requirements - Composite Wood:
1. Composite Wood Evaluation - Composite wood, as defined by the California Air Resources Board, Airborne Toxic Measure to Reduce Formaldehyde Emissions from Composite Wood Products Regulation, shall be documented to have low formaldehyde emissions which meet the California Air Resources Board ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins.

G. Certified Wood: Wood shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-00 and FSC STD-40-004.

H. Sustainability Requirements:
1. Provide products with the maximum amount possible of post-consumer and pre-consumer recycled content.
2. Provide products manufactured and extracted within 100 miles of the project site whenever possible.

2.3 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: Custom.

B. Softwood Lumber:
1. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.
2. Species: Eastern white pine.
3. Cut: Plain sawn.
4. Wood Moisture Content: 5 to 10 percent.
5. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.

2.4 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: Custom.
1. Wood Species: Any closed-grain hardwood.

2. Wood Moisture Content: 5 to 10 percent.

2.5 INTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: Custom.

B. Wood Species: Any closed-grain hardwood.
   1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.
   2. Wood Moisture Content: 5 to 10 percent.

C. Fire-Rated Interior Frames and Jambs: Products fabricated from fire-retardant particleboard with veneered exposed surfaces or fire-retardant MDF and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
   1. Fire Rating: 20 minutes.

2.6 WOOD CABINETS FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: Custom.

B. Type of Construction: Face frame.

C. Door and Drawer-Front Style: Flush overlay.

Retain "Reveal Dimension" Subparagraph below for reveal-overlay style doors and drawer fronts.

1. Reveal Dimension: As indicated on Drawings.

Retain option in "Wood for Exposed Surfaces" Paragraph below if wood characteristics are indicated on Drawings. Otherwise, delete option and retain subparagraphs describing wood characteristics below.

D. Wood for Exposed Surfaces: As indicated on Drawings - match adjacent wood species in adjoining construction.

Retain "Blueprint Matching" Subparagraph below if blueprint-matched paneling is specified for installation area.

1. Blueprint Matching: Comply with veneer and other matching requirements indicated for blueprint-matched paneling.

Retain subparagraphs below if blueprint matching is not required.

2. Cut: Plain sliced/plain sawn.
3. Grain Direction: Vertically for drawer fronts, doors, and fixed panels As indicated on Drawings.

Retain one of three options in "Matching of Veneer Leaves" Subparagraph below for Premium- or Custom-grade cabinets.

4. Matching of Veneer Leaves: Random match.

Retain one of three options in "Veneer Matching within Panel Face" Subparagraph below for Premium-grade cabinets.

5. Veneer Matching within Panel Face: Running match.

Retain "Veneer Matching within Room" Subparagraph below for blueprint matching when only cabinets are to be matched.

6. Veneer Matching within Room: Provide cabinet veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.

Retain "Semiexposed Surfaces" Paragraph below to restrict woodworker's choices established by the Architectural Woodwork Standards.

E. Semiexposed Surfaces:
1. Surfaces Other Than Drawer Bodies: As iindcated on Drawings.
a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
2. Drawer Subfronts, Backs, and Sides: As indicated on Drawings.
3. Drawer Bottoms: As indicated on Drawings.

Retain "Dust Panels" Paragraph below if required. Dust panels are not required by the Architectural Woodwork Standards.

F. Dust Panels: 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers unless located directly under tops.

G. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

2.7 CABINET HARDWARE AND ACCESSORIES

Where close matching of cabinet hardware and door hardware is required, it may be preferable to specify cabinet hardware in door hardware Section.

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Paragraphs below describing hardware items are examples only; revise to suit Project or delete and include a schedule on Drawings. See BHMA standards or the Architectural Woodwork Standards for illustrations of and designations for additional types of cabinet hardware.
1. .

Hinges in "Frameless Concealed Hinges (European Type)" Paragraph below are not as strong as heavy-duty butt hinges.

C. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 135 degrees of opening, self-closing.

D. Wire Pulls: Back mounted, solid metal 4 inches long, 5/16 inch in diameter 2-1/2 inches deep.

First option in "Adjustable Shelf Standards and Supports" Paragraph below specifies standards and clip-type rests for mounting at ends of shelves; second specifies standards and knife-type brackets for mounting at rear of shelves.

E. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.

Rests in "Shelf Rests" Paragraph below are installed in holes drilled in cabinet sides and partitions.

F. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.

Locks specified in "Door Locks" and "Drawer Locks" paragraphs below are deadbolt locks, surface mounted on inside of door or drawer with only the cylinder exposed on outside; revise either paragraph if another type of lock is required.

G. Door Locks: ANSI/BHMA A156.11, E07121.

H. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.

Retain "Float Glass for Cabinet Doors" or "Tempered Float Glass for Cabinet Doors" Paragraph below if glass is required for cabinet doors. Retain one of two options in second paragraph for seamed exposed edges if unframed glass doors are used.

I. Decorative Glass for Cabinet Doors: Provide decorative glass complying with Section 08 8113 "Decorative Glass Glazing."

J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for BHMA finish number indicated.

Subparagraphs below are examples only. Revise to suit Project. If more than one finish is required, insert location of each here or indicate on Drawings. See the Evaluations.

1. Satin Stainless Steel: ANSI/BHMA 630.
2. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.8 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Nailers: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
   1. Preservative Treatment: Provide softwood lumber treated by pressure process, AWPA U1; Use Category UC3b.
      a. Provide where in contact with concrete or masonry.
      b. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
      c. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
      d. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.
   2. Fire-Retardant Treatment: Complying with requirements; provide where indicated.

B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.
   1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
   2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.9 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.
   1. Ease edges to radius indicated for the following:
      a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
      b. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.
   1. Disassemble components only as necessary for shipment and installation.
   2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
   3. Notify Architect seven days in advance of the dates and times interior architectural woodwork fabrication will be complete.

   4. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.
      a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
      b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

2.10 SHOP PRIMING

A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

B. Interior Architectural Woodwork for Opaque Finish: Shop prime with one coat of wood primer as specified in Section 09 9123 "Interior Painting."
   1. Backpriming: Apply one coat of primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

C. Interior Architectural Woodwork for Transparent Finish: Shop-seal concealed surfaces with required pretreatments and first coat of finish as specified in Section 09 9300 "Staining and Transparent Finishing."
   1. Backpriming: Apply one coat of sealer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.11 SHOP FINISHING

A. Finish interior architectural woodwork indicated on Drawings at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.

C. Transparent Finish:
1. Architectural Woodwork Standards Grade: Same as item to be finished.
2. Finish: System - 2, Lacquer, Pre Catalyzed.
3. Finish: System - 5, Varnish, Conversion.
4. Staining: Match Architect's sample.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Sheen: Semigloss, 46-60 gloss units measured on 60-degree gloss meter according to ASTM D523.

D. Opaque Finish:
1. Architectural Woodworking Standards Grade: Same as item to be finished.
2. Color: As selected by Architect from manufacturer's full range.
3. Sheen: Semigloss, 46-60 gloss units measured on 60-degree gloss meter according to ASTM D523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install interior architectural woodwork level, plumb, true in line, and without distortion.
1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWPA M4.

F. Fire-Retardant-Treated Wood: Install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

G. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.
1. Secure with countersunk, concealed fasteners and blind nailing.

2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork.
3. For shop-finished items, use filler matching finish of items being installed.

H. Standing and Running Trim:
1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
2. Do not use pieces less than 60 inches long, except where shorter single-length pieces are necessary.
3. Scarf running joints and stagger in adjacent and related members.
4. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

3.3 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
1. Inspection entity shall prepare and submit report of inspection.

3.4 REPAIR

A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.

B. Where not possible to repair, replace defective woodwork.

C. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.
1. Fill nail holes with matching filler where exposed.
2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

D. Field Finish: See Section 09 9123 "Interior Painting" and Section 09 9300 "Staining and Transparent Finishing" for final finishing of installed interior architectural woodwork not indicated to be shop finished.

3.5 CLEANING

A. Clean interior architectural woodwork on exposed and semiexposed surfaces.

END OF SECTION 06 4023

SECTION 07 1326

SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Modified bituminous sheet waterproofing at vertical walls.
   2. Blindside sheet waterproofing under slab.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
   2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
   1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

C. Samples: For each exposed product and for each color and texture specified, including the following products:
   1. 8-by-8-inch square of waterproofing and flashing sheet.
   2. 4-by-4-inch square of drainage panel.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Research Reports: For modified bituminous sheet waterproofing/termite barrier, showing compliance with ICC AC380.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.
   1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
   1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.8 WARRANTY

A. Manufacturer's Warranty:
   1. Waterproofing Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
      a. Warranty Period: Five years from date of Substantial Completion.
   2. Termite Barrier Warranty: Manufacturer agrees to furnish replacement waterproofing termite barrier material and accessories for waterproofing termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.
      a. Warranty Period: Ten years from date of Substantial Completion.

B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Waterproofing System: Obtain waterproofing materials, protection course, and molded-sheet drainage panels from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet Waterproofing: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil- thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
   1. Products: Subject to compliance with requirements, provide GCP Applied Technologies Inc (formerly Grace Construction Products) Bituthene 3000/Low Temperature or Bituthene 4000 or comparable products by one of the following:
      a. Manufacturers not listed but who do offer products that comply with the requirements of this section will be considered as substitute manufacturers, subject to the conditions specified in Divison 1 Section Product Substitution Procedures.
   2. Physical Properties:
      a. Tensile Strength, Membrane: 250 psi minimum; ASTM D412, Die C, modified.
      b. Ultimate Elongation: 300 percent minimum; ASTM D412, Die C, modified.
      c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D1970/D1970M.
      d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C836/C836M.
      e. Puncture Resistance: 40 lbf minimum; ASTM E154/E154M.
      f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D570.
      g. Water Vapor Permeance: 0.05 perm maximum; ASTM E96/E96M, Water Method.
      h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D5385.
   3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 BLINDSIDE SHEET WATERPROOFING

A. Blindside Sheet Waterproofing for Vertical Applications: Uniform, flexible, multilayered-composite sheet membrane that forms a permanent bond with fresh concrete placed against it; complete with accessories and preformed shapes for an unbroken waterproofing assembly; with the following physical properties:
   1. Products: Subject to compliance with requirements, provide GCP Applied Technologies Inc. (formerly Grace Construction Products; Preprufe 300R or comparable products by one of the following:
      a. Manufacturers not listed but who do offer products that comply with the requirements of this Section will be considered as subsitute manufacturers, subject to the conditions specified in Divison 1 Section Product Substitution Procedures.
   2. Physical Properties:
      a. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D1970/D1970M.
      b. Peel Adhesion to Concrete: 5 lbf/in. minimum; ASTM D903, modified.

c. Lap Adhesion: 5 lbf/in. minimum; ASTM D1876, modified.
d. Hydrostatic-Head Resistance: 230 feet; ASTM D5385, modified.
e. Puncture Resistance: 100 lbf minimum; ASTM E154/E154M.
f. Water Vapor Permeance: 0.1 perm maximum; ASTM E96/E96M, Water Method.
g. Ultimate Elongation: 335 percent minimum; ASTM D412, modified.

B. Blindside Sheet Waterproofing for Horizontal Applications: Uniform, flexible, multilayered-composite sheet membrane that forms a permanent bond with fresh concrete placed against it; complete with accessories and preformed shapes for an unbroken waterproofing assembly; with the following physical properties:

1. Physical Properties:
   a. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D1970/D1970M.
   b. Peel Adhesion to Concrete: 5 lbf/in. minimum; ASTM D903, modified.
   c. Lap Adhesion: 5 lbf/in. minimum; ASTM D1876, modified.
   d. Hydrostatic-Head Resistance: 230 feet; ASTM D5385, modified.
   e. Puncture Resistance: 200 lbf minimum; ASTM E154/E154M.
   f. Water Vapor Permeance: 0.1 perm maximum; ASTM E96/E96M, Water Method.
   g. Ultimate Elongation: 335 percent minimum; ASTM D412, modified.

C. Mastic, Adhesives, and Detail Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

2.4 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne primer recommended for substrate by sheet waterproofing material manufacturer.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet waterproofing material manufacturer.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch, predrilled at 9-inch centers.

G. Protection Course, Extruded-Polystyrene Board Insulation, Unfaced: ASTM C578, Type X, 1/2 inch thick.

H. Stainless steel hose clamp.

I. Provide stainless steel flashing to comply with requirements in Section 07 6200 "Sheet Metal Flashing and Trim."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of waterproofing.
   1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
   2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D4263.
   3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections.

E. Fill form tie holes, honeycomb, aggregate pockets, holes, and other voids.

F. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.
   1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

G. Corners: Prepare, prime, and treat inside and outside corners in accordance with manufacturer's instructions.
   1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:
      a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
      b. At plaza-deck-to-wall intersections, extend liquid membrane or sheet strips onto deck waterproofing and to finished height of sheet flashing.

H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

3.3 INSTALLATION OF MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
   1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

D. Two-Ply Application: Install sheets to form a membrane with lap widths not less than 50 percent of sheet widths, to provide a minimum of two thicknesses of sheet membrane over areas to receive waterproofing.

E. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.

F. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

G. Seal edges of sheet waterproofing terminations with mastic.

H. Install sheet waterproofing and auxiliary materials to tie into adjacent waterproofing.

I. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

J. Immediately install protection course with butted joints over waterproofing membrane.
   1. Board insulation may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

3.4 INSTALLATION OF BLINDSIDE SHEET WATERPROOFING

A. Install blindside sheet waterproofing according to manufacturer's written instructions.

B. Place and secure molded-sheet drainage panels over substrate. Lap edges and ends of geotextile to maintain continuity.

C. Vertical Applications: Install sheet with face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation. Mechanically fasten to substrate.
   1. Securely fasten top termination of membrane with continuous metal termination bar anchored into substrate and cover with detail tape.

D. Horizontal Applications: Install sheet with face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation.

E. Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.

F. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane troweling.

G. Install sheet waterproofing and auxiliary materials to produce a continuous watertight tie into adjacent waterproofing.

H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending 6 inches beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests, and to furnish reports to Architect.

B. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to furnish daily reports to Architect.

C. Waterproofing will be considered defective if it does not pass tests and inspections.

3.6 PROTECTION, REPAIR, AND CLEANING

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 07 1326

SECTION 07 2100

BUILDING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Extruded polystyrene foam-plastic board insulation.
2. Polyisocyanurate foam-plastic board insulation.
3. Glass-fiber blanket insulation.
4. Closed Cell spray-applied polyurethane foam insulation

B. Related Requirements:
1. Section 06 1600 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
2. Section 09 2900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
1. Extruded polystyrene foam-plastic board insulation.
2. Polyisocyanurate foam-plastic board insulation.
3. Glass-fiber blanket insulation.
4. Closed Cell spray applied polyurethane foam insulation.

B. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest or recovery for each raw material. Include distance to Project and cost for each regional material.
3. Product Data: For adhesives and sealants, and insulation productst, indicating compliance with General Emissions evaluation and VOC content requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.
1. For blown-in or sprayed fiberglass and cellulosic-fiber loose-fill insulation, indicate initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed.

2. Sign, date, and post the certification in a conspicuous location on Project site.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:
1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Additional Low-emitting requirements - Adhesives and Sealants:
1. VOC Content Requirements for Wet Applied Products: All adhesives and sealants wetapplied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, amended October 26, 2017, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.
2. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.
3. Do not use adhesives that contain urea formaldehyde.
4. Show compliance with VOC limits as detailed in Section 01 8116 “VOC Limits.”

B. Additional Low-emitting requirements - Thermal and Acoustic Insulation:
1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Methylene chloride and perchloroethylene shall not be intentionally added in insulation products.

C. Foam Insulation:
1. Foam insulation: Provide fire retardants that contain no hexabromocyclododecane (HBCD) flame retardants. Use Polymeric flame retardants (PolyFR) in lieu of these products

D. Sustainability Requirements:
1. Provide products with the maximum amount possible of post-consumer and pre-consumer recycled content.
2. Provide products manufactured and extracted within 100 miles of the project site whenever possible.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Extruded Polystyrene Board Insulation:: ASTM C578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
   1. Basis of Design: Subject to compliance with requirements, provide one of the following or approved equal:
      a. DiversiFoam Products
      b. Owens Corning
      c. Dow Chemical Company
      d. Pactiv Building Products
   2. Manufacturers who are not listed but who do offer products that comply with the requirements of this section shall be considered as substitute manufacturers, subject to the conditions specified in Division 1 Section Product Substitution Procedures.
   3. Type IV, 25 psi minimum, at wall assemblies where indicated.
   4. Type VII, 60 psi minimum, under concrete slabs on grade and perimeter walls below grade, where indicated.
   5. Thickness: as indicated in drawings.
   6. Fire Propagation Characteristics: Passes NFPA 285 Testing as part of an approved assembly.
   7. Labeling: Provide Identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.3 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION

A. Polyisocyanurate Board Insulation, : ASTM C1289, glass-fiber-mat faced, Type II, Class1, Grade 2, felt or glass-fiber mat facer on both major surfaces
   1. Compressive strengthL 20 psi.
   2. Size: 48 by 96 inches.
   3. Thickness: as indicated in drawings.
   4. Basis of Design: Subject to compliance with requirements, provide one of the following or approved equal:
      a. Atlas Roofing Corporation
      b. Carlisle Coatings & Waterproofing Inc.
      c. Firestone Building Products
      d. Hunter Panels
      e. Johns Manville
      f. Rmax, Inc
   5. Manufacturers who are not listed but who do offer products that comply with the requirements of this section shall be considered as substitute manufacturers, subject to the conditions specified in Division 1 Section Product Substitution Procedures.

   6. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
   7. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.4 GLASS-FIBER BLANKET INSULATION

A. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
   1. Free of formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
   2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05 ppm formaldehyde.

B. Glass-Fiber Blanket Insulation, Unfaced : ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
   1. Manufacturers: subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation.
      b. Guardian Building Products, Inc.
      c. Johns Mansville, a Berkshire Hathaway Company.
      d. Knauf Insulation.
      e. Owens Corning.
   2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
   3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
   4. Application: Exterior wood-framed walls where indicated.
   5. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.5 ACCESSORIES

A. Insulation for Miscellaneous Voids:
   1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
   2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
   3. Polyurethane Pour-In-Place Insulation: Closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84, specifically formulated for pour-in-place applications.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
   1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
   1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer.
   1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
   2. Press units firmly against inside substrates.
   3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 2000 "Unit Masonry."

3.5 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

   4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.6 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 2100

SECTION 07 2715

NONBITUMINOUS SELF-ADHERING SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Self-adhering, vapor-permeable, nonbituminous sheet air barriers.
2. Self-adhering flashing at intersections of air barrier system.

B. Related Requirements:
1. Section 06 1600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; and tested physical and performance properties of products.

B. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest or recovery for each raw material. Include distance to Project and cost for each regional material.
3. Product Data: For adhesives and sealants indicating compliance with General Emissions evaluation and VOC content requirements.

C. Shop Drawings: For air-barrier assemblies.
1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

B. Mockups: Install air barriers in mockups of assemblies specificed in other sections that are indicated to receive products specified in this section. Use materials and installation methods specified in this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
1. Protect substrates from environmental conditions that affect air-barrier performance.

2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E2357.

2.3 NONBITUMINOUS SHEET AIR BARRIER

A. Vapor-Permeable Nonbituminous Sheet: Minimum 20-mil- thick, self-adhering sheet consisting of a breathable carrier film or fabric and an adhesive with release liner on adhesive side and formulated for application with primer that complies with VOC limits.
   1. Manufacturers: Subkect to compliance with requirements, provide products by one of the following:
      a. Henry Company
      b. Tremco
      c. VaproShield
      d. WR Grace
   2. Physical and Performance Properties:
      a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E2178.

      b. Puncture Resistance: Minimum 40 lbf; ASTM E154/E154M.
      c. Vapor Permeance: Minimum 15 perms; ASTM E96/E96M, Desiccant Method, Procedure A.

      d. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested according to ASTM D4541 as modified by ABAA.

      e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

      f. UV Resistance: Can be exposed to sunlight for 150 days according to manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

C. Stainless-Steel Sheet: ASTM A240/A240M, Type 304, 0.0250 inch thick, and Series 300 stainless-steel fasteners.

D. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
   1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
   2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
   3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D4263.
   4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

H. Bridge isolation joints expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 INSTALLATION

A. Install materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
   1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.

B. Prepare, treat, and seal inside and outside corners and vertical and horizontal surfaces at terminations and penetrations with termination mastic.

C. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.

D. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.
   1. Apply sheets in a shingled manner to shed water.
   2. Roll sheets firmly to enhance adhesion to substrate.

E. Apply continuous air-barrier sheets over accessory strips bridging substrate cracks, construction, and contraction joints.

F. CMU: Install air-barrier sheet horizontally against the CMU beginning at base of wall. Align top edge of air-barrier sheet immediately below protruding masonry ties or joint reinforcement or ties, and firmly adhere in place.
   1. Overlap horizontally adjacent sheets a minimum of 2 inches and roll seams.
   2. Apply overlapping sheets with bottom edge slit to fit around masonry reinforcing or ties. Roll firmly into place.
   3. Seal around masonry reinforcing or ties and penetrations with termination mastic.
   4. Continue the sheet into all openings in the wall, such as doors and windows, and terminate at points to maintain an airtight barrier that is not visible from interior.

G. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch- wide, transition strip.

H. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

I. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.

1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.

J. Connect and seal exterior wall air-barrier sheet continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

K. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.

L. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

M. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
1. Transition Strip: Roll firmly to enhance adhesion.
2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

N. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier material with foam sealant.

O. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches beyond repaired areas in all directions.

P. Do not cover air barrier until it has been tested and inspected by testing agency.

Q. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.4 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air-barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed.

7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Air barrier has been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (air barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

D. Tests: As determined by testing agency from among the following tests:
1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E1186, chamber pressurization or depressurization with smoke tracers.

2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E783 or ASTM E2357.
3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D4541 for each 600 sq. ft. of installed air barrier or part thereof.

E. Air barriers will be considered defective if they do not pass tests and inspections.
1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

G. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 07 2715

SECTION 07 3113

ASPHALT SHINGLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. asphalt shingles.
2. Underlayment materials.
3. Ridge vents.
4. Metal flashing and trim.

B. Related Requirements:
1. Section 07 7200 "Roof Accessories" for roof ventilators.

1.3 DEFINITIONS

A. Roofing Terminology: See ASTM D1079 for definitions of terms related to roofing Work in this Section.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:
1. Asphalt shingles.
2. Underlayment materials.
3. Ridge vents.
4. Asphalt roofing cement.
5. Elastomeric flashing sealant.

B. Shop Drawings: For metal flashing and trim.

C. Samples: For each exposed product and for each color and blend specified, in sizes indicated.
1. Asphalt Shingles: Full size.
2. Ridge and Hip Cap Shingles: Full size.
3. Ridge Vent: 12-inch- long Sample.
4. Exposed Valley Lining: 12 inches square.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each type of asphalt shingle and underlayment product indicated, for tests performed by a qualified testing agency.

C. Research Reports: For synthetic underlayment, from an agency acceptable to authorities having jurisdiction, indicating that product is suitable for intended use under applicable building codes.

D. Sample Warranty: For manufacturer's materials warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For asphalt shingles to include in maintenance manuals.

B. Materials warranties.

C. Roofing Installer's warranty.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Asphalt Shingles: 100 sq. ft. of each type and in each color and blend, in unbroken bundles.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: An authorized installer who is trained and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Store roofing materials in a dry, well-ventilated location protected from weather, sunlight, and moisture in accordance with manufacturer's written instructions.

B. Store underlayment rolls on end, on pallets or other raised surfaces. Do not double-stack rolls.

C. Protect unused roofing materials from weather, sunlight, and moisture when left overnight or when roofing Work is not in progress.

D. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Proceed with installation only when existing and forecasted weather conditions permit product installation and related Work to be performed in accordance with manufacturer's written instructions and warranty requirements.
   1. Install self-adhering, polymer-modified bitumen sheet underlayment within the range of ambient and substrate temperatures recommended in writing by manufacturer.

1.12 WARRANTY

A. Materials Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Manufacturing defects.
   2. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 80 mph for 15 years from date of Substantial Completion.

   3. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for 10 years from date of Substantial Completion.
   4. Workmanship Warranty Period: 25 years from date of Substantial Completion.

B. Roofing Installer's Warranty: On warranty form at end of this Section, signed by Installer, in which Installer agrees to repair or replace components of asphalt shingle roofing that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of product from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance in accordance with ASTM E108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

2.3 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Laminated-Strip Asphalt Shingles: ASTM D3462/D3462M, laminated, multi-ply overlay construction; glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
   1. Basis of Design: Subject to compliance with requirements, provide Slateline by GAF Roofing Products or an approved equal.

a. Manufacturers not listed but who do offer products that comply with the requirements of this section will be considered as substitute manufacturers, subject to the conditions specified in Division 1 Product Substitution Procedures.

2. Strip Size: Manufacturer's standard.
3. Algae Resistance: Granules resist algae discoloration.
4. Color and Blends: As selected by Architect from manufacturer's full range.

B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

2.4 UNDERLAYMENT MATERIALS

A. Organic Felt: Asphalt-saturated organic felts, nonperforated and complying with the following:
1. ASTM D226/D226M: Type II.

B. Self-Adhering Sheet Underlayment, High Temperature: Minimum of 40-mil-thick; with slip resisting, polymer-film-reinforced or glass-reinforced top surface laminated to layer of butyl or SBS-modified asphalt adhesive; with release backing; cold applied; and evaluated and documented to be suitable for use for intended purpose under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. GAF Materials Corporation
b. Grace Construction Products; WR Grace & Co.
c. Henry Company
2. Thermal Stability: Stable after testing at 240 degrees F according to ASTM D 1970/D 1970M.
3. Low-Temperature Flexibility: Passes after testing at minus 20 degrees F according to ASTM D 1970/D 1970M.

C. Granular-Surfaced Valley Lining: ASTM D3909/D3909M, mineral-granular-surfaced, glass-felt-based, asphalt roll roofing; 36 inches wide.

2.5 RIDGE VENTS

A. Rigid Ridge Vent: Manufacturer's standard, rigid-section, high-density, UV-stabilized plastic ridge vent for use under ridge shingles.
1. Basis of Design: Cor-A-Vent V-300E-7 Ridge Vent, or approved equal.
2. Minimum Net Free Area: <13.5 sq in per lineal foot>.
3. Dimensions: 7 inches wide by 48 inches long by 5/8 inch high
4. Color: Black

2.6 SOFFIT VENTS

A. Continuous Linear Soffit Vent: Manufacturer's standard, rigid-section, high-density, UV-stabilized plastic ridge vent for use along perimeter of soffit.
1. Basis of Design: Cor-A-Vent S-400 Strip Vent, or approved equal.
2. Minimum Net Free Area: 10 sq in per lineal foot.
3. Dimensions: 1 inch wide by 48 inches long by 1 1/2 inch high.
4. Color: black

2.7 ACCESSORIES

A. Starter Strip: Manufacturer's standard self-sealing starter shingle strip
   1. Basis of Design Product: Pro-Start by GAF, or approved equal.

B. Asphalt Roofing Cement: ASTM D4586/D4586M Type II, asbestos free.

C. Elastomeric Flashing Sealant: ASTM C920, Type S, Grade NS, one-part, non-sag, elastomeric polymer sealant; of class and use classifications required to seal joints and remain watertight; recommended in writing by manufacturer for installation of flashing systems.

D. Roofing Nails: ASTM F1667, aluminum, stainless steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- diameter, sharp-pointed, with a 3/8- diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking or extend at least 1/8 inch through sheathing less than 3/4 inch thick.
   1. Shank: Barbed.
   2. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

E. Felt-Underlayment Nails: Aluminum, stainless steel, or hot-dip galvanized-steel wire nails with low-profile metal or plastic caps, 1-inch- minimum diameter.

2.8 METAL FLASHING AND TRIM

A. Comply with requirements in Section 07 6200 "Sheet Metal Flashing and Trim."
   1. Sheet Metal: Stainless steel .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored and that provisions have been made for flashings and penetrations through asphalt shingles.
   3. Verify that vent stacks and other penetrations through roofing are installed and securely fastened.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT MATERIALS

A. Comply with asphalt shingle and underlayment manufacturers' written installation instructions and with recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems" applicable to products and applications indicated unless more stringent requirements are specified in this Section or indicated on Drawings.

B. Self-Adhering, Sheet Underlayment: Install, wrinkle free, on roof deck.
   1. Comply with low-temperature installation restrictions of underlayment manufacturer.
   2. Install lapped in direction that sheds water.
      a. Lap sides not less than 3-1/2 inches.
      b. Lap ends not less than 6 inches, staggered 24 inches between succeeding courses.
      c. Roll laps with roller.
   3. Prime concrete, masonry, and metal surfaces to receive self-adhering sheet.
   4. Eaves: Extend from edges of eaves 36 inches beyond interior face of exterior wall.
   5. Rakes: Extend from edges of rakes 24 inches beyond interior face of exterior wall.
   6. Valleys: Extend from lowest to highest point 18 inches on each side of centerline.
   7. Hips: Extend 18 inches on each side.
   8. Ridges: Extend 36 inches on each side without obstructing continuous ridge vent slot.
   9. Sidewalls: Extend 18 inches beyond sidewalls and return vertically against sidewalls not less than 4 inches.
   10. Dormers, Chimneys, Skylights, and Other Roof-Penetrating Elements: Extend 18 inches beyond penetrating elements and return vertically against penetrating elements not less than 4 inches.
   11. Roof-Slope Transitions: Extend 18 inches on each roof slope.
   12. Cover underlayment within seven days.

C. Granular-Surfaced, Open-Valley Lining: Before installing valley lining, install 36-inch- wide felt underlayment centered in valley. Fasten to roof deck with roofing nails.
   1. Lap roof-deck felt underlayment over valley felt underlayment at least 6 inches.
   2. Install an 18-inch- wide strip of valley lining centered in valley, with granular-surface face down.
   3. Install a second 36-inch- wide strip of valley lining centered in valley, with granular-surface face up.
   4. Lap ends of each strip at least 12 inches in direction to shed water, and seal with asphalt roofing cement.
   5. Stagger end laps between succeeding strips at least 72 inches.
   6. Fasten each strip to roof deck.

3.3 INSTALLATION OF METAL FLASHING AND TRIM

A. Install metal flashings and trim to comply with requirements in Section 07 6200 "Sheet Metal Flashing and Trim."
   1. Install metal flashings in accordance with recommendations in ARMA's "Asphalt Roofing Residential Manual - Design and Application Methods" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
   2. Bed flanges of metal flashings using asphalt roofing cement or elastomeric flashing sealant.

B. Apron Flashings: Extend lower flange over and beyond each side of downslope asphalt shingles and up the vertical surface.

C. Step Flashings: Install with a headlap of 2 inches and extend over underlying shingle and up the vertical face.
   1. Install with lower edge of flashing just upslope of, and concealed by, butt of overlying shingle.
   2. Fasten to roof deck only.

D. Cricket and Backer Flashings: Install against roof-penetrating elements extending concealed flange beneath upslope asphalt shingles and beyond each side.

E. Counterflashings: Coordinate with installation of base flashing and fit tightly to base flashing. Lap joints a minimum of 4 inches secured in a waterproof manner.
   1. Install in reglets or receivers.

F. Open-Valley Flashings: Install centered in valleys, lapping ends at least 8 inches in direction that sheds water. Fasten upper end of each length to roof deck beneath overlap.
   1. Adhere minimum 9-inch- wide strips of self-adhering, polymer-modified bitumen sheet to metal flanges and to underlying self-adhering sheet, polymer-modified bitumen sheet.

G. Rake Drip Edges: Install over underlayment materials and fasten to roof deck.

H. Eave Drip Edges: Install below underlayment materials and fasten to roof deck.

I. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

3.4 ROOF VENTILATION INSTALLATION

A. Install sloped roof ventilation in accordance with manufacturer's instructions at locations indicated on the drawings.

B. Remove protective vinyl film if present immediately before installation.

C. Install sloped roof ventilation watertight.

D. Install sloped roof ventilation to allow for thermal movement.

E. Joint Sealants: Apply joint sealants in accordance with manufacturer's instructions.

3.5 INSTALLATION OF ASPHALT SHINGLES

A. Install asphalt shingles in accordance with manufacturer's written instructions and recommendations in ARMA's "Asphalt Roofing Residential Manual - Design and Application Methods" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip with tabs removedat least 7 inches wide with self-sealing strip face up at roof edge.
   1. Extend asphalt shingles 1/2 inch over fasciae at eaves and rakes.
   2. Install starter strip along rake edge.

C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Fasten asphalt shingle strips with a minimum of six roofing nails, but not less than the number indicated in manufacturer's written instructions for roof slope and design wind speed indicated on Drawings and for warranty requirements specified in this Section.
   1. Locate fasteners in accordance with manufacturer's written instructions.
   2. Where roof slope exceeds 18:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.

   3. Where roof slope is less than 4:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.

   4. When ambient temperature during installation is below 50 deg F, hand seal self-sealing asphalt shingles by applying asphalt roofing cement spots between course overlaps after nailing the upper course.

E. Closed-Cut Valleys: Extend asphalt shingle strips from one side of valley 12 inches beyond center of valley.
   1. Use one-piece shingle strips without joints in valley.
   2. Fasten with extra nail in upper end of shingle. Install asphalt shingle courses from other side of valley and cut back to a straight line 2 inches short of valley centerline.
   3. Trim upper concealed corners of cut-back shingle strips.
   4. Do not nail asphalt shingles within 6 inches of valley center.
   5. Set trimmed, concealed-corner asphalt shingles in a 3-inch- wide bed of asphalt roofing cement.

F. Open Valleys: Cut and fit asphalt shingles at open valleys, trimming upper concealed corners of shingle strips.
   1. Maintain uniform width of exposed open valley from highest to lowest point.
   2. Set valley edge of asphalt shingles in a 3-inch- wide bed of asphalt roofing cement.
   3. Do not nail asphalt shingles to metal open-valley flashings.

G. Ridge Vents: Install continuous ridge vents over asphalt shingles in accordance with manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.

H. Hip and Ridge Shingles: Maintain same exposure of cap shingles as roofing-shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds.
   1. Fasten with roofing nails of sufficient length to penetrate sheathing.
   2. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

END OF SECTION 07 3113

SECTION 07 6200

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Manufactured reglets with counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed low-slope roof sheet metal fabrications.
4. Formed steep-slope roof sheet metal fabrications.
5. Formed wall sheet metal fabrications.
6. Formed overhead-piping safety pans.

B. Related Requirements:
1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 07 7200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
   2. <Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest or recovery for each raw material. Include distance to Project and cost for each regional material. Double click to insert sustainable design text for recycled content.>

C. Shop Drawings: For sheet metal flashing and trim.
   1. Include plans, elevations, sections, and attachment details.
   2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
   3. Include identification of material, thickness, weight, and finish for each item and location in Project.
   4. Include details for forming, including profiles, shapes, seams, and dimensions.
   5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   6. Include details of termination points and assemblies.
   7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
   8. Include details of roof-penetration flashing.
   9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
   10. Include details of special conditions.
   11. Include details of connections to adjoining work.
   12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

D. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

E. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

F. Samples for Verification: For each type of exposed finish.
   1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
   2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
   3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
   4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

B. Special warranty.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
   1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
   2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
1. Design Pressure: As indicated on Drawings.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.
1. Source Limitations: Obtain sheet from single source from single manufacturer.
2. Nonpatinated, Exposed Finish: Mill.

C. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
1. Exposed Coil-Coated Finish:
a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color: As selected by Architect from manufacturer's full range.
3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

D. Stainless Steel Sheet: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.
1. Finish: ASTM A480/A480M, No. 2B (bright, cold rolled) .

E. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation; prepainted by coil-coating process to comply with ASTM A755/A755M.
1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finish:

a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Color: As selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.

1. Basis of Design: Subject to compliance with requirmeents, provide Henry Company, or a comparable product by one of the following:
   a. Carlisle Residential
   b. Grace Construction Products
   c. Metal-Fab Manufacturing
   d. Owens Corning.
2. Source Limitations: Obtain underlayment from single source from single manufacturer.
3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
   a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
   b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
   c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
2. Fasteners for Copper Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

5. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
6. Fasteners for Zinc Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.

C. Solder:
1. For Copper: ASTM B32, with maximum lead content of 0.2 percent.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

I. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.
1. Basis of Design: Subject to compliance with requirements, provide products by Hohmann & Barnard, Inc. or a comparable product by one of the following:
   a. Fry Reglet Corporation
   b. Heckmann Building Products, Inc.
   c. Hickman Company, W.P.
   d. Keystone Flashing Company, Inc.

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:
1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

G. Seams:
1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.

H. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:
1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
2. Fabricate in minimum 96-inch- long sections.
3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness .
4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.

5. Gutter Profile: As shown on Drawings in accordance with cited sheet metal standard.
6. Expansion Joints: Lap type.
7. Gutters with Girth up to 15 Inches: Fabricate from the following materials:
   a. Aluminum: 0.032 inch thick.

B. Downspouts: Fabricate round downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.
1. Hanger Style: Projecting mount downspout bracket.
   a. Basis of Design: Projecting mount downspout brackets by Classic Gutter Systems, or approved equal..
2. Fabricate from the following materials:

a. Aluminum: 0.024 inch thick.

C. Splash Pans: Fabricate to dimensions and shape required and from the following materials:
1. Aluminum: 0.040 inch thick.

2.7 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:
1. Aluminum: 0.032 inch thick.

B. Drip Edges: Fabricate from the following materials:
1. Aluminum: 0.032 inch thick.

C. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:
1. Aluminum: 0.032 inch thick.

D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Aluminum: 0.032 inch thick.

E. Flashing Receivers: Fabricate from the following materials:
1. Aluminum: 0.032 inch thick.

F. Roof-Penetration Flashing: Fabricate from the following materials:
1. Stainless Steel: 0.0188 inch thick.

2.8 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12-foot- long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch- high, end dams. Fabricate from the following materials:
1. Copper: 16 oz./sq. ft..

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 8 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:
1. Copper: 16 oz./sq. ft..

2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:
1. Stainless Steel: 0.0188 inch thick.

B. Overhead-Piping Safety Pans: Fabricate from the following materials:
1. Stainless Steel: 0.0250 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.
   1. Install in shingle fashion to shed water.
   2. Lap joints not less than 2 inches.

B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
   1. Lap horizontal joints not less than 4 inches.
   2. Lap end joints not less than 12 inches.

C. Self-Adhering, High-Temperature Sheet Underlayment:
   1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
   2. Prime substrate if recommended by underlayment manufacturer.
   3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
   4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
   5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
   6. Roll laps and edges with roller.
   7. Cover underlayment within 14 days.

D. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.
   1. Install in shingle fashion to shed water.
   2. Lapp joints not less than 4 inches.

3.3 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
   1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.
9. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
   a. Embed hooked flanges of joint members not less than 1 inch into sealant.
   b. Form joints to completely conceal sealant.
   c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
   d. Adjust setting proportionately for installation at higher ambient temperatures.
      1) Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 07 9200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.

2. Do not solder metallic-coated steel and aluminum sheet.
3. Do not pretin zinc-tin alloy-coated copper.

4. Do not use torches for soldering.
5. Heat surfaces to receive solder, and flow solder into joint.
   a. Fill joint completely.
   b. Completely remove flux and spatter from exposed surfaces.
6. Stainless Steel Soldering:
   a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
   b. Promptly remove acid-flux residue from metal after tinning and soldering.
   c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
7. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters:
1. Join sections with riveted and soldered joints or joints sealed with sealant.
2. Provide for thermal expansion.
3. Attach gutters at eave or fascia to firmly anchor them in position.
4. Provide end closures and seal watertight with sealant.
5. Fasten gutter spacers to front and back of gutter.
6. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.

7. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet apart. Install expansion-joint caps.

C. Downspouts:
1. Join sections with 1-1/2-inch telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches o.c.
4. Provide elbows at base of downspout to direct water away from building.
5. Connect downspouts to underground drainage system.

3.5 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:
1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints minimum of 4 inches.
4. Secure in waterproof manner by means of anchor and washer spaced at 36 inches o.c. along perimeter and 6 inches o.c. at corners areas unless otherwise indicated.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric or butyl sealant and clamp flashing to pipes that penetrate roof.

3.6 INSTALLATION OF WALL FLASHINGS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

C. Reglets: Installation of reglets is specified in Section 03 3000 "Cast-in-Place Concrete."

3.7 INSTALLATION OF MISCELLANEOUS FLASHING

A. Equipment Support Flashing:
1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
2. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans:
1. Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings.
2. Pipe and install drain line to plumbing waste or drainage system.

3.8 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.9 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

3.10 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 07 6200

SECTION 07 7200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Preformed flashing sleeves.

B. Related Requirements:
   1. Section 07 6200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

1.3 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.
   1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
   1. Size and location of roof accessories specified in this Section.
   2. Method of attaching roof accessories to roof or building structure.

3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Wind-Restraint Performance: As indicated on Drawings.

2.2 PREFORMED FLASHING SLEEVES

A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and slotted metal collar.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Custom Solution Roof and Metal Products
b. Menzies Metal Products
c. Thaler Metal Industries, Ltd.
2. Metal: Aluminum sheet, 0.063 inch thick.
3. Diameter: As indicated on Drawings.
4. Finish: Manufacturer's standard.

B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Custom Solution Roof and Metal Products
b. Menzies Metal Products
c. Milcor; Commercial Products Group of Hart & Cooley, Inc.

2. Metal: Aluminum sheet, 0.063 inch thick.
3. Height: 13 inches.
4. Diameter: As indicated on Drawings .
5. Finish: Manufacturer's standard.

2.3 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.

C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

D. Underlayment:
1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
2. Polyethylene Sheet: 6-mil- thick polyethylene sheet complying with ASTM D4397.
3. Slip Sheet: Building paper, 3 lb/100 sq. ft. minimum, rosin sized.
4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.

F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

G. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

H. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

I. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install roof accessories according to manufacturer's written instructions.
   1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
   2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
   3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
   4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of uncoated aluminum or stainless steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
   3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

D. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09 9113 "Exterior Painting."

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 7200

SECTION 07 9200

JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Preformed joint sealants.
5. Acoustical joint sealants.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to project for each regional material.
3. Product Data: For adhesives and sealants indicating compliance with General Emissions evaluation and VOC content requirements.

C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.

4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
1. Joint-sealant location and designation.
2. Manufacturer and product name.
3. Type of substrate material.
4. Proposed test.
5. Number of samples required.

D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

E. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

F. Field-Adhesion-Test Reports: For each sealant application tested.

G. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.
1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.

3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with stone substrates.
4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.

7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
   a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
      1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.8 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
   1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
   2. Disintegration of joint substrates from causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Low-emitting requirements - Interior Products
   1. General Emissions Evaluation: Interior products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010, using the applicable exposure scenario.

C. Additional Low-emitting requirements - Adhesives and Sealants:
   1. VOC Content Requirements for Wet Applied Products: All adhesives and sealants wet applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, amended October 26, 2017, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.
   2. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.
   3. Do not use adhesives that contain urea formaldehyde.
   4. Show compliance with VOC limits as detailed in Section 01 8116 “VOC Limits”

D. Sustainability Requirements:
   1. Provide products with the maximum amount possible of post-consumer and pre-consumer recycled content.
   2. Provide products manufactured and extracted within 100 miles of the project site whenever possible.

E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 790.
      b. Pecora Corporation; 301 NS, 311 NS, 890, or 890FTS.
      c. Sika Corporation, Construction Products Division; SikaSil WS-290.
      d. Tremco Incorporated; Spectrem 1 or Spectrem 800.

B. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 795.
      b. Pecora Corporation; 864, 895 or 898.
      c. Sika Corporation, Construction Products Division; SikaSil WS-295.

2.3 URETHANE JOINT SEALANTS

A. Urethane, M, NS, 50, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Use NT.
   1. Pecora Corporation; Dynatrol II

B. Urethane, M, NS, 25, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. BASF Building Systems; MasterSeal NP 2.
      b. Pecora Corporation; Dynatred.
      c. Sika Corporation, Construction Products Division; Sikaflex 2c NS EZ Mix.
      d. Tremco Incorporated; Vulkem 227

2.4 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. STPE, Mildew Resistant, S, NS, 50, NT: Mildew-resistant, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, silyl-terminated polyether joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. BASF Building Systems; MasterSeal NP 150.
      b. Pecora Corporation; 898 NST.
      c. Tremco Incorporated; Tremsil 200.

2.5 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Pecora Corporation; AC-20+.
   b. Pecora Corporation; AC-20 FTR
   c. Pecora Corporation: AIS 919
   d. Tremco Incorporated: Tremflex 834

2.6 PREFORMED JOINT SEALANTS

A. Preformed Silicone Joint Sealants: Manufacturer's standard seal consisting of precured low modulus silicone extrusion, with a neutral-curing silicone sealant for bonding extrusions to substrates.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 123 Silicone Seal.
      b. Pecora Corporation; Sil-Span.
      c. Tremco Incorporated; Spectrem Simple Seal.
   2. Joint Seal Width: Joint size indicated on Drawings plus 0.75 inch.
   3. Joint Seal Color: As selected by Architect from full range of industry colors.

B. Preformed, Foam Joint Seals: Manufacturer's standard joint seal manufactured from urethane or EVA (ethylene vinyl acetate) foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. EMSEAL Joint Systems, Ltd.; Emseal 25V.
      b. MM Systems Corporation; EIF EIS SIF.
      c. Tremco Incorporated; ExoAir Eco
      d. Tremco Incorporated; ExoAir Trio
      e. Tremco Incorporated; Illmod 600
   2. Design Criteria:
      a. Nominal Joint Width: As indicated on Drawings.
      b. Minimum Joint Width: As indicated on Drawings.
      c. Maximum Joint Width: As indicated on Drawings.
      d. Movement Capability: -25 percent/+25 percent.
   3. Joint Seal Color: As selected by Architect from full range of industry colors.

2.7 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C 834.

B. Products: Subject to compliance with requirements, provide one of the following:
   1. Acoustical Sealant for Exposed and Concealed Joints:
      a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
      b. Pecora Corporation; AIS-919.
      c. USG Corporation; SHEETROCK Acoustical Sealant.
   2. Acoustical Sealant for Concealed Joints:
      a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
      b. Hilti CP605
      c. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
      d. Pecora Corporation; AIS-919.
      e. Tremco, Inc.; Tremco Acoustical Sealant.
   3. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.8 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin)Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.9 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

   3. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.
   4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C1193.
   5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C1193.
      a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.5 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
   1. Extent of Testing: Test completed and cured sealant joints as follows:
      a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
      b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
   2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
      a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
   3. Inspect tested joints and report on the following:
      a. Whether sealants filled joint cavities and are free of voids.
      b. Whether sealant dimensions and configurations comply with specified requirements.
      c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.6 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.7 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.8 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior and interior joints in horizontal traffic surfaces.
1. Joint Locations:
2. Joint Sealant: Urethane,M NS 25 T..
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Sealant:
   a. Silicone, S, NS, 100/50, NT
   b. Silicone, S, NS, 50 NT.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces <JS-#>.
1. Joint Sealant: Latex OP NF.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces <JS-#>.
1. Joint Sealant: STPE, Mildew Resistant, S, NS, NT..
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Sealant: Acoustical.
2. Joint-Sealant Color: As selected by Architect from Manufacturer's full range.

END OF SECTION 07 9200

SECTION 08 1416

FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Solid Core Five-ply flush wood doors for opaque finish.
2. Fire-rated wood door frames.
3. Factory priming flush wood doors.
4. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:
1. Section 06 4023 "Interior Architectural Woodwork" for wood door frames.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction, louvers and trim for openings. Include factory-finishing specifications

B. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest or recovery for each raw material. Include distance to Project and cost for each regional material.
3. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
4. Chain-of-Custody Qualification Data: For manufacturer and vendor.
5. Product Data: For composite wood products, adhesives and sealants, indicating compliance with Composite Wood Evaluation, General Emissions evaluation and VOC content requirements.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:
1. Details of frame for each frame type, including dimensions and profile.
2. Dimensions and locations of blocking for hardware attachment.
3. Dimensions and locations of mortises and holes for hardware.

4. Clearances and undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and application requirements.

D. Samples for Initial Selection: For factory-finished doors.

E. Samples for Verification:
1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
2. Plastic laminate, 6 inches square, for each color, texture, and pattern selected.
3. Polymer edging, in manufacturer's standard colors.
4. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
5. Louver blade and frame sections, 6 inches long, for each material and finish specified.
6. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.
1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
3. Submit copy of DHI's Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body and is a certified participant in AWI's Quality Certification Program.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

B. Environmental Limitations: Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors and frames that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Delamination of veneer.
      b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
      c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
   2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors and frames.

   3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Masonite Architectural - ASSA ABLOY Group
   2. Oregon Door
   3. VT Indust

B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Low-emitting requirements - Interior Producs
   1. General Emissions Evaluation: Interior products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010, using the applicable exposure scenario.

B. Additional Low-emitting requirements - Adhesives and Sealants:
   1. VOC Content Requirements for Wet Applied Products: All adhesives and sealants wetapplied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, amended October 26, 2017, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.

2. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.
3. Do not use adhesives that contain urea formaldehyde.

C. Additional Low-emitting requirements - Thermal and Acoustic Insulation
1. Free of formaldehyde: insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Methylene chloride and perchloroethylene shall not be intentionally added in insulation products.

D. Low-emitting requirements - Composite Wood:
1. Composite Wood Evaluation - Composite wood, as defined by the California Air Resources Board, Airborne Toxic Measure to Reduce Formaldehyde Emissions from Composite Wood Products Regulation, shall be documented to have low formaldehyde emissions which meet the California Air Resources Board ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins.

E. Certified Wood: Wood shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-00 and FSC STD-40-004.

F. Sustainability Requirements:
1. Provide products with the maximum amount possible of post-consumer and pre-consumer recycled content.
2. Provide products manufactured and extracted within 100 miles of the project site whenever possible.

G. Wood Veneers: All wood veneers for Project, for each species, despite trade, regardless of use, must be coordinated with the Contractor, and be purchased from the same vendor and flitch selection.

2.3 FLUSH WOOD DOORS AND FRAMES, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."
1. Provide labels from AWI certification program indicating that doors and frames comply with requirements of grades specified.

2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

B. WDMA I.S.1-A Performance Grade:
1. Heavy Duty unless otherwise indicated.
2. Extra Heavy Duty: Public toilets, janitor's closets, assembly spaces, exits and where indicated.
3. Standard Duty: Closets (not including janitor's closets) and private toilets and where indicated.

C. Structural-composite-lumber-core Doors:
1. Structural Composite Lumber: WDMA I.S.10.
   a. Screw withdrawal, Face: 700 lbf.
   b. Screw withdrawal, Edge: 400 lbf.

2.4 SOLID-CORE FIVE-PLY FLUSH WOOD DOORS FOR OPAQUE FINISH

A. Interior Solid-Core Doors :
   1. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty .
   2. Architectural Woodwork Standards Grade: Custom.
   3. Faces: MDO Hardboard or MDF.
      a. Apply MDO to standard-thickness, closed-grain, hardwood face veneers.
      b. Hardboard Faces: ANSI A135.4, Class 1 (tempered) or Class 2 (standard).
      c. MDF Faces: ANSI A208.2, Grade 150 or Grade 160.
   4. Exposed Vertical and Top Edges: Any closed-grain hardwood.
   5. Core for Non-Fire-Rated Doors:
      a. WDMA I.S. 10 structural composite lumber.
         1) Screw Withdrawal, Door Face: 550 lbf.
         2) Screw Withdrawal, Vertical Door Edge: 400 lbf.
      b. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
   6. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.
   1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
   2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.
   1. Locate hardware to comply with DHI-WDHS-3.
   2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.

   3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
   4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.

   5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Factory cut and trim openings through doors.
   1. Light Openings: Trim openings with moldings of material and profile indicated.
   2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 8000 "Glazing."
   3. Louvers: Factory install louvers in prepared openings.

2.6 FACTORY PRIMING

A. Doors for Opaque Finish: Factory prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 09 9123" Interior Painting."

2.7 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.
   1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
   2. Finish faces, all four edges, edges of cutouts, and mortises.
   3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors that are indicated on Drawings to receive transparent finish.

C. Opaque Finish:
   1. Grade: Premium.
   2. Finish: Architectural Woodwork Standards System-10, UV Curable, Water Based.
   3. Color: As selected by Architect from manufacturer's full range.
   4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.
   1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
   2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 08 7100 "Door Hardware."

B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 1416

SECTION 08 3113

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Access doors and frames.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.

B. Sustainable Design Submittals
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
   2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest or recovery for each raw material. Include distance to Project and cost for each regional material.

C. Shop Drawings:
   1. Include plans, elevations, sections, details and attachments to other work.
   2. Detail fabrication and installation of access doors and frames for each type of substrate.

D. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 3 by 5 inches in size.

E. Product Schedule: For access doors and frames.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection and temperature-rise limit ratings indicated, according to NFPA 252 or UL 10B.

B. Sustainability Requirements:

1. Provide products with the maximum amount possible of post-consumer and pre-consumer recycled content.
2. Provide products manufactured and extracted within 100 miles of the project site whenever possible.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Babcock-Davis.
2. J.L. Industries, Inc.; Div. of Activar Construction Products Group.
3. Larsen's Manufacturing Company.
4. MIFAB, Inc.
5. Nystrom, Inc.

D. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
1. Material: Steel
2. Basis of Design: Nystrom NT/NW/NP
3. Style: 1 inch exposed flange, or drywall/plaster bead where required,
4. Hinge: Concealed spring
5. Finish: Painted to match adjacent wall or ceiling color and finish.
6. Location: Typical.
7. Door Size: As required,
8. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gauge.
   a. Finish - factory prime
9. Frame Metal: Same material, thickness and finish as door.
10. Hardware: Latch.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

D. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

E. Stainless Steel Flat Bars: ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

F. Aluminum Extrusions: ASTM B221, Alloy 6063.

G. Aluminum Sheet: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

H. Frame Anchors: Same material as door face.

I. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
   1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
   2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
   1. For recessed doors with plaster infill, provide self-furring expanded-metal lath attached to door panel.

E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
   1. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

F. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
   1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 3113

SECTION 08 5200

WOOD WINDOWS AND DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes
1. Aluminum-clad wood windows.
2. Aluminum-clad wood doors.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review, discuss, and coordinate the interrelationship of wood windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for wood windows.

B. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to project and cost for each regional material.
3. Chain-of-Custody Certificates: For certified wood products, include statement of cost.
4. Chain-of-Custody Qualification Data: For manufacturer and vendor.

C. Shop Drawings: For wood windows and doors.

1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

D. Samples: For each exposed product and for each color specified, 2 by 4 inches in size.

E. Samples for Initial Selection: For units with factory-applied finishes.
1. Include Samples of hardware and accessories involving color selection.

F. Samples for Verification: For wood windows and doors and components required, prepared on Samples of size indicated below:
1. Exposed Finishes: 2 by 4 inches.
2. Exposed Hardware: Full-size units.

G. Product Schedule: For wood windows and doors. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each type of wood window, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For manufacturer's warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by and FSC-accreddited certification body and is a certified participant in AWI's Quality Certification Program.

B. Vendor Qualifications: A vendor that is qualified for chain of custody by an FSC-accredited certification body.

C. Installer Qualifications: An installer acceptable to wood window manufacturer for installation of units required for this Project.

D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
1. Build mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure to meet performance requirements.
      b. Structural failures including excessive deflection, water leakage, and air infiltration.
      c. Faulty operation of movable sash and hardware.
      d. Deterioration of materials and finishes beyond normal weathering.
      e. Failure of insulating glass.
   2. Warranty Period:
      a. Window: 10 years from date of Substantial Completion.
      b. Glazing Units: 10 years from date of Substantial Completion.
      c. Aluminum-Cladding Finish: 20 years from date of Substantial Completion.
      d. Hardware: 10 years from date of Substantial Completion

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wood windows and doors from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
   1. Window Certification: WDMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
   1. Minimum Performance Class: CW.
   2. Minimum Performance Grade: 50 .

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.35 Btu/sq. ft. x h x deg F.

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.30 .

E. Low-emitting requirements - Interior Producs
   1. General Emissions Evaluation: Interior products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010, using the applicable exposure scenario.

F. Additional Low-emitting requirements - Adhesives and Sealants:
   1. VOC Content Requirements for Wet Applied Products: All adhesives and sealants wetapplied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, amended October 26, 2017, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.

2. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.
3. Do not use adhesives that contain urea formaldehyde.

G. Low-emitting requirements - Composite Wood:
1. Composite Wood Evaluation - Composite wood, as defined by the California Air Resources Board, Airborne Toxic Measure to Reduce Formaldehyde Emissions from Composite Wood Products Regulation, shall be documented to have low formaldehyde emissions which meet the California Air Resources Board ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins.

H. Certified Wood: Wood shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-00 and FSC STD-40-004.

I. Sustainability Requirements:
1. Provide products with the maximum amount possible of post-consumer and pre-consumer recycled content.
2. Provide products manufactured and extracted within 100 miles of the project site whenever possible.

2.3 ALUMINUM CLAD WOOD WINDOWS

A. Aluminum-Clad Wood Windows:
1. Basis of Design: Subject to compliance with requirements, provide Aluminum Clad Ultimate windows as manufactured by Marvin Windows and Doors, Warroad, Minnesota, or a comparable product.
a. Manufacturers not listed but who do offer products that comply with the requirements of this section will be considered as substitute manufacturers, subject to the conditions specified in Division 1 Section Product Substitution Procedures.

B. Operating Types: Provide the following operating types in locations indicated on Drawings:
1. Casement: Project out.
2. Horizontal sliding.
3. Fixed.

C. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch deep by 2 inches wide; water-repellent preservative treated.
1. Exterior Finish:
a. Aluminum Finish: Manufacturer's standard fluoropolymer two-coat system with fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight and complying with AAMA 2605.

b. Color: As selected by Architect from manufacturer's full range.
2. Interior Finish: Manufacturer's standard stain-and-varnish finish.
a. Exposed Unfinished Wood Surfaces: Pine.

D. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ALUMINUM CLAD WOOD DOORS

A. Aluminum-Clad Wood Doors:
   1. Basis of Design: Subject to compliance with requirements, provide Aluminum Clad Ultimate windows as manufactured by Marvin Windows and Doors, Warroad, Minnesota, or a comparable product.
      a. Manufacturers not listed but who do offer products that comply with the requirements of this section will be considered as substitute manufacturers, subject to the conditions specified in Division 1 Section Product Substitution Procedures.

B. Frame Description
   1. Finger-jointed, edge-glued Pine core with non-finger-jointed Pine veneer
      a. Kiln dried to moisture content no greater than twelve (12) percent at the time of fabrication.
      b. Water repellent, preservative treated in accordance with WDMA I.S.4.
   2. Frame width: 4 9/16 inches
   3. Frame thickness: 1 1/16 inches
   4. Exterior extruded aluminum clad 0.050 inches thick
   5. Sill options:
      a. Low profile thermal barrier saddle low profile .250 inches by 7.125 inch sill.

C. Weather Strip
   1. Head hamb and hinge jamb: bulb type weather strip
   2. Color: Black

2.5 MATERIALS

A. Glazing: Satisfy requirements specified in Section 08 8000 Glazing.
   1. Kind: Fully tempered where indicated on Drawings and where required by authorities having jurisdiction.

B. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials. Designed to smoothly operate, tightly close, and securely lock windows, and sized to accomodate sash weight and dimensions.
   1. Exposed Hardware Color and Finish: As selected by Architect from Manufacturer's full range.

C. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

D. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
   1. Exposed fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.6 ACCESSORIES

A. Dividers (False Muntins): Provide divider grilles in designs indicated for each sash lite.
   1. Quantity and Type: Three per sash, two permanently located at exterior and interior lites and one permanently located between insulating-glass lites.

2. Material: Manufacturer's standard.
3. Pattern: As indicated on Drawings.
4. Profile: As selected by Architect from manufacturer's full range.
5. Color: As selected by Architect from manufacturer's full range.

2.7 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.
   1. Type and Location: Full, inside for project-out sashes.

B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
   1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.
   2. Finish for Interior Screens: Baked-on organic coating in color selected by Architect from manufacturer's full range.
   3. Finish for Exterior Screens: Baked-on organic coating in color selected by Architect from manufacturer's full range.

2.8 FABRICATION

A. Fabricate wood windows and doors in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze wood windows and doors in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
   1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
   1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
   2. Air-Infiltration Testing:
      a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
      b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
   3. Water-Resistance Testing:
      a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
      b. Allowable Water Infiltration: No water penetration.
   4. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
   5. Test Reports: Prepared according to AAMA 502.

C. Windows will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.
   1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 08 5200

SECTION 08 7100

DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:

   a. Swinging doors.

2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 07 Section “Joint Sealants” for sealant requirements applicable to threshold installation specified in this section.
2. Division 08 Section “Flush Wood Doors”
3. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.

1.02 REFERENCES

A. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives

3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:

   a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.
   b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
   c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Door Hardware Schedule:

   a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
   b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
   c. Indicate complete designations of each item required for each opening, include:
      1) Door Index: door number, heading number, and Architect’s hardware set number.
      2) Quantity, type, style, function, size, and finish of each hardware item.
      3) Name and manufacturer of each item.
      4) Fastenings and other pertinent information.
      5) Location of each hardware set cross-referenced to indications on Drawings.
      6) Explanation of all abbreviations, symbols, and codes contained in schedule.
      7) Mounting locations for hardware.
      8) Door and frame sizes and materials.
      9) Degree of door swing and handing.

10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

3. Key Schedule:

   a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
   b. Use ANSI/BHMA A156.28 “Recommended Practices for Keying Systems” as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
   c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
   d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
   e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
   f. Prepare key schedule by or under supervision of supplier, detailing Owner’s final keying instructions for locks.

4. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:

   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
   b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Factory order acknowledgement numbers (for warranty and service)
   d. Name, address, and phone number of local representative for each manufacturer.
   e. Parts list for each product.
   f. Final approved hardware schedule edited to reflect conditions as installed.
   g. Final keying schedule
   h. Copies of floor plans with keying nomenclature
   i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
   j. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit a written report of the results of functional testing and inspection for fire door assemblies, in compliance with NFPA 80.

    a. Written report to be provided to the Owner and be made available to the Authority Having Jurisdiction (AHJ).
    b. Report to include the door number for each fire door assembly, door location, door and frame material, fire rating, and summary of deficiencies.

2. Submit a written report of the results of functional testing and inspection for required egress door assemblies, in compliance with NFPA 101.

    a. Written report to be provided to the Owner and be made available to the Authority Having Jurisdiction (AHJ).
    b. Report to include the door number for each required egress door assembly, door location, door and frame material, fire rating, and summary of deficiencies.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

    a. Warehousing Facilities: In Project's vicinity.
    b. Scheduling Responsibility: Preparation of door hardware and keying schedules.
    c. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies like those indicated for this Project.
    d. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
        1) Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

    a. For door hardware: DHI certified AHC or DHC.
    b. Can provide installation and technical data to Architect and other related subcontractors.
    c. Can inspect and verify components are in working order upon completion of installation.
    d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:

a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
b. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:

a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware

a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:

a. Comply with governing accessibility regulations cited in “REFERENCES” article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference

a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2) Preliminary key system schematic diagram.
3) Requirements for key control system.
4) Requirements for access control.
5) Address for delivery of keys.

2. Pre-installation Conference

a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Inspect and discuss preparatory work performed by other trades.
c. Inspect and discuss electrical roughing-in for electrified door hardware.
d. Review sequence of operation for each type of electrified door hardware.
e. Review required testing, inspecting, and certifying procedures.
f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:

    a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer’s original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

1.07 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.

    a. Mechanical Warranty
        1) Locks
            a) Schlage L Series: 3 year
        2) Closers
            a) LCN 4050 Series: 25 year
            b) LCN 1450 Series: 25 year
        3) Accessories
            a) Ives Continuous Hinges: Lifetime

1.08 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

B. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other

work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru bolts are required.
4. Install hardware with fasteners provided by hardware manufacturer.

2.03 HINGES

A. Manufacturers and Products as listed below, or approved equal:

1. Basis of Design Manufacturer and Product:

a. Ives 5BB series

2. Acceptable Manufacturers and Products:

a. PBB
b. Bommer BB5000 series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:

a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:

a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. 2 inches or thicker doors:

a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
b. Interior: Heavy weight, steel, 5 inches (127 mm) high

6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
9. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

a. Steel Hinges: Steel pins
b. Non-Ferrous Hinges: Stainless steel pins
c. Out-Swinging Exterior Doors: Non-removable pins
d. Out-Swinging Interior Lockable Doors: Non-removable pins
e. Interior Non-lockable Doors: Non-rising pins

10. Provide hinges with electrified options as scheduled in the hardware sets. Provide with enough and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CONTINUOUS HINGES

A. Manufacturers and Products as listed below, or approved equal:

1. Basis of Design Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Roton
b. ABH

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with enough and wire gage to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 MORTISE LOCKS

A. Manufacturers and Products as listed below, or approved equal:

1. Basis of Design Manufacturer and Product:

a. Schlage L9000 series

2. Acceptable Manufacturers and Products:

a. Accurate 9000/9100 series
b. Corbin-Russwin ML2000 series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.

5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
8. Provide motor based electrified locksets with electrified options as scheduled in the hardware sets and comply with the following requirements:

    a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
    b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case
    c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
    d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
    e. Connections – provide quick-connect Molex system standard.

9. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

    a. Lever Design: Latitude.

2.06 DEADLOCKS

A. Manufacturers and Products as listed below, or approved equal:

1. Basis of Design Manufacturer and Product:

    a. Schlage L400 series

2. Acceptable Manufacturers and Products:

    a. Corbin-Russwin DL4000 series
    b. Dorma D900 series

B. Requirements:

1. Provide mortise deadlock series conforming to ANSI/BHMA A156.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide deadlocks with standard 2-3/4 inches (70 mm) backset. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
4. Provide manufacturer’s standard strike.

2.07 CYLINDERS

A. Manufacturers and Products as listed below, or approved equal:

1. Basis of Design Manufacturer and Product:

a. Schlage Everest 29 T

2. Acceptable Manufacturers and Products:

a. Best CORMAX
b. Corbin-Russwin Patented and Restricted Keyway

B. Requirements:

1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.

a. Conventional Patented Restricted: cylinder with interchangeable core with patented, restricted keyway.

3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
4. Nickel silver bottom pins.

C. Construction Keying:

1. Replaceable Construction Cores.

a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
1) 3 construction control keys
2) 12 construction change (day) keys.

b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2.08 KEYING

A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Provide cylinders/cores keyed into Owner's existing keying system managed by Owner's locksmith, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference. Contact:

1. Firm Name:
2. Contact Person:
3. Telephone:

C. Requirements:

1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.

a. Master Keying system as directed by the Owner.

2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
3. Provide keys with the following features:

    a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
    b. Patent Protection: Keys and blanks protected by one or more utility patent(s).

4. Identification:

    a. Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
    b. Identification stamping provisions must be approved by the Architect and Owner.
    c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
    d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
    e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

5. Quantity: Furnish in the following quantities.

    a. Change (Day) Keys: 3 per cylinder/core.
    b. Permanent Control Keys: 3.
    c. Master Keys: 6.

2.09 KEY CONTROL SYSTEM

A. Manufacturers as listed below, or approved equal:

1. Basis of Design Manufacturer:

    a. Telkee

2. Acceptable Manufacturers:

    a. HPC
    b. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.

    a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
    b. Provide hinged-panel type cabinet for wall mounting.

2.10 DOOR CLOSERS

A. Manufacturers and Products as listed below, or approved equal:

1. Basis of Design Manufacturer and Product:

a. LCN 4050A series

2. Acceptable Manufacturers and Products:

a. Falcon SC70A series
b. Sargent 351 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with cast aluminum cylinder.
3. Closer Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter heat-treated pinion journal and full complement bearings.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and all weather requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and back check.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Provide stick on templates, special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.11 DOOR CLOSERS

A. Manufacturers and Products as listed below, or approved equal:

1. Basis of Design Manufacturer and Product:

a. LCN 1450 series

2. Acceptable Manufacturers and Products:

a. Falcon SC80A series
b. Sargent 1331 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory.
2. Provide door closers with fully hydraulic, full rack and pinion action with cast aluminum cylinder.
3. Closer Body: 1-3/8-inch (35 mm) diameter with 5/8-inch (16 mm) diameter pinion journal diameter heat-treated pinion journal and full complement bearings.

4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Pressure Relief Valve (PRV) Technology: Not permitted.
7. Provide stick on and special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.12 DOOR TRIM

A. Manufacturers as listed below, or approved equal:

1. Basis of Design Manufacturer:

a. Ives.

2. Acceptable Manufacturers:

a. Trimco
b. Burns

B. Requirements:

1. Provide push plates, push bars, pull plates, and pulls with diameter and length as scheduled.

2.13 PROTECTION PLATES

A. Manufacturers as listed below, or approved equal:

1. Basis of Design Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Trimco

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.14 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers as listed below, or approved equal:

1. Basis of Design Manufacturers:

    a. Glynn-Johnson

2. Acceptable Manufacturers:

    a. Rixson
    b. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
2. Provide friction type at doors without closer and positive type at doors with closer.

2.15 DOOR STOPS AND HOLDERS

A. Manufacturers as listed below, or approved equal:

1. Basis of Design Manufacturer:

    a. Ives

2. Acceptable Manufacturers:

    a. Trimco
    b. Burns

2.16 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers as listed below, or approved equal:

1. Basis of Design Manufacturer:

    a. Zero International

2. Acceptable Manufacturers:

    a. National Guard
    b. Reese
    c. Legacy

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.17 SILENCERS

A. Manufacturers as listed below, or approved equal:

1. Basis of Design Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.18 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
3. Protection Plates: BHMA 630 (US32D)
4. Overhead Stops and Holders: BHMA 630 (US32D)
5. Door Closers: Powder Coat to Match
6. Wall Stops: BHMA 630 (US32D)
7. Latch Protectors: BHMA 630 (US32D)
8. Weatherstripping: Clear Anodized Aluminum
9. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Where on-site modification of doors and frames is required:

1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
2. When modifications are exposed to view, use concealed fasteners, when possible.
3. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:

a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

H. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.
3. Furnish permanent cores to Owner for installation.

I. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

L. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

M. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

N. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

O. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

P. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

Q. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

R. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL

A. Inspection and Testing:

1. Provide functional testing and inspection of fire door assemblies by a qualified person in accordance with NFPA 80.

    a. Schedule fire door assembly inspection within 90 days of Substantial Completion of the Project.
    b. Submit a signed, written final report as specified in Paragraph 1.03.E.1.
    c. Correct all deficiencies and schedule a reinspection of fire door assemblies noted as deficient on the inspection report.
    d. Inspector to reinspect fire door assemblies after repairs are made.

2. Provide inspection of required egress door assemblies by a qualified person in accordance with NFPA 101.

    a. Schedule egress door assembly inspection within 90 days of Substantial Completion of the Project for the required openings.

b. Submit a signed, written final report as specified in Paragraph 1.03.E.2.
c. Correct all deficiencies and schedule a reinspection of egress door assemblies noted as deficient on the inspection report.
d. Inspector to reinspect required egress door assemblies after repairs are made.

3.05 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.06 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer’s instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.07 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier’s responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

END OF SECTION

Hardware Group No. 01

For use on Door #(s):
200 300

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224XY		313AN	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 18 09-509		613	SCH
1	EA	FSIC CORE	23-030		613	SCH
1	EA	SURFACE CLOSER	4050 SCUSH		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	DRIP CAP	142AA		AA	ZER
1	EA	GASKETING	BY ALUMINUM DOOR MFR			
1	EA	DOOR SWEEP	8197AA		D	ZER
1	EA	THRESHOLD	545A		D	ZER

Hardware Group No. 02

For use on Door #(s):
103A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		613	IVE
1	EA	STOREROOM LOCK	L9080T 18		613	SCH
1	EA	FSIC CORE	23-030		613	SCH
1	EA	OH STOP	100S		US10B	GLY
3	EA	SILENCER	SR65		GRY	IVE

Hardware Group No. 03

For use on Door #(s):
105

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		613	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 18 09-509		613	SCH
1	EA	FSIC CORE	23-030		613	SCH
1	EA	OH STOP	100S		US10B	GLY
1	EA	SURFACE CLOSER	1450 REG OR PA AS REQ		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
3	EA	SILENCER	SR65		GRY	IVE

Hardware Group No. 04

For use on Door #(s):
104

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		613	IVE
1	EA	PRIVACY LOCK	L9040 18 L583-363 L283-722		613	SCH
1	EA	SURFACE CLOSER	1450 SCUSH		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
3	EA	SILENCER	SR65		GRY	IVE

Hardware Group No. 05

For use on Door #(s):
100

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224XY		313AN	IVE
1	EA	DBL CYL DEAD LOCK	L462T		613	SCH
2	EA	FSIC CORE	23-030		613	SCH
2	EA	PUSH/PULL BAR	9266-12"-PR		613	IVE
1	EA	OH STOP	100S		US10B	GLY
1	EA	SURFACE CLOSER	4050 EDA		695	LCN
1	EA	DRIP CAP	142AA		AA	ZER
1	EA	PERIMETER GASKETING	BY ALUMINUM DOOR MFR			
1	EA	DOOR SWEEP	8197AA		D	ZER
1	EA	THRESHOLD	545A		A	ZER
1	EA	SIGNAGE	"THIS DOOR TO REMAIN UNLOCKED DURING OCCUPIED HOURS"			

Door Numbers	HwSet#
100	05
103A	02
104	04
105	03
200	01
300	01

SECTION 08 8000

GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Glass for windows and doors.
   2. Glazing sealants and accessories.

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review temporary protection requirements for glazing during and after installation.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
   2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest or recovery for each raw material. Include distance to Project and cost for each regional material.
   3. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
   4. Chain-of-Custody Qualification Data: For manufacturer and vendor.
   5. Product Data: For composite wood products, adhesives and sealants, indicating compliance with Composite Wood Evaluation, General Emissions evaluation and VOC content requirements.

C. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
   1. Coated glass.
   2. Laminated glass.
   3. Insulating glass.

D. Glazing Accessory Samples: For gaskets, sealants and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of adjoining framing system.

E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

F. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturers of fabricated glass units.

B. Product Certificates: For glass and glazing products, from manufacturer.
   1. Product Test Reports:For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

C. Preconstruction adhesion and compatibility test report.

D. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved and certified by primary glass manufacturer.

B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
   1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
   2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
   3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
   4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
   5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
   1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.12 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.
1. Warranty Period: 10 years from date of Substantial Completion.

D. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent within specified warranty period. Coverage for any other cause is excluded.
1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
1. Design Wind Pressures: As indicated on Drawings.
2. Design Snow Loads: As indicated on Drawings.
3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.

4. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
   2. For laminated-glass lites, properties are based on products of construction indicated.
   3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
   4. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
   5. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
   6. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

F. Sound Rating: Provide sound control assemblies identical to those of assemblies tested as sound-retardant units by an acoustical testing agency, and have the following minimum rating:
   1. STC Rating: As indicated on Drawings as calculated by ASTM E413 when tested in an operable condition according to ASTM E90.

G. Low-emitting requirements - Interior Producs
   1. General Emissions Evaluation: Interior products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010, using the applicable exposure scenario.

H. Additional Low-emitting requirements - Adhesives and Sealants:
   1. VOC Content Requirements for Wet Applied Products: All adhesives and sealants wetapplied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, amended October 26, 2017, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.
   2. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.
   3. Do not use adhesives that contain urea formaldehyde.

I. Sustainability Requirements:
   1. Provide products with the maximum amount possible of post-consumer and pre-consumer recycled content.
   2. Provide products manufactured and extracted within 100 miles of the project site whenever possible.

2.2 MANUFACTURERS

A. Basis of Design: Subject to compliance with requirements, provide glass products by Vitro Architectural Glass or a comparable product by one of the following:
   1. Guardian Industries Corp.
   2. Pilkington North America.
   3. Vetrotech Saint-Gobain.
   4. Viracon, Inc.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.3 GLASS PRODUCTS, GENERAL

A. Glass shall conform to ASTM C1048 and ASTM C1036, Type I, Quality-Q3, Class I – glazing select, and the following:
   1. Glass edges shall be clean scored and cut.
   2. Glass shall conform to the requirements of the Consumer Product Safety Commission's Standard 16 CFR 1201, the Safety Certification Council, ANSI Z97.1-1975, and local codes, whichever is most stringent. Notify Engineer if safety glazing is required.

B. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
   2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
   3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
   4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

C. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

D. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.

E. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
   1. Minimum Glass Thickness for Exterior Lites: 6 mm.

F. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide kind HS heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide Kind FT heat-treated float glass.

G. Low Emissivity Coated Float Glass
   1. Comply with ASTM C1376 coated by vacuum deposition (sputter-coating) process, and complying with other requirements specified in this section.

H. Glass and Glazing, in combination with adjacent construction, shall provide a fully weathertight system that promptly drains all incidental water to the exterior. Glass and glazing materials shall not block weeps or otherwise impede drainage. All glazing pockets shall drain incidental water at the sill of each lite of glass; internal drainage of the glazing pockets at vertical mullions is not acceptable.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3, unless otherwise indicated.

B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

D. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
   1. Construction: Laminate glass with polyvinyl butyral interlayer ionoplast interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written instructions.
   2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
   3. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
   1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
   2. Perimeter Spacer: Manufacturer's standard spacer material and construction .
   3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
   1. Neoprene complying with ASTM C 864.
   2. EPDM complying with ASTM C 864.
   3. Silicone complying with ASTM C 1115
   4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene EPDM silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

C. Lock-strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.8 GLAZING SEALANTS

A. General:
1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

B. Neutral-Curing Silicone Glazing Sealant, Class 100/50: Complying with ASTM C920, Type S, Grade NS, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Dow Corning Corporation; DOWSIL 795.
b. Pecora Corporation; 896.
c. Tremco Incorporated: Proglaze or Tremsil 600.

2.9 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.10 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:
   1. Elastomeric material with Shore A durometer hardness of 85, plus or minus 5.
   2. Type recommended in writing by sealant or glass manufacturer.

D. Spacers:
   1. Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
   2. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:
   1. Elastomeric material with Shore A durometer hardness per manufacturer's written instructions.
   2. Type recommended in writing by sealant or glass manufacturer.

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.11 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
   1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
      a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep systems.
   3. Minimum required face and edge clearances.
   4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch- minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
   1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 LAMINATED GLASS SCHEDULE

A. Clear Laminated Glass Type : Two plies of annealed float glass.
   1. Kind LA, consisting of two lights of 6.0 mm annealed float glass.
   2. Outer Lite: 1/4" clear Glass
   3. Interlayer Thickness: 0.030 inch but not less than that required to comply as a Type II safety glass material.
   4. Indoor Lite: 1/4" clear Glass.
   5. Glass shall be annealed, heat-strengthened or tempered as required by codes and as specified on drawings.

   6. Provide safety glazing labeling.

3.9 INSULATING GLASS SCHEDULE

A. Low-E-Coated, Clear Insulating Glass Type :
   1. Basis-of-Design Product: <**Marvin Ultimate Series Dual Pane** >.

2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Annealed float glass.
5. Interspace Content: Air.
6. Indoor Lite: Annealed float glass.
7. Low-E Coating: Sputtered on second surface.
8. Winter Nighttime U-Factor: <0.28> maximum.
9. Visible Light Transmittance: <**64%**> percent minimum.
10. SGHC: <0.27> maximum.
11. Safety glazing where required.

END OF SECTION 08 8000

SECTION 09 2900

GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:
1. Section 07 9219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
2. Section 09 3013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.:

B. Sustainable Design Submittals:
1. Product Data: For recycled content, indicate postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest or recovery for each raw material. Include distance to Projedt and cost for each regional material.

C. Samples: For the following products:
1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.
1. Build mockups for the following:
a. Each level of gypsum board finish indicated for use in exposed locations.
b. Each texture finish indicated.
2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.Environmental Certification: provide materials carrying certification by one of the following:
1. Greenguard Gold Certification
2. UL Environment ISR 100

C. Low-emitting requirements - Interior Producs
1. General Emissions Evaluation: Interior products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010, using the applicable exposure scenario.

D. Additional Low-emitting requirements - Paints and Coatings
1. VOC Content Requirements for Wet Applied Products: All paints and coatings wetapplied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective February 5, 2016.
2. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.

E. Additional Low-emitting requirements - Adhesives and Sealants:
1. VOC Content Requirements for Wet Applied Products: All adhesives and sealants wetapplied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, amended October 26, 2017, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.
2. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.
3. Do not use adhesives that contain urea formaldehyde.

F. Additional Low-emitting requirements - Thermal and Acoustic Insulation
1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Methylene chloride and perchloroethylene shall not be intentionally added in insulation products.

2.2 GYPSUM BOARD, GENERAL

A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C1396/C1396M.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. CertainTeed Corp.
b. National Gypsum Company
c. USG Corporation

B. Gypsum Board, Type X: ASTM C1396/C1396M.
1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

C. Flexible Gypsum Board: ASTM C1396/C1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
1. Thickness: 1/4 inch.
2. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C1396/C1396M.
1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed Corp.
   b. National Gypsum Company
   c. USG Corporation
2. Thickness: 5/8 inch.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet .
2. Shapes:
   a. Cornerbead.
   b. Bullnose bead.
   c. LC-Bead: J-shaped; exposed long flange receives joint compound.
   d. L-Bead: L-shaped; exposed long flange receives joint compound.
   e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
   f. Expansion (control) joint.
   g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fry Reglet Corp.
   b. Gordon, Inc.
   c. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:
1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
2. Recycled Content of Blankets: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimter joints and openings in building construction by testing representative assemblies according to ASTM E90.
1. Acoustical Sealant for Exposed or Concealed Joints:
   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
   b. USG Corporationl SHEETROCK Acoustical Sealant
2. Acoustical Sealant for Concealed Joints:
   a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant
   b. Pecora Corporation; AIS-919
   c. Tremco, Inc; Tremco Acoustical Sealant

F. Thermal Insulation: As specified in Section 07 2100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
   1. Wallboard Type X: Vertical surfaces unless otherwise indicated.
   2. Flexible Type: Apply in double layer at curved assemblies.
   3. Ceiling Type: Ceiling surfaces.
   4. Abuse-Resistant Type: As indicated on Drawings.
   5. Impact-Resistant Type: As indicated on Drawings.
   6. Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:
   1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
   2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
      a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
   3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
   4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:
   1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

   2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
   3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

   4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:
   1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- long straight sections at ends of curves and tangent to them.
   2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 INSTALLATION OF TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners unless otherwise indicated.
2. Bullnose Bead: Use where indicated.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated.
5. U-Bead: Use where indicated.
6. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile .
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
   a. Primer and its application to surfaces are specified in Section 09 9123 "Interior Painting."
   b. For Level 4 gypsum board finish, embed tape in joint compound and apply first, fill (second) and finish (third) coarts of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration.
5. Level 5: Where indicated on Drawings.

a. Primer and its application to surfaces are specified in Section 09 9123 "Interior Painting."
b. Where Level 5 gypsum board finish is indicated, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories; and apply a thin, uniform skim coat of joint compound over entire surface. For skim coat, use joint compound specified for third coat, or a product specially formulated for this purpose and acceptable to gypsum board manufacturer. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects, tool marks, and ridges and ready for decoration.

E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.

3.8 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 2900

SECTION 09 3013

TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Ceramic mosaic tile.
2. Glazed wall tile.
3. Waterproof membrane for thinset applications.
4. Crack isolation membrane.
5. Metal edge strips.

B. Related Requirements:
1. Section 07 9200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

2. Section 09 2900 "Gypsum Board" for cementitious backer units.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

C. Face Size: Actual tile size, excluding spacer lugs.

D. Module Size: Actual tile size plus joint width indicated.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
   1. Level Surfaces: Minimum 0.6.
   2. Step Treads: Minimum 0.6.
   3. Ramp Surfaces: Minimum 0.8.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
   2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to project and cost for each regional material.
   3. Product Data: For adhesives and sealants, flooring products, and interior products, indicating compliance with General Emissions Evaluation and VOC content requirements.

C. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

D. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

E. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required.
   2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
   3. Full-size units of each type of trim and accessory for each color and finish required.
   4. Metal edge strips in 6-inch lengths.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product.

D. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

   2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.9 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer is a Five-Star member of the National Tile Contractors Association.
   2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
   3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers for Project.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
   1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
   1. Waterproof membrane.
   2. Crack isolation membrane.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
   1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

E. Low-emitting requirements - Interior Producs
   1. General Emissions Evaluation: Interior products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010, using the applicable exposure scenario.

F. Additional Low-emitting requirements - Adhesives and Sealants:
   1. VOC Content Requirements for Wet Applied Products: All adhesives and sealants wetapplied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, amended October 26, 2017, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.
   2. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.
   3. Do not use adhesives that contain urea formaldehyde.

G. Additional Low-emitting requirements - Flooring:
   1. FloorScore Compliance: Tile for floors shall comply with requirements of FloorScore Standard.

H. Sustainable Product Certification: Gold level certification according to ANSI/INSF 140.

I. Sustainability Requirements:
   1. Provide products with the maximum amount possible of post-consumer and pre-consumer recycled content.
   2. Provide products manufactured and extracted within 100 miles of the project site whenever possible.

2.3 TILE PRODUCTS

A. Ceramic Tile Type: Factory-mounted glazed ceramic tile.
   1. Basis of Design Product: Subject to compliance with requirements, provide the following product or approved equal for floor and wall tile locations:
      a. Daltile Color Wheel Collection - Glazed Ceramic
      b. Manufacturers not listed but who do offer products that comply with the requirements of this section will be considered as subsitute manufacturers, subject to the conditions specified in Division 1 Section Product Substitution Procedures.
   2. Composition: Porcelain
   3. Face Size:
      a. Floor: 2x2 mosaic - Dot-mounted
      b. Walls: 6x6 wall tile
   4. Thickness:
      a. Floor: 1/4 inch
      b. Wall: 5/16 inch
   5. Face: Plain with square or cushion edges.
   6. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
   7. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
      a. Bullnose - match pattern of adjacent wall tile

2.4 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Schluter Systems, LP; KERDI

2.5 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch nominal thickness.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Schluter Systems LP; DITRA

2.6 SETTING MATERIALS

A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ARDEX Americas.
   b. LATICRETE SUPERCAP, LLC.
   c. MAPEI Corporation.
2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.

3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.7 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Standard Cement Grout: ANSI A118.6.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ARDEX Americas.
   b. LATICRETE SUPERCAP, LLC.
   c. MAPEI Corporation.
2. Color: Selected from Manufacturer's full range.

2.8 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.'
1. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

C. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; white zinc alloy or stainless steel, ASTM A276/A276M or ASTM A666, 300 Series exposed-edge material.
1. Basis of Design Product: Subject to compliance with requirements, provide products by Schluter Systems LP or comparable product by one of the following:
   a. Blanke Corporation.
   b. Ceramic Tool Company, Inc.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bonsal American, an Oldcastle Company.
   b. Custom Building Products
   c. Summitville Tiles, Inc.

2.9 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
   2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
      a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
      b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
   3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
   4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION OF CERAMIC TILE

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
   1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
      a. Exterior tile floors.
      b. Tile floors in wet areas.
      c. Tile swimming pool decks.
      d. Tile floors in laundries.
      e. Tile floors consisting of tiles 8 by 8 inches or larger.
      f. Tile floors consisting of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
   1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
   2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
   1. Ceramic Mosaic Tile: 1/8 inch.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

K. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 INSTALLATION OF TILE BACKING PANEL

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.5 INSTALLATION OF WATERPROOF MEMBRANE

A. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.6 INSTALLATION OF CRACK ISOLATION MEMBRANE

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.7 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.8 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.9 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:
   1. TCNA F122: Thin-set mortar on waterproof membrane
      a. Thinset Mortar: Modified dry-set mortar.
      b. Grout: Standard Cement Grout.

B. Interior Walls, Wood studs or Furring:
   1. W244: Thin-set mortar on cementitious backer units or fiber cement underlayment.
      a. Thinset Mortar: Modified dry-set mortar.
      b. Grout: Standard Cement Grout.

END OF SECTION 09 3013

SECTION 09 9113

EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes surface preparation and the applicaiton of paint systems on the following exterior substrates:
   1. Fiber-cement board
   2. Wood

B. Related Requirements:
   1. Section 05 5000 "Metal Fabrications" for shop priming metal fabrications.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include preparation requirements and application instructions.
   2. Indicate VOC content.

B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to project and cost for each regional material.
3. Product Data: For paints and coatings indicating compliance with General Emissions evaluation and VOC content requirements.

C. Samples: For each type of topcoat product.

D. Samples for Initial Selection: For each type of topcoat product.

E. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

F. Product Schedule: Use same designations indicated on Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
   a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
   b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Benjamin Moore & Co.
2. Dunn-Edwards Corporation.
3. Ecos Paints
4. Kelly-Moore Paint Company Inc.
5. PPG Architectural Coatings.

2.2 Sherwin-Williams Company (The).PAINT PRODUCTS, GENERAL

A. MPI Standards: Products shall comply with MPI Standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:
1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

C. Low-emitting requirements – Interior Products
1. General Emissions Evaluation: Interior products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010, using the applicable exposure scenario.

D. Additional Low-emitting requirements – Paints and Coatings:
1. VOC Content Requirements for Wet Applied Products: All paints and coatings wetapplied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective February 5, 2016.
2. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.
3. Show compliance with VOC limits as detailed in Section 01 8116 “VOC Limits”

E. Sustainability Requirements:
1. Provide products with the maximum amount possible of post-consumer and preconsumer recycled content.

2. Provide products manufactured and extracted within 100 miles of the project site whenever possible.

F. Colors: Match Architect's samples.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Fiber-Cement Board: 12 percent.
2. Wood: 15 percent.

C. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.
1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems specified in this Section.

D. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

E. Wood Substrates:
1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
2. Sand surfaces that will be exposed to view, and remove sanding dust.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 INSTALLATION

A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual.".
1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.

4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in the Exterior Painting Schedule may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed to view:
    a. Equipment, including panelboards and switch gear.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
   1. Contractor shall touch up and restore painted surfaces damaged by testing.
   2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
   1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
   2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
   3. Allow empty paint cans to dry before disposal.
   4. Collect waste paint by type and deliver to recycling or collection facility.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Wood-Framing Substrates, including wood trim:
   1. Latex over Latex Primer System :
      a. Prime Coat: Latex for exterior wood, MPI #6, 17, X-Green 17, 39, 50, X-Green 50, 137, X-Green 137:
         1) Benjamin Moore Fresh Start High-Hiding All Purpose Primer 046.
         2) PPG Paints; Hydrosealer Exterior 100% Acrylic Bonding Primer/Sealer; 6001-1200G; applied at 1.4 mils dft.
      b. Intermediate Coat: Matching topcoat.

      c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.
         1) Benjamin Moore®Ultra Spec® 500 Interior Low Sheen Finish.
         2) PPG Architectural; Lifemaster Interior 100% Acrylic Eggshell.

B. Cementitious Composition Board Substrates: Siding Trim.
   1. Latex System MPI EXT 3.3A:
      a. Prime Coat: Latex, exterior, matching topcoat..
      b. Intermediate Coat: Latex, exterior, Matching topcoat.
      c. Topcoat: Low sheen, MPI #15

1) Benjamin Moore Ultra Spec EXT Satin N448 (46g/L).

END OF SECTION 09 9113

SECTION 09 9123

INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes surface preparation and the application of paint systems on interior substrates:

B. Related Requirements:
1. Section 05 5000 "Metal Fabrications" for shop priming metal fabrications.
2. Section 09 9300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to project and cost for each regional material.
3. Product Data: For paints and coatings indicating compliance with General Emissions evaluation and VOC content requirements.

C. Samples: For each type of topcoat product.

D. Samples for Initial Selection: For each type of topcoat product.

E. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

F. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
   a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
   b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Benjamin Moore & Co.
2. Dunn-Edwards Corporation.
3. Ecos Paints
4. Kelly-Moore Paint Company Inc.
5. PPG Architectural Coatings.

2.2 PAINT PRODUCTS, GENERAL

A. Material Compatibility:
1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated

B. .Low-emitting requirements – Interior Products
1. General Emissions Evaluation: Interior products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010, using the applicable exposure scenario.

C. Additional Low-emitting requirements – Paints and Coatings:
1. VOC Content Requirements for Wet Applied Products: All paints and coatings wetapplied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective February 5, 2016.
2. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.
3. Show compliance with VOC limits as detailed in Section 01 8116 “VOC Limits”

D. Sustainability Requirements:
1. Provide products with the maximum amount possible of post-consumer and preconsumer recycled content.
2. Provide products manufactured and extracted within 100 miles of the project site whenever possible.
3.

E. Colors: Match Architect's samples.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
   1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
   2. Testing agency will perform tests for compliance with product requirements.
   3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent.
   2. Wood: 15 percent.
   3. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Aluminum Substrates: Remove loose surface oxidation.

I. Wood Substrates:
   1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
   2. Sand surfaces that will be exposed to view, and dust off.
   3. Prime edges, ends, faces, undersides, and backsides of wood.
   4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

J. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 INSTALLATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
   1. Use applicators and techniques suited for paint and substrate indicated.
   2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
   4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
   5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
   1. Paint the following work where exposed in equipment rooms:
      a. Equipment, including panelboards and switch gear.
      b. Uninsulated metal piping.
      c. Uninsulated plastic piping.
      d. Pipe hangers and supports.
      e. Metal conduit.
      f. Plastic conduit.
      g. Tanks that do not have factory-applied final finishes.
      h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   2. Paint the following work where exposed in occupied spaces:
      a. Equipment, including panelboards.
      b. Uninsulated metal piping.
      c. Uninsulated plastic piping.
      d. Pipe hangers and supports.
      e. Metal conduit.
      f. Plastic conduit.
      g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
      h. Other items as directed by Architect.
   3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
   1. Contractor shall touch up and restore painted surfaces damaged by testing.
   2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
   1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
   2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
   3. Allow empty paint cans to dry before disposal.
   4. Collect waste paint by type and deliver to recycling or collection facility.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Traffic Surfaces:
   1. Water-Based Concrete Floor Sealer System MPI INT 3.2G :
      a. First Coat: Sealer, water-based, for concrete floors, Matching topcoat.
      b. Topcoat: Sealer, Water-based concrete floor sealer, MPI #99
         1) PPG Paints; Perma-Crete Plex-Seal WB Interior/Exterior 100% Acrylic Clear Sealer, 4-6200XI Seriesl applied at 0.8 mil dft per coat, or approved equal.

B. Finish Carpentry: Wood trim Doorsand Architectural Woodwork.
   1. Institutional Low-Odor/VOC Latex System MPI INT 6.3V:
      a. Prime Coat: Primer, latex, for interior wood, MPI #6, 39, 137.
         1) Benjamin Moore®Sure Seal¢Latex Primer Sealer 027 (48 g/L).
         2) PPG Paints; Gripper Interior/Exterior 100% Acrylic Primer/Sealer, 3210XI; applied at 1.6 mils dft.
      b. Topcoat: flat (MPI Gloss Level 1), MPI #53, 53 X-Green, 143, 143 X-Green.
         1) Benjamin Moore®Natura®Interior Waterborne Flat Finish 512 (0 g/L).
         2) Benjamin Moore®Eco Spec®WB Silver Interior Latex Flat Finish 473 (0g/L).
         3) Benjamin Moore®Eco Spec®WB Interior Latex Flat Finish N373 (0 g/L),
         4) Benjamin Moore®Ultra Spec® 500 Interior Flat Finish N536 (0 g/L),
         5) PPG Paints; Speedhide zero Interior Latex Flat, 6-4110XI Series; applied at 1.4 mils dft per coat.
      c. Topcoat: Eggshell (MPI Gloss Level 2), MPI #44, 44 X-Green, 144, 144 X-Green.
         1) Benjamin Moore®Natura®Interior Waterborne Eggshell Finish 513 (0 g/L).
         2) Benjamin Moore®Ultra Spec® 500 Interior Low-Sheen Finish N537 (0 g/L).
         3) PPG Paints; Speedhide zero Interior Latex Eggshell, 6-4310XI Series; applied at 1.4 mils dft per coat.
      d. Topcoat: Eggshell (MPI Gloss Level 3), MPI #52, 52 X-Green, 139, 139 X-Green, 145, 145 X-Green.
         1) Benjamin Moore®Eco Spec®WB Interior Latex Eggshell Finish N374 (0g/L).
         2) Benjamin Moore®Ultra Spec® 500 Interior Eggshell Finish N538 (0 g/L).
         3) PPG Paints; Speedhide zero Interior Latex Satin, 6-4410XI Series; applied at 1.4 mils dft per coat.
      e. Topcoat: Semi-Gloss (MPI Gloss Level 4), MPI #43, #43 X-Green, 140, 140 XGreen, 146, 146 X-Green .
         1) Benjamin Moore®Ultra Spec® 500 Interior Semi-Gloss N539 (0 g/L).
      f. Topcoat: semi-gloss (MPI Gloss Level 5), MPI #54, 54 X-Green, 141, 141 XGreen, 147, 147 X-Green .
         1) Benjamin Moore®Ultra Spec® 500 Interior Gloss Finish N540 (0 g/L).
         2) PPG Paints; Speedhide zero Interior Latex Semi-Gloss, 6-4510XI Series applied at 1.4 mils dft per coat.

C. Gypsum Board Substrates:
   1. Institutional Low-Odor/VOC Latex System MPI INT 9.2M:
      a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #50, 50 XGreen, 149, 149 X-Green.
         1) Benjamin Moore®Fresh Start®Natura®Zero-VOC Primer 511 (0 g/L).
         2) Benjamin Moore®Eco Spec®WB Interior Latex Primer N372 (0 g/L).
         3) Benjamin Moore®Ultra Spec® 500 Interior Primer N534 (0 g/L).P
         4) PG Paints; Speedhide zero Interior Latex Sealer, 6-4900XI Series; applied at 1.4 mils dft.
      b. Intermediate Coat: matching topcoat.
      c. Topcoat: flat (MPI Gloss Level 1), MPI #53, 53 X-Green, 143, 143 X-Green.
         1) Benjamin Moore®Natura®Interior Waterborne Flat Finish 512 (0 g/L).
         2) Benjamin Moore®Eco Spec®WB Silver Interior Latex Flat Finish 473 (0 g/L).
         3) Benjamin Moore®Eco Spec®WB Interior Latex Flat Finish N373 (0 g/L).
         4) Benjamin Moore®Ultra Spec® 500 Interior Flat Finish N536 (0 g/L).5)
         5) PPG Paints; Speedhide zero Interior Latex Flat, 6-4110XI Series; applied at 1.4 mils dft per coat.
      d. Topcoat: Latex, Eggshell (MPI Gloss Level 2), MPI #44, 44 X-Green, 144, 144 XGreen.
         1) Benjamin Moore®Natura®Interior Waterborne Eggshell Finish 513 (0 g/L).
         2) Benjamin Moore®Ultra Spec® 500 Interior Low-Sheen Finish N537 (0 g/L).
         3) PPG Paints; Speedhide zero Interior Latex Eggshell, 6-4310XI Series; applied at 1.4 mils dft per coat.
      e. Topcoat: Eggshell (MPI Gloss Level 3), MPI #52, 52 X-Green, 139, 139 X-Green, 145, 145 X-Green.
         1) Benjamin Moore®Eco Spec®WB Interior Latex Eggshell Finish N374 (0 g/L).
         2) Benjamin Moore®Ultra Spec® 500 Interior Eggshell Finish N538 (0 g/L).
         3) PPG Paints; Speedhide zero Interior Latex Satin, 6-4410XI Series; applied at 1.4 mils dft per coat.
      f. Topcoat: Semi-Gloss (MPI Gloss Level 4), MPI #43, 43 X-Green, 140, 140 XGreen, 146, 146 X-Green.
         1) Benjamin Moore®Ultra Spec® 500 Interior Semi-Gloss N539 (0 g/L).
      g. Topcoat: Semi-gloss (MPI Gloss Level 5), 54, 54 X-Green, 141, 141 X-Green, 147, 147 X-Green.
         1) Benjamin Moore®Ultra Spec® 500 Interior Gloss Finish N540 (0 g/L).
         2) PPG Paints; Speedhide zero Interior Latex Semi-Gloss, 6-4510XI Series; applied at 1.4 mils dft per coat.

END OF SECTION 09 9123

SECTION 09 9300

STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and application of wood stains and transparent finishes on the following substrates:
   1. Interior Substrates:
      a. Dressed lumber (finish carpentry or woodwork).
      b. Wood-based panel products.

B. Related Requirements:
   1. Section 09 9123 "Interior Painting" for stains and transparent finishes on concrete floors.

1.3 DEFINITIONS

A. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
   1. Satin.

B. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
   1. Semi-gloss

C. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
   1. Gloss

D. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.
   1. High Gloss

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
   2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to project and cost for each regional material.

C. Product Data: For paints and coatings indicating compliance with General Emissions evaluation and VOC content requirements.Samples for Initial Selection: For each type of product.

D. Samples for Verification: For each type of finish system and in each color and gloss of finish required.
   1. Submit Samples on representative samples of actual wood substrates, 8 inches square or 8 inches long.
   2. Apply coats on Samples in steps to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

E. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
      b. Other Items: Architect will designate items or areas required.
   2. Final approval of stain color selections will be based on mockups.
      a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures less than 5 deg F above the dew point, or to damp or wet surfaces.

C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following for exterior and Interior wood varnish systems:
1. Cabot Stains Inc.
2. Defy Wood Stain
3. Imperial Paint
4. Messmers
5. PPG Architectural Coatings.
6. Sherwin-Williams Company (The).
7. Vermont Natural Coatings

2.2 MATERIALS, GENERAL

A. Material Compatibility:
1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Low-emitting requirements – Interior Products
1. General Emissions Evaluation: Interior products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010, using the applicable exposure scenario.

C. Additional Low-emitting requirements – Paints and Coatings:
1. VOC Content Requirements for Wet Applied Products: All paints and coatings wetapplied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective February 5, 2016.
2. Methylene chloride and perchloroethylene shall not be intentionally added in paints, coatings, adhesives, or sealants.
3. Show compliance with VOC limits as detailed in Section 01 8116 “VOC Limits”

D. Sustainability Requirements:
1. Provide products with the maximum amount possible of post-consumer and preconsumer recycled content.
2. Provide products manufactured and extracted within 100 miles of the project site whenever possible.

E. Stain Colors: Match Architect's samples.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

C. Maximum Moisture Content of Interior Wood Substrates: 13 percent, when measured with an electronic moisture meter.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with finish application only after unsatisfactory conditions have been corrected.
   1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
   1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
   1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
   2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

D. Exterior Wood Substrates:
   1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
   2. Prime edges, ends, faces, undersides, and backsides of wood.
      a. For solid hide stained wood, stain edges and ends after priming.
      b. For varnish-coated stained wood, stain edges and ends and prime with varnish. Prime undersides and backsides with varnish.
   3. Countersink steel nails, if used, and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.

E. Interior Wood Substrates:
   1. Scrape and clean knots, and apply coat of knot sealer before applying primer.

2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
3. Sand surfaces exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
   1. Use applicators and techniques suited for finish and substrate indicated.
   2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
   3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD -FINISH-SYSTEM SCHEDULE

A. Wood Substrates: Wood trim architectural woodwork and wood board paneling.
   1. Water-Based Varnish over Stain System:
      a. Stain Coat: Stain, semitransparent, for interior wood.
      b. First Intermediate Coat: Water-based varnish matching topcoat.
      c. Second Intermediate Coat: Water-based varnish matching topcoat.
      d. Topcoat: Varnish, water based, clear, satin (MPI Gloss Level 4).

END OF SECTION 09 9300

SECTION 10 2800

TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Private-use bathroom accessories.
2. Underlavatory guards.

B. Related Requirements:
1. Section 09 3013 "Ceramic Tiling" for ceramic toilet and bath accessories.

1.3 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to project and cost for each regional material.
3. Product Data: For paints and coatings indicating compliance with General Emissions evaluation and VOC content requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.

3. Include electrical characteristics.

B. Samples: For each exposed product and for each finish specified, full size.
1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated.
   2. Identify accessories using designations indicated.

D. Delegated-Design Submittal: For grab bars.
   1. Include structural design calculations indicating compliance with specified structural-performance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, visible silver spoilage defects.
   2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Low-emitting requirements - Interior Products
   1. General Emissions Evaluation: Interior products must be tested and determined compliant in accordance with California Dpeartment of Public Health (CDPH) Standard Method v1.1-2010, using the applicable exposure scenario.

C. Sustainability Requirements:
   1. Provide products with the maximum amount possible of post-consumer and preconsumer recycled content.
   2. Provide products manufactured and extracted within 100 miles of the project site whenever possible.

2.2 MANUFACTURERS

A. Source Limitations: Obtain washroom accessories from single source from single manufacturer.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
   1. American Specialties, Inc.
   2. Bobrick Washroom Equipment, Inc.
   3. Bradley Corporation.
   4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
   5. Tubular Specialties Manufacturing, Inc.

2.3 WASHROOM ACCESSORIES

A. Toilet Tissue (Roll) Dispenser T1:
   1. Basis-of-Design product: Bobrick Washroom Equipment, Inc. B-2890
   2. Mounting: Surface mounted.
   3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

B. Liquid-Soap Dispenser T2:
   1. Basis-of-Design Product: GOJO LTX foaming
   2. Description: Designed for dispensing soap foam, touchless dispenser.

C. Grab Bar T3 & T4:
   1. Basis of Design: Bobrick B-6806
   2. Mounting: Flanges with concealed fasteners.
   3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
      a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
   4. Outside Diameter: 1-1/2 inches (38 mm).
   5. Configuration and Length:
      a. ADA Stall & Family Toilet Rooms: Provide rear grab bar, as indicated on Drawings; side grab bar as indicated on Drawings
      b. Vertical Grab bar T4: As indicated on Drawings.

D. Mirror Unit T5:
   1. Frameless unit.
   2. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
      a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
      b. 3. Size: As indicated on Drawings.

E. Paper Towel Dispenser T6:
   1. Basis of Design: Bobrick B-359039
   2. Mounting: Surface-mounted
   3. Material: Stainless Steel
      a. Finish: Smooth, No. 4 Finish (satin) on ends

F. Waste Receptacle T7:
   1. Basis of Design: Bobrick B-2260
   2. Floor-standing Waste Receptacle with Open Top
   3. Material: Stainless Steel
      a. Finish: Smooth, No. 4 Finish (satin)

G. Sanitary-Napkin Disposal Unit T8:
   1. Basis of Design: Bobrick B-270
   2. Mounting: Surface Mounted.

3. Receptacle: Removable.
4. Material and Finish: Stainless Steel, No. 4 finish (satin).

2.4 UNDERLAVATORY GUARDS

A. Underlavatory Guard :
1. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

2.5 MATERIALS

A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.

C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch-minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.

G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.6 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
   1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.

C. Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 10 2800

SECTION 10 4416

FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers mounting brackets and security accessories for fire extinguishers.

B. Owner-Furnished Material: Hand-carried fire extinguishers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
   b. Faulty operation of valves or release levers.
2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
   1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Amerex Corporation.
      b. JL Industries, Inc.; a division of the Activar Construction Products Group.
      c. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
      d. Larsens Manufacturing Company.
   2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
   3. Valves: Manufacturer's standard.
   4. Handles and Levers: Manufacturer's standard.
   5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Steel Container : UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Amerex Corporation.
      b. JL Industries, Inc.; a division of the Activar Construction Products Group.
      c. Larsens Manufacturing Company.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
   1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
      a. Orientation: Horizontal.

2.4 THEFT DETERRENT

A. Fire Exstinguisher Theft Deterrent: Provide battery-powered theft-deterrent device that attaches to the fire extinguisher that produces audible alarm when extinguisher is removed from hook.
   1. Locations: All exterior fire extinguishers
   2. Manufacturers:
      a. Basis-of-Design: STI Fire Extinguisher Theft Stopper or approved equal.
         1) Model number 6200.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
   1. Mounting Brackets: Top of fire extinguisher to be at 54 inches above finished floor.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10 4416

SECTION 10 7516 - GROUND-SET FLAGPOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes ground-set flagpoles made from aluminum.

B. Owner-Furnished Material: Flags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Shop Drawings: For flagpoles.
   1. Include plans, elevations, and attachment details. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.
   2. Include section, and details of foundation system.

C. Samples for Verification: For each type of exposed finish, in manufacturer's standard sizes.

D. Delegated-Design Submittal: For flagpoles.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design flagpole assemblies.

B. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand design loads indicated within limits and under conditions indicated.
   1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location is 90 MPH.

   2. Base flagpole design on polyester nylon or cotton flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

2.3 ALUMINUM FLAGPOLES

A. Aluminum Flagpoles: Cone -tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B241/B241M, Alloy 6063, with a minimum wall thickness of 3/16 inch.

B. Exposed Height: 30 feet.

C. Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:
   1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.
   2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.

D. Sleeve for Aluminum Flagpole: PVC pipe foundation sleeve, made to fit flagpole, for casting into concrete foundation.
   1. Flashing Collar: Same material and finish as flagpole.

2.4 FITTINGS

A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.
   1. 0.063-inch spun aluminum, finished to match flagpole.

B. External Halyard: Ball-bearing, nonfouling, revolving truck assembly of cast metal with continuous 5/16-inch- diameter, braided polypropylene halyard and 9-inch cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.
   1. Halyards and Cleats: One at each flagpole.
   2. Halyard Flag Snaps: Nickel plated zinc swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.

2.5 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

B. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.

C. Sand: ASTM C33/C33M, fine aggregate.

2.6 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.

D. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.

E. Sleeves: Locate and secure sleeves in forms by bracing to reinforcement and forms.

F. Anchor Bolts: Locate and secure anchor bolts in forms with templates and by tying to reinforcement.

G. Place concrete, as specified in Section 03 3000 "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.

H. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.2 FLAGPOLE INSTALLATION

A. General: Install flagpoles where indicated and according to Shop Drawings and manufacturer's written instructions.

B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric joint sealant and cover with flashing collar.

C. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.

END OF SECTION 10 7516

SECTION 11 1200

PARKING CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Automatic barrier gates.
2. Vehicle detectors.
3. Pay stations.
4. Miscellaneous parking control equipment.
5. Access control units.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
2. Verify that equipment operation is consistent with system description.
3. Review sequence of operation for each type of parking control equipment.
4. Review coordination of interlocked equipment specified in this Section and elsewhere.
5. Review required testing, inspecting, and certifying procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for parking control equipment.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties.

B. Shop Drawings: For parking control equipment.
1. Include plans, elevations, sections and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.
4. Vehicle Detectors: Layout and method of placement of vehicle loop detector system.

C. Samples: For each exposed product and for each color and texture specified, 6 inches square in size.

D. Samples for Initial Selection: For units with factory-applied finishes.

E. Samples for Verification: For each type of exposed finish 6 inches square in size.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For parking control equipment to include in emergency, operation, and maintenance manuals.

B. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Gate Arms: Two breakaway gate arms for each gate installed, complete with accessory components.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain parking control equipment from single source from single manufacturer.

2.2 AUTOMATIC BARRIER GATES

A. General: Provide parking control device consisting of operator and controller housed in a weathertight, tamper-resistant cabinet enclosure with gate arm. Device shall be activated by a signal from access or revenue control device. Fabricate unit with gate-arm height in down position of not more than 35 inches above pavement.
1. Basis of Design: Subject to compliance with requirements, provide Automatic Barrier Gates from FAAC International, INC or approved equal.
a. In areas where lane widths are 12 feet or less, provide Parking Pro model.
b. In areas where lane widths are more than 12 feet, provide Access Pro Barrier. When indicated on drawings, provide solar-powered battery backup 24V option.
2. Standards: Barrier gate operators that are listed and labeled according to UL 325 by a qualified testing agency.

B. Controller: Factory-sealed, solid-state, plug-in type, with galvanized-steel box for wiring connections. Noncommunicating type.
   1. Noncommunicating Type:
      a. Capable of logic for one- and two-way lanes.
      b. Separate momentary contacts for transient patrons, monthly patrons, vehicle entries, and vehicle exits.
   2. Physical Characteristics:
      a. On-off power supply switch.
      b. Automatic-manual switch.
      c. Differential counter.
      d. Communication port.
      e. Internal resettable counters.
      f. Thermal-overload protection with manual reset.
      g. Plug-in connectors for two vehicle loop detectors.
      h. Thermostatically controlled heater with on/off/auto switch.
      i. Thermostatically controlled fan with on/off/auto switch.
      j. Switch to test motor and limit switches.
      k. Emergency manual disconnect.
      l. Battery backup.
   3. Operational Characteristics:
      a. Able to store successive inputs and sequentially processing each one.
      b. Automatic instant-reversing obstacle detector mechanism that stops downward motion of gate arm if arm contacts or nears an object and that immediately returns arm to upward position. Include a zero- to 60-second, variable-time reset device.
      c. Directional arming logic.
      d. Broken gate-arm monitoring.
      e. Programmable automatic timer.
      f. Diagnostic mode for on-site testing.
      g. Automatic and continuous testing of inputs and outputs.
      h. Reversible arm capability for right- or left-handed operation.

C. Cabinets: Fabricated from sheet metal with seams welded and ground smooth; approximately 15 inches square by 40 inches tall. Provide single, gasketed access door for each cabinet with flush-mounted locks. Furnish two keys for each lock, all locks keyed alike. Fabricate cabinet with internal reinforcing and four mounting holes accessible only from inside cabinet.
   1. Steel Sheet: Not less than 0.097-inch- thick, galvanized- steel sheet.
      a. Finish cabinet, interior and exterior, with manufacturer's standard white baked-enamel or powder-coat finish.
   2. Aluminum Sheet: Not less than 0.125-inch- thick, aluminum sheet.
      a. Finish cabinet, interior and exterior, with manufacturer's standard white baked-enamel or powder-coat finish.
   3. Stainless-Steel Sheet: Not less than 0.109-inch- thick, stainless-steel sheet.
      a. Finish cabinet exterior with No. 4 finish.
   4. Folding Gate Arm: Traffic-Side Face: Reflective painted finish and red diagonal stripes.
   5. Length: As indicated on Drawings.
   6. Mounting Flange: Provide with breakaway feature to ensure a clean break if arm is struck by vehicle.

2.3 VEHICLE DETECTORS

A. General: Provide detection devices that sense presence or transit of vehicles and emit signals activating gate-arm operators.
   1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Active Infrared Vehicle Detector: Emitter/receiver-type presence detector with adjustable detection zone pattern and sensitivity, designed to detect the presence or transit of vehicle in gate-arm pathway by interrupting infrared beam in zone pattern and to emit signal activating gate-arm operator. Include automatic closing timer with adjustable time delay before closing, timer cut-off switch, and vehicle presence detector designed to hold gate arm open until traffic clears.

2.4 PAY STATIONS

A. General: Provide self-contained, cashiering entry pay stations designed for self-service operation; with mechanisms, components, controllers, and fee computers housed in a combined enclosure.

B. Basis of Design: Subject to compliance with the following, provide Automated Fee Station Model 600 by Ventek International or approved equal. System Requirements:
   1. General:
      a. 120 volt AC power.
      b. Internal battery backup power suitable for up to 24 hour operation if primary power is interrupted (this will not be required if emergency generator can power machine).
      c. Maintenance free, vandal resistant exterior housing.
      d. Weatherproof enclosure, insulated and equipped with a thermostatically controlled heater to keep interior temperature above 35 degrees F and a cooling fan to ventilate the enclosure when the interior temperature exceeds 90 degrees F.
      e. Capable of accepting cash and credit card payment. Machine must be capable of issuing change for cash transactions.
      f. Quick pick feature display for selection of payment options (i.e., day use, camping, boat launch, etc.)
      g. Software for processing credit card and/or other electronic payment options (options/preferences for operating system, i.e. Windows, DOS, etc.)
      h. Expandable to accommodate additional reader hardware/software for processing of access cards issued by Maryland DNR in the future.
      i. Field programmable to adjust rate and payment options
      j. Machine equipped with a keypad for data entry (campground site, etc.)
      k. Equipped with printer to issue ticket/receipt on moisture resistant paper stock.
      l. Printed tickets including day use pass, multiple day passes, annual pass, etc.
   2. Display:
      a. Backlit LCD.
   3. Software Capacities:
      a. System software and language development software shall be existing, industry accepted, and of a type widely used in commercial systems. Operating system shall be multi-user/ multi-tasking capable of operating in a non-proprietary CPU. The application software, substantially as offered, shall be written in a high level, industry standard programming language. The system shall be modular in nature, allowing the system capacities to be easily expanded without requiring major changes to the system operation and maintaining all defined system data as well as historical information.

4. Languages: English and Spanish.
5. Payment Options: Equipment shall be capable of processing the following payment options.
    a. Cash
    b. Credit card
    c. Maryland Park Pass
    d. Golden Age Pass
    e. Youth Group Pass
    f. Universal Disability Pass
6. Housing:
    a. Powder coated paint system in a variety of colors
    b. Reinforced heavy duty service door for access with pick resistant lock or cross bar with high security stainless steel disc lock
    c. Cash vault with a separate lock.:

2.5 ACCESS CONTROL UNITS

A. General: Provide access control unit that activates barrier gates compatible with barrier gate operations.

B. Unit Housing: Fabricate from welded cold-rolled steel or aluminum sheet with weatherproof front access panel equipped with flush-mounted lock and two keys. Provide face-lighted unit fully visible at night.
    1. Steel Finish: Manufacturer's standard baked-enamel or powder-coat finish system.

C. Digital Keypad Controlled Unit: Functions only when authorized code is entered on keyed keypad.
    1. System: Programmable, multiple-code capability.
        a. Multiple-code capability of no fewer than five possible individual codes.
        b. Programmable, multiple-code capability permitting validation or voiding of no fewer than 100 possible individual codes, consisting of one to six digits, and permitting four different access time periods.
    2. Operation: Online communication to remote security-access control system computer.
    3. Characteristics: Timed antipassback Limited-time usage Capable of monitoring and auditing barrier gate activity.
    4. Mounting: With pedestal.

2.6 ANCHORAGES

A. Anchor Bolts: Galvanized.
    1. Hot-dip galvanized according to ASTM A153/A153M and ASTM F2329/F2329M.
    2. Stainless steel, Type 304.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including equipment bases; accurate placement, pattern, and orientation of anchor bolts; critical dimensions; and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical and communication systems to verify actual locations of connections before parking control equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Excavation for Traffic Controllers: Saw cut existing pavement for recessed traffic controllers and hand-excavate recesses to dimensions and depths and at locations as required by traffic controller manufacturer's written instructions and as indicated on Drawings.

3.3 INSTALLATION, GENERAL

A. Install parking control equipment as required for complete and integrated installation.
   1. Rough-in electrical connections.

3.4 INSTALLATION OF AUTOMATIC BARRIER GATES

A. Anchor cabinets to concrete bases with anchor bolts or expansion anchors, and mount barrier gate arms.
   1. Install barrier gates according to UL 325.

3.5 INSTALLATION OF VEHICLE DETECTORS

A. Bury and seal wire loop at locations indicated on Drawings according to manufacturer's written instructions. Connect to parking control equipment operated by detector.

3.6 INSTALLATION OF PAY STATIONS

A. Attach cabinets to concrete bases with anchor bolts or expansion anchors per manufacturer instructions.
   1. Connect equipment to remote computer.
   2. Load ticket dispenser with supply of tickets.

3.7 INSTALLATION OF ELECTRICAL

A. Connect wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 26 0526 "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Parking control equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 ADJUSTING

A. Adjust parking control equipment to function smoothly, and lubricate as recommended by manufacturer.

B. Confirm that locks engage accurately and securely without forcing or binding.

C. After completing installation of exposed, factory-finished parking control equipment, inspect exposed finishes and repair damaged finishes.

3.10 PROTECTION

A. Remove barrier gate arms during the construction period to prevent damage, and install them immediately before Substantial Completion.

3.11 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
   1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.12 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain parking control equipment.

END OF SECTION 11 1200

SECTION 12 3619 - WOOD COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Wood countertops.
2. Shop finishing of wood countertops.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Sustainable Design Submittals:
1.
2. Product Data: For recycled content, indicating post-consumer and pre-consumer recycled content and cost
3. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harves, or recover for each raw material. Include distance to PRoject and cost for each regional material.
4. Chain-of-Custody Certificates: For certified wood products, include statement of costs.
5. Chain-of-Custody Qualification Data: For manufacturer and vendor.
6. Product Data: For adhesives and sealants, paints and coatings, and insulation products indicating compliance with General Emissions evaluation.

C. Shop Drawings: For wood countertops.
1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
2. Show locations and sizes of cutouts and holes for items installed in wood countertops.
3. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

4. Apply AWI Quality Certification Program label to Shop Drawings.

D. Samples: For each shop-applied transparent finish and for each color and wood species specified, in manufacturer's or fabricator's standard size.

E. Samples for Initial Selection: For shop-applied transparent finishes in each wood species and in each type and color required in fabricator's standard size.

F. Samples for Verification: For the following:
   1. Lumber for Transparent Finish: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
   2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished wood countertops.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For the following:
   1. Composite wood and agrifiber products.
   2. Adhesives.

C. Quality Standard Compliance Certificates: AWI Quality Certification Program.

D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
   1. Shop Certification: AWI's Quality Certification Program accredited participant.

B. Installer Qualifications: Fabricator of products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.

B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

C. Keep finished surfaces of countertops covered with protective covering during handling and installation.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wood countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install wood countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where wood countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Established Dimensions: Where wood countertops are indicated to fit to other construction, establish dimensions for areas where wood countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 WOOD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of wood countertops indicated for construction, finishes, installation, and other requirements.
1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that countertops comply with requirements of grades specified.

2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Grade: Custom.

C. Solid-Wood Countertops: For transparent finish. Fabricated from solid wood, edge glued where required, with crown direction reversed in adjacent boards, to produce widths indicated. Select boards for similarity of color and grain, and arrange boards for optimum match between adjacent boards. Edge treatment as indicated on Drawings.
1. Wood Species: As indicated on Drawings, and coordinated with adjacent wood species.
2. Wood Cut: As indicated on Drawings.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of wood countertop and quality grade specified unless otherwise indicated.
1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.
2. Wood Moisture Content: 5 to 10 percent.

2.3 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate wood countertops to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
2. Edges of Members More Than 3/4 Inch Thick: 1/8 inch.

C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect seven days in advance of the dates and times countertop fabrication will be complete.

   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

D. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
   1. Seal edges of openings in countertops with a coat of varnish.

2.4 SHOP FINISHING

A. General: Finish wood countertops at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Finish Materials: Use finish materials that comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Shop Priming: Shop apply the prime coat including backpriming, if any, for items specified to be field finished. Refer to Section 09 9300 "Staining and Transparent Finishing" for material and application requirements.

D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood countertops, as applicable to each unit of work.
   1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood countertops. Apply two coats to end-grain surfaces.

E. Transparent Finish:
   1. Grade: Same as item to be finished.
   2. Finish: System - 2, precatalyzed lacquer 3, postcatalyzed lacquer or5, conversion varnish.
   3. Washcoat for Closed-Grain Woods: Apply washcoat sealer to woodwork made from closed-grain wood before staining and finishing.
   4. Staining: None required.
   5. Filled Finish for Open-Grain Woods: After staining, apply washcoat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.

   6. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition wood countertops to average prevailing humidity conditions in installation areas for not less than 72 hours.

B. Before installing wood countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing and application of backpriming.

3.2 INSTALLATION

A. Grade: Install wood countertops to comply with same grade as item to be installed.

B. Assemble wood countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
   1. Secure field joints in countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Scribe and cut wood countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical-treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

F. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
   1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inchesvariation from a straight, level plane.

G. Shop Finishes: Touch up finishing after installation of wood countertops.
   1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective wood countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

B. Clean wood countertops on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 12 3619

SECTION 22 0101

PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for all plumbing work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers.

B. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 22.

B. Visit the site and study all aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of all labor, equipment and materials, and the performance of all operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for, including all necessary signatures and paperwork, all permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Government.

E. Plumbing work of this project includes, as a brief general description, the following:

1. Removal of existing domestic water heater, fixtures, and plumbing piping to the extent indicated on the plumbing plans.
2. Installation of new domestic water heater, fixtures, plumbing piping and accessories and valves.
3. Installation of condensate piping to serve new mechanical equipment.

F. See Division 01 for requirements related to Government's occupancy of the premises, limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 22 specifications.

B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for all coordination and additional costs as specified in the article "Substitutions," below for substitutions.

C. Products specified by reference standards or by description only: Any product meeting those standards or description.

D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance, and shall not be construed as limiting competition. Contractor may use products of any manufacturer, which meet the specifications.

E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 22 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to the Government.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse the Government for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project, and of representative manufacturer. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. All equipment, construction and installation must meet requirements of local, state and federal governing codes.

C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

1. Furnish: Supply item
2. Install: Mount and connect item
3. Provide: Furnish and install.

E. All materials and equipment shall be installed and completed in a first class and workmanlike manner and in accordance with the best modern methods, practice and manufacturers' instructions. Any work which shall not present an orderly and neat or workmanlike appearance shall be removed and replaced with satisfactory work when so directed in writing by the DGS Project Manager.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall workmanship.

G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the DGS Project Manager will determine sizes to be utilized.

H. In all cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the DGS Project Manager of said uncertainty, doubt, or conflict and obtain a decision as to the intent before starting any work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the DGS Project Manager and await a written decision.

B. Plan and coordinate all work to proceed in an orderly and continuous manner without undue delay, and in conformance with project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate plumbing work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of all piping, ductwork, light fixtures, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor’s responsibility to bring this to the attention of the DGS Project Manager prior to initiation of work. Correct improperly coordinated installation at no additional cost.

E. The Contractors' assistants shall include a competent foreman, who shall be on the premises at all times to check, layout, coordinate and superintend the installation of work. The foreman shall establish all grades and lines relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers' and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for all equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of shop drawings and product data for every item of equipment. Shop drawings or product data will not be considered until manufacturers' lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor's name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.
3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.
4. All exclusively electrical items furnished as items associated with plumbing items but not specifically described in the plumbing item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the plumbing item by identification specification paragraph.
5. Product data sheets shall be 8.5-inch by 11-inch cut sheets for operating and maintenance manual.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of Government's representative, and project type and size.

E. After the work is completed, submit all required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the Government prior to final acceptance of the work.

1.10 SPECIALIST

A. The term "Specialist" as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer's direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:

   a. Contract drawings.
   b. Specifications
   c. Addenda
   d. Change orders and other modifications to the Contract
   e. Reviewed shop drawings, product data, and samples

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:

   a. Manufacturer's name and product model and number
   b. Product options, substitutions, or alternates utilized
   c. Changes made by addenda and modifications

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:

   a. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   b. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
   c. Field changes of dimension and detail.
   d. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.
2. Lubrication charts: Prepare lubrication charts for each piece of mechanical equipment that requires grease or oil.

   a. Include the following:

(1) Types of lubricants required
(2) Locations of lubrication points
(3) Frequency of lubrication.

b. Provide one extra set of lubrication charts mounted in plastic covers, besides those required in Operating and Maintenance Manuals.

3. Binders: Three-ring binders with vinyl-covered hard covers. Provide large enough binders, and sufficient quantity, that the required contents can be easily turned, removed, and reinserted.
4. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," and title of project. Print on spine of binder "O & M INSTRUCTIONS." If more than one binder is required, print covers and spines with volume numbers. Include in the front of every binder an index to all binders.
5. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
6. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.
7. Part 1: Directory, listing names, addresses, and telephone numbers of mechanical engineers; Contractor; mechanical subcontractors; and major mechanical equipment suppliers.
8. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

a. Significant design criteria, including pump curves and similar performance charts.
b. List of plumbing equipment, including operating weight of each.
c. Parts list for each plumbing fixture, faucet, and pump, including recommended spare parts list.
d. Operating instructions.
e. Maintenance instructions for plumbing equipment and systems.
f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
g. Valve charts, including locations of flow fittings.

9. Part 3: Project documents and certificates, including the following:

a. Shop drawings and product data for plumbing systems.
b. Photocopies of certificates.
c. Photocopies of warranties and guarantees.
d. Test reports: Copies of the results of all tests required under all sections of specifications.

10. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.
11. Submit final volumes revised, within ten days after final inspection.

1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The plumbing, mechanical, electrical, building, fire, and safety codes of the state and county or city in which the work is being performed.
2. The National Electric Code, NFPA 70 (NEC).
3. The National Fire Protection Association Code. (NFPA).
4. International Energy Conservation, Fire, Fuel Gas, Mechanical, and Plumbing Codes (ICC).

1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply. Products shall be certified by manufacturers to meet the requirements of referenced standards.

1. Federal Specifications (FS)
2. Military Specification (MS)
3. Military Standards (Mil. Std.)
4. Air Conditioning and Refrigeration Institute (ARI)
5. Air Movement and Control Association (AMCA)
6. Associated Air Balance Council (AABC)
7. American Association State Highway and Transportation Officials (AASHTO)
8. American National Standards Institute (ANSI)
9. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
10. ASME International (ASME)
11. American Society for Testing and Materials (ASTM)
12. American Society of Sanitary Engineering (ASSE)
13. American Water Works Association (AWWA)
14. International Code Council (ICC)
15. Manufacturer's Standardization Society of the Valve and Fittings Industry Inc. (MSS)
16. National Electrical Code, NFPA 70 (NEC)
17. National Electrical Manufacturer's Association (NEMA)
18. National Fire Protection Association (NFPA)
19. National Fuel Gas Code, NFPA 54
20. National Sanitary Foundation (NSF)
21. National Standard Plumbing Code (NSPC)
22. The Occupational Safety and Health Act (OSHA)
23. Piping and Drainage Institute (PDI)
24. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
25. Underwriters Laboratory Inc. (UL)
26. Maryland Occupational Safety and Health Act (MOSHA)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for all contents within these areas. Provide all security measures necessary for this area.

B. Area shall be maintained and shall be returned to original condition at the completion of the project.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair all damage or soiling to the complete satisfaction of the DGS Project Manager; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, all at no addition to the Contract Sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer's recommended temperatures.

E. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.16 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.17 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in "Cutting and Patching" below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the DGS Project Manager in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.18 WARRANTY

A. All work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties specified in individual sections.

B. During the correction period, the Contractor shall begin correcting any work found to be not in accordance with the requirements of the Contract Documents within 4-hours of receiving written notice from the DGS Project Manager. Provide detailed schedule for completion of work within 24-hours of receiving written notice from the DGS Project Manager and revise schedule based on any Government comments generated. Except as otherwise required in General Conditions and Division 01, the correction period is one year after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

1. Service reports for warranty work shall be provided to the Government.

C. When use of the permanent equipment has been permitted for temporary heating or ventilation of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Government.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers' standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of pipes, ducts and appurtenances. Close superfluous openings and remove all debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the DGS Project Manager.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and all materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.3 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or DGS Project Manager finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, and the DGS Project Manager shall each be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

END OF SECTION

SECTION 22 0500

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to more than one section of Division 22.

B. Basic material and equipment required for the plumbing piping work.

C. Identification of plumbing systems and equipment.

D. Cleaning and painting.

E. Backboards for piping specialties.

F. Treated wood lumber.

G. Operating instructions.

H. Piping tests.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 22 0101.

B. Operation and Maintenance Manuals: Division 01 and Section 22 0101.

1.3 REFERENCES

A. American Society of Mechanical Engineers

1. ASME A 13.1: Scheme for the Identification of Piping Systems
2. ASME B 31.9: Building Services Piping

B. American Society of Testing and Materials

1. ASTM B 32: Standard Specification for Solder Metal
2. ASTM B 88: Standard Specification for Seamless Copper Water Tube
3. ASTM B 813: Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
4. ASTM D 635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
5. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials
6. ASTM E 548: Standard Guide for General Criteria Used for Evaluating Laboratory Competence

C. American Welding Society

1. AWS D1.1: Structural Welding - Steel
2. AWS D10.9: Specification for Qualification of Welding Procedures and Welders for Piping and Tubing

D. NSF

1. NSF/ANSI 61: Drinking Water System Components - Health Affects
2. NSF/ANSI 372: Drinking Water System Components – Lead Content

1.4 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

C. DN: Dimension Nominale, nominal pipe size in millimeters, in accordance with the metric system for construction, Systeme Internationale (SI).

D. NPS: Nominal pipe size in inches, in accordance with standard U.S. designations for manufactured pipe. Pipe sizes do not change when projects are designed and built in metric units; each size has a consistent name (nominal dimension) in each system.

1.5 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed based on use of the particular manufacturer's products specified and scheduled on the drawings.

B. Products of other manufacturers that are listed under the article "Available Manufacturers," or permitted as "equal," are permitted provided:

1. Product shall meet the specifications.
2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that render their use impractical, or cause functional fit, access, or connection problems.

1.6 SUBMITTALS

A. Shop drawings:

1. Schedule of welding and brazing procedures proposed for each piping system in the project.
2. Shop drawings of backboards for piping specialties.

B. Certifications: Proof of operator and testing agency personnel qualifications as required for welding and brazing in the article "Quality Assurance" below.

C. Test reports: Field test results for each piping system as specified in Part 3 below.

1.7 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the plumbing, mechanical, electrical, building, fire, health and safety, and other applicable codes and regulations of the state, county or city in which the work is performed.

1. Product specifications herein may not necessarily meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

B. Welding procedures and operator qualifications for structural welding: AWS D1.1, Structural Welding Code Steel, electric arc process.

C. Brazing, and soldering procedures and operator qualifications for building systems piping:

1. ASME B31.9, Building Services Piping.
2. Copper Development Association "Copper Tube Handbook."
3. Safe Drinking Water Act.

D. Electrical control panels, equipment, materials and devices provided or installed as work of Division 22 shall bear UL label or, if UL label is not available, the item shall be tested and labeled by a qualified testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70 (NEC). Provide testing, if required, without addition to the contract sum.

E. VOC content: Field-applied adhesives and sealants, limits per South Coast Air Quality Management District (SCAQMD), Rule No. 1168.

F. Products shall contain no urea-formaldehyde content.

PART 2 - PRODUCTS

2.1 GENERAL

A. General piping techniques, testing, identification, painting, and operating instructions specified in this section apply to products specified in other sections of Division 22.

B. Equipment that uses or processes date and time data in order to perform its function shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

2.2 PIPING MATERIALS

A. Soldering materials:

1. Solder: Free of lead, antimony, and zinc and meeting the requirements of ASTM B 32. No solder containing lead is permitted.

a. Tin 95.5 percent, copper 4 percent, and silver 0.5 percent.

(1) Equal to "Silvabrite 100" manufactured by Engelhard Corporation.

b. Tin, copper, bismuth, and silver.

(1) Equal to "Oatey Silver" manufactured by Oatey.

2. Flux:

   a. Meeting the requirements of ASTM B 813 and NSF 61 certified.
   b. Equal to Oatey H-2095.

B. Threaded pipe joint materials:

1. Pipe jointing compound:

   a. Pipe joint compound recommended by the manufacturer for use at the temperature and pressure of the system.
   b. For sanitary piping overhead of food storage, preparation, and serving and dining areas: Litharge and glycerin.

2. Pipe joint tape: Polytetrafluoroethylene (PTFE) pipe thread tape, “Teflon.”

2.3 IDENTIFICATION DEVICES AND MATERIALS

A. Stenciling materials:

1. Stencils: Manufactured standard stencils prepared for required applications, conforming to ASME A 13.1 for color and size of legend letters, including arrows showing direction of flow.
2. Paint: Exterior type enamel, colors conforming to ASME A 13.1, or black.

B. Equipment identification tags:

1. Laminated plastic with adhesive back, white core and black outer layers, which, when engraved, will produce white letters and numerals on a black background.
2. Tags installed on curved surfaces shall be aluminum or brass.

C. Valve tags: Brass, 1.5 inch (40 mm) in diameter with black-filled numbers not less than 0.25 inch (6 mm) high, complete with brass attachment chains.

D. Ceiling identification tags: Laminated plastic with adhesive back, engraved black letters on white background, minimum 0.5 inch (15 mm) wide and length as required for 0.375 inch (10 mm) high letters for name of concealed device and number.

2.4 MATERIALS FOR BACKBOARDS FOR PIPING SPECIALTIES

A. Backboards: Marine plywood: BS-1080, Veneer Grade A/B, moisture-resistant, spruce-pine-fir multiple ply, 5-ply minimum, pressure-treated construction, 0.563-inch (14-mm) thick minimum

B. Supports: Fiber reinforced plastic (FRP) composite structural shapes: ASTM D 635 and E 84, Pultruded FRP structural shapes, non-corrosive, flame retardant, thermosetting polyester resin, composite factory-fabricated shapes for assorted assemblies and field erection.

1. Ultimate tensile strength: 30,000 psi (207 MPa).
2. Modulus of elasticity: 2.8×10^6 psi (19,300 MPa).
3. Specific gravity: 1.6 to 1.75.
4. Density: 0.062 to 0.070 pounds/cubic inch (1.72 to 1.94 grams/cubic centimeter).
5. Flame spread: ASTM E 84 Class A, 25 maximum.
6. Color: Yellow.
7. Shapes and sizes as required to support the load, and in accordance with minimum sizes indicated on the drawings
8. Acceptable manufacturers:

a. Bedford Reinforce Plastics Company
b. Composites USA, Inc.
c. Liberty Pultrusions, Inc.
d. Strongwell Corporation
e. Structural Fiberglass, Inc.

C. Fasteners: Corrosion-resistant and suitable for secure anchorage into wall behind backboards.

2.5 TREATED WOOD LUMBER

A. Wood-preservative-treated lumber: Treated by pressure process, AWPA C2, with chemicals acceptable to authorities having jurisdiction, and marked with treatment quality mark of an inspection agency approved by ALSC Board of Review.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS AND EQUIPMENT

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify the DGS Project Manager if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

B. The contract drawings are diagrammatic and do not indicate all fittings or offsets in pipe, all access panels, or all specialties required. Provide required fittings, offsets, access panels, and specialties to coordinate the work.

C. No pipe shall be run below the head of a window or door.

D. Equipment and pipes installed in areas without a suspended ceiling shall be as tight to structure as possible, but at least above a height of 6'-8", unless otherwise noted.

E. Items which require access for operation or maintenance shall be easily accessible. Do not cut or form hand holes for operation or maintenance of appliances through walls or ceilings.

3.2 PIPE INSTALLATION

A. Install pipe exposed to view parallel to building lines and as close to walls, columns, and ceilings as may be practical, maintaining proper clearances for access at all parts requiring servicing.

B. Install pipe a sufficient distance from other work to permit a clearance of not less than 0.5 inch (15 mm) between its finished covering and adjacent work.

C. Remove burrs resulting from cutting pipe or from any other operation.

D. Provide for expansion and contraction of piping and connections so that no breakage or excessive strain will occur. Provide anchors and guides of approved design where shown on drawings and where necessary to allow for proper expansion and contraction. At the time of installation, expansion loops shall be cold sprung to one-half of the calculated expansion.

E. Pipe connection flexibility:

1. Connect domestic hot water risers and branch connections to mains with at least five pipe fittings, including tee in main.
2. Connect domestic hot water risers and branch connections to equipment and fixtures with at least four pipe fittings, including tee in riser.
3. Connect mains and branch connections to equipment and fixtures with at least four pipe fittings, including tee in main.
4. Connections shall be arranged so that movement in piping due to expansion and contraction will not transmit excessive force to equipment or fixtures.

F. Install unions or flanges in the piping at each item of equipment, solenoid valve, central thermostatic mixing valve, and appliance, so as to provide easy removal of the equipment, valve, or appliance.

G. Pitch water piping so that air in the system can be properly vented. Provide shutoff valves where necessary to isolate parts of system for repairs without draining the entire system.

H. Interface with other products:

1. Where pipe is provided through walls, provide finished, permanent, waterproof installation complete with inserts, sleeves, supports or hangers, seals, and other appurtenances as required. Do not pierce, cut, or notch any footing or other structural member.
2. Waterproofing and dampproofing of the building shall be unharmed by the installation of the work. Where pipe has to pierce waterproofing or dampproofing, including outside walls, the penetration shall be made watertight. Waterproofing damaged or destroyed shall be repaired or replaced with new waterproofing.

I. Thoroughly clean pipe and fittings before they are installed, and keep them clean until the acceptance of the completed work. Cap or plug the ends of the lines so as to prevent earth and other debris from entering during construction.

J. Threaded connections:

1. Cut threads full and clean.
2. Apply specified pipe joint compound or tape on male threads only.
3. Where piping is installed in crawl spaces and tunnels, cover exposed threads with rust-inhibitive paint. Apply after joints have been assembled and tested.

K. Copper tubing installation:

1. Cut pipe with a tubing cutter or fine-tooth saw. Cuts made with a saw shall be true and square, and the end shall be filed smooth with a fine-tooth file. Remove all marks and burrs with sandpaper.
2. Solder joints for copper tubing: Clean ends of tubing and inside of fitting ends thoroughly with emery cloth before applying flux.
3. Provide dielectric fittings between copper and steel piping to prevent electrolysis.
4. Follow the techniques for soldering and brazing pipe, fittings, and valves as recommended by the manufacturer.

3.3 IDENTIFICATION

A. General: Do not apply identification until insulation and finish painting work is complete.

B. Equipment:

1. Stencil equipment with minimum two-inch (50-mm) -high letters or provide identification tags. Clearly identify function, equipment served, and area served.
2. Firmly fasten each identification tag to its appropriate piece of equipment with drive screws, sheet metal screws, or rivets. Do not interfere with operation of, or damage the item being marked.

C. Piping:

1. Mark by stenciling.
2. Mark to identify service with arrows showing direction of flow. Apply markings near building walls where pipes enter or leave an accessible space and in intermediate locations so that markings are no more than 30 feet (9 m) apart. They shall be readily visible to a person standing on the floor.
3. Fully identify all piping installed as work of the project.
4. Mark pipe with letters of height and with colors as required by OSHA and conforming to ASME A 13.1.
5. Identify every thermometer, gauge, and control device.
6. Provide valve tags for all valves except shutoff valves on individual fixtures or equipment where their function is obvious, or where the fixture or equipment is immediately adjacent. Numbers shall correspond to those shown on the Valve Chart. Attach tags to valve shaft.

D. Ceiling identification tags: Provide on the access door or, in suspended ceilings, on the ceiling support adjacent to the unit.

1. Valves: Identify with the same number shown on the valve tag.

3.4 CLEANING AND PAINTING

A. Cleaning: Clean all piping and equipment. Where items are to be painted, clean ready for painting.

B. Painting: Coordinate painting with requirements of Division 09. Paint the items identified below to be painted. Use paint materials and systems specified in Division 09.

C. Items to be painted:

1. Piping exposed in finished spaces, insulated and uninsulated.

D. Items not to be painted: Copper, stainless steel, and equipment furnished with manufacturer's finish.

E. Paint systems for exposed piping: Primer compatible with the substrate, whether steel, galvanized steel, insulation jacket, or other material; one coat or two, if required to cover, to match adjacent surfaces in color and texture.

3.5 BACKBOARDS FOR PIPING SPECIALTIES

A. Provide wall-mounted backboards, sizes and locations as indicated on the drawings, for mounting piping specialties. Assembly shall consist of plywood board, FRP supports, and fasteners.

3.6 TREATED WOOD LUMBER

A. Provide wood-preservative-treated lumber where wood members are required as detailed on the drawings and in the following applications:

1. Cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.
2. Sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.

3.7 OPERATING INSTRUCTIONS (DEMONSTRATION)

A. Furnish the necessary technicians, skilled workers, and helpers to operate all the plumbing systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Government's designated personnel in operation, maintenance, lubrication, and adjustment of all systems and equipment.

1. Instructions by manufacturer's technical representative for each type of equipment shall include the performance of the recommended preventive maintenance procedures for that equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions, for use by instructors and Government personnel.

E. Schedule the general and specialized instruction periods for a time agreed upon by DGS Project Manager.

3.8 PIPING TESTS

A. Hydrostatic testing:

1. Notify Government in writing at least 24 hours prior to the test.
2. Test before pipes are concealed or insulated.
3. Piping may be tested in sections as the work progresses.
4. Provide fluid, pumps, valves, and gages required for testing.
5. Where water is used as the test fluid, provide ambient temperature water and provide means to avoid freezing. Drain and dispose of test fluid when testing is concluded.
6. Isolate equipment and expansion tanks during test.
7. Isolate or remove any components with a pressure rating below the required test pressure.
8. Brace and support piping during the test, so that no movement, displacement, or damage results from the application of the test pressure.
9. Provide a pressure relief valve, set at a pressure no more than one-third higher than test pressure, to protect against damage caused by expanding liquid or other source of overpressure during test.
10. Replace piping or fittings found defective with new material.
11. Sanitary and storm drainage piping tests:

a. Before connection of the plumbing fixtures, and before connection to the sewer, cap or plug all new sanitary and storm drainage piping systems of the building.
b. Test following the methods of testing required by the plumbing code, and no less than the duration and pressures required in the Schedule of Piping Systems Tests.
c. Where pipes are in trenches, leave the trenches open until the completion of the test.

12. Air conditioning condensate piping tests:

a. Before connection of condensate producing HVAC equipment, cap or plug all new air conditioning condensate drain piping systems of the building.
b. Test following the methods of testing required by the plumbing code, and no less than the duration and pressures required in the Schedule of Piping Systems Tests.
c. Where pipes are in trenches, leave the trenches open until the completion of the test.

13. Documentation of tests: Prepare a test report for each portion of piping tested, identified by service, material, location, and pipe size. Include these items:

a. Date of test.
b. Starting and completion times.
c. Initial test pressure.
d. Final test pressure.
e. Problems or leaks detected.
f. Corrective actions taken.
g. Record of successful completion of testing.
h. Name, title, and signature of person conducting test.

14. Piping Systems Test Schedule:

System	Test Pressure psig (kPa)	Duration	Allowable Drop	Medium
Domestic water service & exterior water piping	150 (1030)	4 Hours	None	Water
Domestic water piping (cold, hot, tempered, & recirculated)	125 (860)	4 Hours	None	Water
Air conditioning condensate drain piping	4.3 (30)	4 Hours	None	Water
Sanitary waste piping	4.3 (30)	4 Hours	None	Water

* If pressure drops, locate leaks with soap and water solution

END OF SECTION

SECTION 22 0501

EXCAVATION AND FILL FOR PLUMBING WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Trenching, backfilling, and compacting for plumbing work underground inside the building and extending five feet beyond exterior building walls.

1.2 RELATED SECTIONS

A. Cutting and patching: Division 01 and Section 22 0101.

B. Piping:

1. Domestic water piping: Section 22 1116.
2. Sanitary waste and vent piping: Section 22 1316.
3. Storm drainage piping: Section 22 1413.

1.3 REFERENCES

A. ASTM D 1557: Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/cu ft (2700 kN-m/cu m).

1.4 SUBMITTALS

A. Shop drawings: At the same scale as the contract drawings, showing field verified locations of utilities, and proposed detailed trenching plan.

B. Product data: Warning tape

C. Certifications: Test reports showing that compaction meets specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill: Earth materials, free from perceptible amounts of wood, debris, or topsoil, free of frost at the time of placement, and not containing marl or other elements which tend to stay in a plastic state.

B. Underground warning tape: Polyethylene 0.004 inch (0.102 mm) thick for metallic lines, and for non-metallic lines polyethylene both sides with metallic lining, six inches (152 mm) wide.

1. Colors: In accordance with APWA and AASHTO standards.
2. Markings: Repeated continuously along the entire length, legend appropriate for line being identified.

2.2 EQUIPMENT

A. Mechanical tampers for compacting backfill: Capable of exerting a blow equal to 250 pounds per square foot (12 kPa) of area of the tamping face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Contact local utility company underground information service (BGE Miss Utility) before beginning excavation outside buildings.

B. The general locations of underground utilities are indicated on the drawings and are not to be assumed to be accurate or complete. Before beginning work, field check the area with the most accurate instruments available, such as Fisher Labs' Pipe and Cable Locators.

3.2 INSTALLATION

A. Perform all excavating, cutting of paved areas, trenching, sheeting, shoring, backfilling, and compacting required for the proper installation of the work.

B. Where obstructions are encountered, obtain written approval and make necessary changes in line, grade or location.

C. Protect existing utilities from damage during excavation and backfilling. Repair damaged new or existing work at no addition to the contract sum. Bracing, shoring and other protection of existing utilities is part of this work.

D. Do not damage or remove existing shrubs or trees including their root systems, without prior notification to the DGS Project Manager.

E. Provide temporary roadways over trenches with railings and other safeguards, including amber blinker lamps or other warnings for night use.

F. Note the depths of footings. In cases where piping is in close proximity to or below footings and where the natural earth under footings is disturbed, after the line is installed, the voids shall be filled up to bottoms of such footings with solid concrete.

3.3 CUTTING

A. Cut concrete and asphalt concrete with masonry saw prior to breaking it into smaller pieces for removal.

B. Cut sidewalks perpendicular to the length at the closest existing joint that is a minimum of 24 inches back from either side of the top of the new trench.

3.4 TRENCHING

A. Excavations inside the building shall be carefully planned. Stockpile excavated earth so as not to interfere with other construction. Dig trenches to the proper depths, providing extra depressions where required for hubs of pipes.

B. Trenches shall be of necessary depth and width for the proper laying of pipe with a minimum of 8 inches (205 mm) on each side of the joint.

1. The sides shall be as nearly vertical as practicable. Unless local regulations are more strict, trenches 4 ft. (1220 mm) and deeper shall have shored sides as required by OSHA trenching regulations.

2. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length, except for bell holes and for the proper sealing of the pipe joints.
3. No greater length of trench shall be left open, in advance of the completed structure placed in it, than can be completed in that day's operation.
4. Except where rock is encountered, do not excavate below the depths required. Where rock excavation is required, excavate to a depth of at least 6 inches (150 mm) below the trench depth and fill the overdepth with compacted crusher run or bank run stone or sand. Unauthorized overdepths in excavation shall be backfilled with crushed stone, slag or gravel, thoroughly compacted.
5. Whenever wet or otherwise unstable soil is encountered, it shall be removed to the depth and extent directed, and the trench backfilled to the proper grade with crushed stone, slag or gravel.

C. Should springs be encountered within the work area, or soft soil conditions at the elevations required for load bearing, immediately notify the DGS Project Manager and do not place any portion of the work on such surfaces until instructions are received.

D. Furnish and maintain pumps, flumes, gutters, and appurtenances if required to keep the excavations free from water. Water shall be directed to a point remote from building operations, shown on the approved shop drawing.

E. Excavation for manholes and similar structures shall be sufficient to leave a minimum of 12 inches (305 mm) and a maximum of 24 inches (610 mm) clearance on all sides. Fill over-depth excavation with concrete.

3.5 BACKFILL

A. Place no backfill until the adjacent construction or the utility to be covered has been inspected, tested, and approved.

B. Installing underground warning tape: Install in backfill above exterior buried lines not encased in concrete. Select legend and color appropriate for type of line. Install metallic lined tape for non-metallic lines. Install approximately 12 inches (305 mm) below grade.

C. Plumbing systems backfill:

1. Backfill and compact in six-inch (150-mm) layers up to spring line of the pipe. The installations shall then be inspected and tested.
2. Following inspection, backfill in six-inch (150-mm) layers, each compacted, until the pipe has a cover of not less than one foot (305 mm). Place the remainder of the backfill material in the trench in eight-inch (200-mm) compacted layers.
3. Excavations improperly backfilled shall be reopened, then refilled and compacted to the required grade and compaction, and smoothed off.
4. Open trenches across roadways or other areas to be paved shall be backfilled as specified above, except that the entire depth of trench shall be backfilled in six-inch (150-mm) layers, and each layer shall be mechanically compacted.
5. Completed work shall have uniform graded surface, in accordance with the surface and grade indicated on the drawings.

D. Structure backfill:

1. Do not backfill against structures with cement mortar joints until the mortar is at least twelve hours old.

3.6 COMPACTION

A. Test in accordance with the requirements of ASTM D 1557.

B. Compact under slabs, roads, and sidewalks to a 95 percent density.

C. Compact unpaved areas to a 90 percent density.

D. Backfill and compact trench in unpaved areas to within 4 inches (102 mm) of existing grade. Furnish and install compacted select topsoil for the final layer to finish even with existing grade. Remove surplus earth and rake unpaved areas for final planting.

E. Take particular care in compaction of earth under joints of plumbing piping.

END OF SECTION

SECTION 22 0502

SLEEVES AND PLATES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sleeves and escutcheon plates for piping systems.

B. Mechanical seals for piping penetrations.

1.2 SUBMITTALS

A. Product data: Sleeves, plates, sealants, and mechanical penetration seals.

PART 2 - PRODUCTS

2.1 SLEEVES, PLATES, AND ACCESSORIES

A. Steel sleeves: Schedule 40 black steel pipe, ASTM A 53.

B. Copper sleeves: Type L, ASTM B 88 hard drawn.

C. Cast-iron sleeves:

1. Extra heavy, with waterstop and ends as shown on the drawings.
2. Equal to product of U.S. Pipe Co.

D. Plastic sleeves: Schedule 40 PVC, ASTM D 1785.

E. Sealing compound in walls and floors:

1. Bare and insulated pipes carrying fluids 150 degrees F (65 degrees C) and below:

   a. High-performance, moisture cured, 1-component, polyurethane-based, non-sag, elastomeric sealant. Use a primer for applications required by the manufacturer.
   b. Basis of design: Sika Corporation “Sikaflex – 1a.”

2. Bare and insulated piping carrying fluids 151 degrees F (66 degrees C) and above:

   a. One-part RTV silicone, neutral-cured, architectural grade sealant. Use a primer for applications required by the manufacturer.
   b. Basis of design: Dow Corning Corporation “795 Silicone.”

F. Floor, wall, and ceiling plates for existing piping: Stamped or cast brass with chrome finish and set screw, split and tabbed.

G. Floor, wall, and ceiling plates for new piping: Stamped or cast brass with chrome finish and set screw.

H. Mechanical penetration seals:

1. Seals shall be modular mechanical type, consisting of interlocking synthetic links shaped to continuously fill the annular space between the pipe and wall opening. Bolt and nut fasteners for the seals shall be stainless steel for units used in penetrations below grade.
2. Basis of design: PSI "Link-Seal Modular Seals" or Calpico Sealing Link "LINX".

PART 3 - EXECUTION

3.1 INSTALLING SLEEVES

A. Install sleeves for piping, or piping with insulation continuous through sleeve, passing through walls, partitions, beams, or slabs.

B. Do not cut, drill, or burn structural steel for installation of piping without specific instructions from the DGS Project Manager.

C. Locations in nonfire-rated construction:

1. Install steel sleeves for penetrations of steel, iron, and insulated piping.
2. Install copper sleeves for penetrations of uninsulated copper tubing and piping.
3. Install plastic sleeves for penetrations of plastic piping. Plastic piping and sleeves are not permitted in ceiling spaces used as HVAC system plenums, or in shafts used for building HVAC air distribution.

D. Locations in floors and fire-rated construction: Sleeves used in piping penetrations through fire-rated construction shall be an acceptable component of the through-penetration firestop assembly as specified in Division 07.

1. Where firestop assembly is UL listed, sleeve material shall be as directed in the listing.
2. Where other specified approval and acceptance is required, sleeve shall be as described in the approved assembly.

E. Install sleeves through walls and partitions flush with finished surfaces.

F. Sleeves through floors shall extend 0.375 inch (10 mm) above top of finished floor and be finished neat and level. Sleeves through mechanical or equipment room floors shall extend one inch (25 mm) above finished floor. Provide projecting sleeves with anchor clips to prevent them from being loosened and knocked down in the floor construction.

G. Sleeves for insulated piping shall be large enough to pass piping and insulation.

H. Seal spaces between sleeves and pipe, or pipe insulation, in nonrated walls, with mineral wool.

I. Penetrations in exterior masonry or concrete walls and foundations:

1. Sleeves: Cast iron, or in cast concrete may be core drilled.
2. Above grade: Mechanical penetration seal at outside face of wall.
3. Below grade: Mechanical penetration seal, at outside face of wall.

3.2 INSTALLING PLATES

A. Exposed piping passing through interior walls, partitions, floors, and ceilings shall be fitted with plates of size and depth to conceal sleeves. Secure plates firmly in place with set screws.

END OF SECTION

SECTION 22 0504

PLUMBING DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Extent and location of demolition are shown on the drawings.

1.2 RELATED SECTIONS

A. Demolition: Section Division 02.

1.3 QUALITY ASSURANCE

A. Demolition shall be carried out as expeditiously as possible in accordance with accepted practice and applicable building code provisions.

1.4 PROJECT CONDITIONS

A. If, in the course of the work, workers encounter a material they suspect to be asbestos, to contain lead or PCBs, or to present some other hazard:

1. Promptly notify the DGS Project Manager in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

B. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.

C. Locate, identify, and protect mechanical and electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Comply with demolition and disposal requirements of Division 02.

B. Perform removal work neatly with the least possible disturbance to the building.

C. Provide temporary barriers, danger signals, and appurtenances for protection of personnel and equipment during removal operations.

D. Demolish, remove, demount, and disconnect inactive and obsolete piping, fittings and specialties, equipment, ductwork, controls, fixtures, and insulation.

1. Piping and ducts embedded in floors, walls, and ceilings may be abandoned in place if they do not interfere with new installations. Cut back to at least one inch below finished surface.
2. Remove materials above accessible ceilings.
3. Drain and cap items to remain behind finished surfaces.
4. Patch and repair surface materials as required in Division 01 and Section 22 0101 article, “Cutting and Patching.”

E. Remove anchors, bolts, and fasteners associated with piping and equipment to be removed.

3.2 DISPOSAL

A. Dispose of equipment and materials removed, and rubbish and waste material, as work progresses. Do not allow demolition debris to accumulate on site. Remove products of demolition from the building daily.

3.3 PROTECTION

A. Provide adequate and positive protection to existing building and equipment that is to remain, particularly to prevent entry of either dust or water. Ensure weathertightness at all times. Keep standby patching materials on hand to patch and maintain protection as required.

END OF SECTION

SECTION 22 0506

CURBS AND FLASHINGS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe boot assemblies and flashing devices for plumbing items and equipment penetrating roof and mounted on roof.

1.2 RELATED SECTIONS

A. Rough carpentry: Division 06.

B. Piping:

1. Domestic water piping: Section 22 1116.
2. Sanitary waste and vent piping: Section 22 1316.
3. Storm drainage piping: Section 22 1413.

1.3 SUBMITTALS

A. Shop drawings: Flashing assemblies and devices showing compatibility with roof membrane, insulation, and slope, and configuration for the supported equipment.

B. Product data: Each type of manufactured unit, accessory, and accessory material.

1.4 SEQUENCING

A. Coordinate installation of supports with roof structure and membrane. Loads and penetrations shall not exceed or damage structural capacity or weathertightness.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wood-preservative-treated lumber: As specified in Division 06 and in Section 22 0500.

1. Application: Treat items indicated on the drawings, and the following:

a. Wood cants, nailers, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.

2.2 PENETRATIONS OF SINGLE PIPE OR VENT

A. Basis-of-design product: Subject to compliance with requirements, provide the specified product, or comparable product by another manufacturer.

B. Plumbing vents on sloped roofs:

1. Base size 15 by 15 inch (380 by 380 mm); weight of lead, 4 lbs (1.8 kg per 0.09 sq. m); angle of roof as shown on the drawings. Flashing shall be formed to fit over top of pipe and in one continuous piece down to roof.
2. Basis of design: Oatey Flashings type “Hi Collar Lead Flashing”

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Plumbing vent shall extend 8 inches (205 mm) above finished roof. Clamp devices shall be tightly sealed to vent. Space between vent hub and pipe shall be lightly caulked with lead to provide for movement in piping.

B. Flashing of roofing felts into clamping devices of roof drains and sleeves through roof, and flashing shall be as specified under Division 07, including all material and labor to waterproof roof.

C. Where dissimilar metals would come in contact with each other, coat them with bituminous protective coating or other coating compatible with adjacent materials.

END OF SECTION

SECTION 22 0509

PLUMBING EXPANSION SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Precharged bladder-type expansion tank for potable water system.

1.2 RELATED SECTIONS

A. Piping: Section 22 1116.

B. Supports: Section 22 0529.

1.3 SUBMITTALS

A. Product data: Each type of expansion system or tank, including each relief and air separation device and all accessories.

1. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

1.4 QUALITY ASSURANCE

A. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61, NSF/ANSI 372 with requirements for "lead-free" plumbing as defined by state laws and U.S. Safe Drinking Act.

B. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements.

C. Product specifications herein may not necessarily meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the specified and scheduled products, comparable products by one of the following, or approved equal:

1. Expansion tanks:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell and Gossett Domestic Pump Div of ITT
d. Taco
e. Wessels
f. Or approved equal.

2.2 EXPANSION TANK FOR POTABLE WATER

A. Pressurized bladder type tank, containing impermeable bladder which separates the air cushion from the system water. Operating temperature: 240 degrees F maximum. Precharge to manufacturer's standard pressure.

B. Shell: Welded steel, constructed, tested and stamped in accordance with ASME BPV for Unfired Pressure Vessels for a working pressure of 125 psi. Lined with protective coating.

C. Bladder: Butyl rubber, flexible but not stretchable under working conditions, removable for inspection.

D. FDA approval: Wetted components FDA-approved materials.

E. Size and capacity: Shown on the drawings.

F. Supports: For horizontal or vertical support on concrete equipment foundation, as diagramed on the drawings.

G. Basis of design: Taco PAX model number scheduled on the drawings.

2.3 AUTOMATIC AIR VENT

A. Float type vent, size and capacity recommended by manufacturer for tank and system.

PART 3 - EXECUTION

3.1 INSTALLING EXPANSION TANKS

A. Follow manufacturer's instructions and recommendations.

B. Install piping, air separation apparatus, and vents as diagramed on drawings.

C. Install supports as shown on drawings.

3.2 OPERATING INSTRUCTIONS

A. As specified in Section 22 0500, provide operating instructions.

END OF SECTION

SECTION 22 0523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Valves for various piping systems.

1.2 RELATED SECTIONS

A. Piping installation and testing: Section 22 0500.

B. Piping systems:

1. Domestic water piping: Section 22 1116.
2. Sanitary waste and vent piping: Section 22 1316.
3. Storm drainage piping: Section 22 1413.

C. Automatically operating valves: Section 22 1119.

D. Access doors: Section Division 08.

E. Automatic water temperature control valve for domestic hot water: Section 22 1119.

1.3 REFERENCES

A. ASME B16.10: Face-to-Face and End-to-End Dimensions of Valves.

B. ASME B16.34: Valves - Flanged, Threaded, and Welding End.

1.4 SUBMITTALS

A. Product data: For each type of valve. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

1. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

B. Maintenance data: For inclusion in operation and maintenance manual specified in Division 01 and Section 22 0101. Include manufacturer's instructions for adjusting, servicing, disassembling, and repairing.

C. Valve charts: Furnish valve charts typed on 8.5 by 11-inch (216 by 279-mm) bond paper, showing locations of all manual and automatic control valves, and flow meters. Include:

1. Number
2. Location
3. Service
4. Function
5. Area served

D. Valve numbering system shall be approved by the Government prior to final submittal. Place one copy of approved chart in a plastic envelope and mount on wall where directed. Provide another copy for each of the Operating and Maintenance Manuals.

1.5 QUALITY ASSURANCE

A. Ferrous valves shall conform to ASME B16.10 and B16.34 for dimension and design criteria.

B. Copper alloy valves (brass and bronze) shall have no more than 15 percent zinc in the alloy.

C. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61, NSF/ANSI 372 with requirements for "lead-free" plumbing as defined by state laws and U.S. Safe Drinking Act.

D. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements. Product specifications herein may not define all product options necessary to meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Ball valves: Subject to compliance with requirements, provide the specified NIBCO valve, comparable product by one of the following, or approved equal:

1. Apollo Valves
2. Milwaukee Valve Co.
3. NIBCO
4. Stockham Valve & Fittings
5. Walworth Co.
6. Watts Regulator Co.
7. Or approved equal.

B. Check valves: Subject to compliance with requirements, provide the specified NIBCO valve, comparable product by one of the following, or approved equal:

1. Combination Pump and Valve Co.
2. Mueller Steam Specialty
3. NIBCO
4. Or approved equal.

C. Drain valves: Subject to compliance with requirements, provide the specified NIBCO valves, comparable products by one of the following, or approved equal:

1. Apollo Valves
2. Milwaukee Valve Co.
3. NIBCO
4. Stockham Valve & Fittings
5. Walworth Co.
6. Watts Regulator Co.
7. Or approved equal.

2.2 VALVES

A. Ball valves:

1. Valves NPS 0.25 (DN 8) through NPS 2 (DN 50:

a. 600 psi CWP, two-piece silicon bronze alloy body, full port, blowout-proof stem, PTFE seats, stainless-steel ball and stem, extension handle for use in insulated piping, threaded or soldered ends.
b. Basis of design: NIBCO T-685-66-LF or S-685-66-LF.

B. Check valves:

1. Center-guided, spring-loaded silent-action type check valves:

a. Valves NPS 0.5 (DN 15) through NPS 2 (DN 50):

(1) 250 psi CWP, silicone bronze body, PTFE disk, stainless-steel stem and spring, threaded or soldered ends.
(2) Basis of design: NIBCO T-480-Y-LF or S-480-Y-LF.

2.3 DRAIN VALVES

A. Drain valves:

1. Provide with supplemental ASSE 1011 backflow preventer.
2. Full-port, two-piece ball valve, bronze body, bronze ball, replaceable PTFE seats and seals, vinyl-covered steel handle, threaded or soldered inlet, threaded cap with brass chain. Provide extension handles where used in insulated piping. Remove handle where valve is accessible to the general public.
3. Pressure rating: 600-psig (4137-kPa).
4. NPS 0.75 (DN 20) inlet.
5. NPS 0.75 (DN 20) ASME B1.20.7 garden-hose thread outlet.
6. Basis of design: NIBCO T-585-80-LF-HC or T-585-80-LF-HC.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install valves to be readily accessible for operation and maintenance, and with ample clearance for turning handles or operators.

B. For valves in inaccessible locations, provide access doors as specified in a related section.

C. Identify valves as specified in Section 22 0500, Common Work Results for Plumbing.

1. Provide tags for all valves except stop valves on individual fixtures or equipment where their function is obvious, or where the fixture or equipment is immediately adjacent. Numbers shall correspond to those shown on the Valve Chart. Attach tags to valve shaft.
2. Provide ceiling identification tags where valves are above an accessible suspended ceiling. Number shall correspond to tag number.

3.2 INSTALLING GATE VALVES AND BALL VALVES

A. Install shutoff valves for water piping where indicated:

1. Sizes NPS 4 (DN 50) and smaller: Ball valves.

3.3 INSTALLING CHECK VALVES

A. Provide center-guided, spring-loaded silent-action type check valves in domestic water lines.

3.4 INSTALLING DRAIN VALVES

A. Provide drain valve at every low point of a water system, and where indicated.

END OF SECTION

SECTION 22 0529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe hangers and supports.

B. Metal framing systems.

C. Insulation protection.

D. Fasteners.

E. Equipment supports

1.2 RELATED SECTIONS

A. Plumbing Piping Insulation: Section 22 0719.

1.3 REFERENCES

A. American Society of Mechanical Engineers

1. ASME B31.9: Building Services Piping.

B. ASTM International

1. ASTM A 36: Standard Specification for Carbon Structural Steel
2. ASTM A 53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A 307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
4. ASTM A 563: Standard Specification for Carbon and Alloy Steel Nuts
5. ASTM A 1064: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
6. ASTM C 533: Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
7. ASTM C 552: Standard Specification for Cellular Glass Thermal Insulation
8. ASTM F 594: Standard Specification for Stainless Steel Nuts
9. ASTM F 3125: Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated

C. American Welding Society

1. AWS-D.1.1: Structural Welding – Steel

D. Metal Framing Manufacturer's Association

1. MFMA-4: Metal Framing Standards Publication
2. MFMA-103: Guidelines for the Use of Metal Framing

E. Manufacturer's Standardization Society

1. MSS SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

1.4 DEFINITIONS

A. Hot Systems: Maximum operating (service) temperatures 120 degrees F (49 degrees C) and above.

B. Ambient Systems: Maximum operating temperatures 60 to 119 degrees F (16 to 48 degrees C).

C. Cold Systems: Maximum operating temperatures 59 degrees F (15 degrees C) and below.

1.5 SUBMITTALS

A. Product data:

1. Provide manufacturer's literature showing compliance with specifications for each type of hanger, framing system, support, fastener and accessory materials.
2. Provide a schedule of piping types and sizes and associated pipe hanger types.
3. Provide a schedule of building attachment types and associated attachment hardware.
4. Provide a schedule of pipe types and sizes and proposed hanger spacing and support rod diameters.
5. Provide manufacturer's recommended pipe hanger spacing criteria for stainless steel piping.
6. For supports used as components of fire protections systems, include certification of listing and label as required in "Quality Assurance" below.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Qualifications of welders: As specified in Section 220500, Common Work Results for Plumbing.

B. Hangers and supports used as components of fire protection systems shall:

1. Comply with NFPA 13.
2. Be listed and labeled by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS:

A. Pipe hangers:

1. Anvil International
2. Carpenter and Paterson, Inc.
3. Cooper Industries
4. National Pipe Hanger Corporation
5. PHD Manufacturing, Inc.
6. PHP Systems/Design
7. Or approved equal.

B. Metal framing systems:

1. Anvil International

2. Cooper Industries
3. Hydra-Zorb
4. PHD Manufacturing, Inc.
5. PHP Systems/Design
6. Unistrut
7. Or approved equal.

C. Pipe covering protection shields:

1. Anvil International
2. Carpenter and Patterson, Inc.
3. Cooper Industries
4. National Pipe Hanger Corporation
5. PHD Manufacturing, Inc.
6. Pipe Shields, Inc.
7. Rilco Manufacturing Co., Inc.
8. Or approved equal.

2.2 PIPE HANGERS AND SUPPORTS

A. General: Comply with requirements of MSS SP-58.

B. Hangers and clamps:

1. Crawl spaces, tunnels, and wet areas: Galvanized steel.
2. Typical interior applications: Galvanized steel or factory painted.
3. Exterior and corrosive applications: Stainless steel.
4. For use with uninsulated copper pipe: Copper plated.

C. Supplemental materials:

1. Threaded rod: Continuously threaded.

   a. Zinc-plated or galvanized carbon steel for indoor applications.
   b. Stainless steel for outdoor and corrosive applications.

2. Nuts and washers: Provide the same material used for threaded rods (ASTM A 563 for steel, ASTM F 594 for stainless steel).
3. Structural carbon-steel shapes: ASTM A 36.
4. Steel pipe: ASTM A 53, Grade B, Type E (electric resistance welded), Schedule 40, black and galvanized steel.

D. Metal framing systems:

1. Description: Shop- or field-fabricated, pipe-support assembly made of channels, nuts, bolts, structural connections, accessories, fittings, and other manufactured components.
2. Standard: Comply with MFMA-4 for factory-fabricated components for field assembly.
3. Channels: Continuous slotted galvanized steel channel with inturned lips, width selected for applicable load criteria.
4. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Metal framing system pipe clamps:

   a. Galvanized steel clamp pipe support with elastic stop nut, and hex head machine screw, and manufactured to connect to metal framing system channels.

b. For insulated piping: Clamp shall have friction tape on inside of clamp surface, manufactured to connect to pipe clamp insulating insert over pipe.
c. For uninsulated piping: Clamp shall have an integral molded thermoplastic elastomer clamping insert on inside of clamp surface, manufactured to connect to uninsulated pipe.

E. Insulation protection:

1. Pipe covering protection shield:

a. Shield: Galvanized steel, meeting the requirements of MSS SP-58 Type 40. Provide with alignment ridges when used in conjunction with pipe hanger.
b. Structural insulation insert: Structural insulation insert to form the insulation for the lower half of, or the entire pipe circumference Provide ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength; or ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength. Insert thickness shall match adjacent piping insulation thickness.

2. Combination insulating insert and insulation protection shield:

a. Insulating insert material for cold and ambient system piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength and vapor barrier. Insert thickness shall match adjacent piping insulation thickness.
b. Insulating insert material for hot system piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength; or ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength. Insert thickness shall match adjacent piping insulation thickness.
c. Insulation protection shield: Galvanized steel.
d. Insulating insert and insulation protection shield shall cover entire circumference of pipe.
e. Insulating insert length: Extend 2 inches minimum (50 mm) beyond insulation protection shield.

3. Pipe covering protection saddle:

a. Saddle: Steel, meeting requirements of MSS SP-58 Type 39
b. Insulation insert: Insulating material located in the space between saddle and pipe.

4. Pipe clamp insulating insert:

a. Insulating insert material: Closed-cell, sponge or expanded rubber, ASTM C 534, Type I for tubing material, with integral supports constructed from non-compressive closed cell material, single piece construction with self-adhesive closure strips. Insert thickness shall match adjacent piping insulation thickness. If insulation thickness is not available, provide maximum available thickness and seal insulation vapor barrier at thickness transition.
b. Insulation protection jacket: Aluminum or stainless steel, bonded to insulation insert.
c. Insulating insert and jacket shall cover entire circumference of pipe.
d. Basis of design: Armacell “Armafix” insulating inserts.

2.3 FASTENERS

A. Mechanical expansion anchors:

1. Self-drilling type expansion shields or machine bolt drop-in anchors for drilled holes. Fasteners to floor slabs shall be vibration and shock resistant. Load applied to fasteners shall not exceed 25 percent of manufacturer's stated load capacity in 3500 psi (24,000 kPa) concrete. Provide zinc-coated anchors for indoor applications and stainless-steel anchors for outdoor applications.
2. Basis of design: ITT Phillips Anchors "Red Head."

B. Fasteners to drywall or cavity wall construction:

1. Toggle bolts with hollow wall drive anchors or nylon anchors as required.
2. Basis of design: ITT Phillips Anchors "Red Head" toggle bolts.

C. Fasteners to wood construction: Lag bolts.

D. Bolts, nuts, and washers: ASTM A 307, or ASTM F 3125 where high strength is required.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide hangers and supports in accordance with schedules at the end of this section, as modified by specifications for each location and type.

B. Comply with MSS SP-58. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

C. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Where required, provide structural steel shapes or metal framing system channels and hardware to transfer load from a hanger location to multiple locations in the structure in order to get support from an appropriate location or to increase the strength of the connection to the structure.

E. Support horizontal piping from above with hangers and threaded rod where possible, unless otherwise indicated.

F. Secure vertical piping at stack bases.

G. Support vertical piping at each floor with riser clamps. Provide additional supports as needed not to exceed scheduled maximum vertical support spacing.

H. Provide hanger sizes to allow for continuous insulation for insulated piping systems.

I. Fabricate wall-mounted and floor-mounted supports using metal framing systems or structural steel where required.

J. Support groups of small piping along a structural wall using a metal framing system secured to the wall.

K. Trim threaded rods with a maximum excess length of 1 inch (25 mm). Provide protective rubber red end caps on the ends of threaded rods exposed and within 8 feet (2.4 meters) of the floor, roof, or grade below.

L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

M. Install lateral bracing with pipe hangers and supports to prevent swaying.

N. Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

P. Coordinate with requirements for hangers that require vibration control. See Section 230548.

Q. Metal framing systems: Provide where required for grouping of parallel runs of piping, and support together on field-assembled strut systems. Comply with MFMA-103 for metal framing system selections and applications.

3.2 BUILDING ATTACHMENTS

A. Attaching to concrete slabs:

1. Obtain approval from the structural engineer and confirm allowable loads prior to supporting pipe from concrete slabs or composite slabs. Where approved, provide mechanical expansion anchors and steel bolts or rods.

B. Attaching to steel decks: Not permitted.

C. Attaching to wood construction:

1. Trusses: Follow roof truss manufacturers' recommendations for attachment locations, loads, spacing, and methods of attachment.
2. Joists: Provide MSS SP-58 Type 34 side beam connectors.

3.3 INSTALLING CAST-IRON PIPING

A. Support piping within 18 inches (460 mm) of each horizontal joint in addition to satisfaction of maximum hanger spacing. Where there are multiple joints in a 4 foot (1.2 m) section, supports may be provided at every other joint.

B. Support piping at changes in direction.

C. Where pipe is supported by hangers more than 18 inches (460 mm) long, provide lateral support at a maximum interval of 40 feet (12.2 m) with sway bracing.

D. Secure closet bends, traps, and similar items against movement in any direction.

3.4 INSTALLING EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor. Provide lateral bracing, to prevent swaying.

B. Coordinate exact size, configuration and location of equipment, foundations, and supports using approved shop drawings of equipment.

3.5 PIPING HANGER AND SUPPORT SCHEDULES

A. Insulated cold and ambient applications: Applications include, but are not limited to, domestic cold water and insulated sanitary and storm water systems.

HANGERS & SUPPORTS FOR INSULATED COLD AND AMBIENT APPLICATIONS		
MSS SP-58 Classification	Description	Piping Applications
Hung from Above		
Types 1 & 40	Clevis hanger & pipe covering protection shield.	NPS 0.5 (DN 15) through NPS 2 (DN 50)
Types 1 & 40 (with structural insulation insert)	Clevis hanger & pipe covering protection shield, with structural insulation insert.	NPS 2.5 (DN 65) and larger
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	NPS 0.5 (DN 15) through NPS 4 (DN 100)
Supported from Below		
Type 37 (with combination insulating insert and insulation protection shield)	Adjustable pipe stanchion saddle with U-bolt and floor flange anchored to floor (with combination insulating insert and insulation protection shield).	All sizes where supported from floor or a concrete support pier.
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	NPS 0.5 (DN 15) through NPS 8 (DN 200)

B. Insulated hot applications: Applications include, but are not limited to domestic hot water and domestic hot water return systems.

HANGERS & SUPPORTS FOR INSULATED HOT APPLICATIONS		
MSS SP-58 Classification	Description	Piping Applications
Hung from Above		
Types 1 & 40	Clevis hanger & pipe covering protection shield.	NPS 0.5 (DN 15) through NPS 2 (DN 50)
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	NPS 0.5 (DN 15) through NPS 4 (DN 100)
Supported from Below		
Type 37 (with combination insulating insert and insulation protection shield)	Adjustable pipe stanchion saddle with U-bolt and floor flange anchored to floor (with combination insulating insert and insulation protection shield).	All sizes where supported from the floor or a concrete support pier. Use only where no significant horizontal pipe movement is anticipated.
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	NPS 0.5 (DN 15) through NPS 6 (DN 150)

C. Uninsulated applications: Applications include, but are not limited to uninsulated storm water, sanitary, vent, compressed air, and laboratory gas systems.

HANGERS & SUPPORTS FOR UNINSULATED APPLICATIONS		
MSS SP-58 Classification	Description	Piping Applications
Hung from Above		
Type 1	Clevis hanger	All sizes
Type 10	Adjustable swivel ring	NPS 0.5 (DN 15) through NPS 4 (DN 100)
N/A	Metal framing system with metal framing system pipe clamps for uninsulated piping.	NPS 0.5 (DN 15) through NPS 4 (DN 100)
Supported from Below		
Type 37	Adjustable pipe stanchion saddle with U-bolt, with floor flange and base anchored to floor.	All sizes where supported from the floor or a concrete support pier.
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	NPS 0.5 (DN 15) through NPS 8 (DN 200)

D. Minimum threaded rod sizes: Provide at least the following minimum rod diameters for single rods supporting a single pipe hanger.

Pipe Size	Minimum Rod Diameter
NPS 2 (DN 50) and below	0.375 inches (10 mm)
NPS 2.5 and NPS 3 (DN 65 and DN 75)	0.5 inches (15 mm)

E. Maximum hanger and support spacing for pressurized piping: Provide additional hangers or supports for concentrated loads such as flanges, valves, expansion compensators, fittings, and other specialties.

1. Horizontal spacing:

Pipe Size	Copper Piping
NPS 0.75 (DN 20) and below	5 feet (1.5 m)

2. Vertical spacing:

Copper Piping
10 feet (3 m)

F. Maximum hanger and support spacing for metal and PVC gravity piping: Provide additional hangers or supports for concentrated loads such as fittings, and other specialties.

1. Horizontal spacing:

<table>
<tr><th>Pipe Size</th><th>Copper DWV Tubing</th><th>Cast-iron (Hub & Spigot)</th><th>Cast-iron (No-hub)</th></tr>
<tr><td>1.5 inches (40 mm)</td><td rowspan="2">8 feet (2.4 m)</td><td>N/A</td><td rowspan="4">5 feet (1.5 m)</td></tr>
<tr><td>2 inches (50 mm)</td><td rowspan="3">5 feet (1.5 m)</td></tr>
<tr><td>3 inches (75 mm)</td><td rowspan="2">10 feet (3 m)</td></tr>
<tr><td>4 inches (100 mm)</td></tr>
<tr><td colspan="4">Cast-iron horizontal support spacing may be increased up to but not in excess of 10 feet (3 m) where 10 foot (3 m) or greater lengths of pipe are used.</td></tr>
</table>

2. Vertical spacing:

Copper DWV Tubing	Cast-iron (Hub & Spigot)	Cast-iron (No-hub)
10 feet (3 m)	15 feet (4.5 m)	15 feet (4.5 m)

END OF SECTION

SECTION 22 0700

PLUMBING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Definitions and general requirements applicable to the insulation systems specified in "Related Sections."

1.2 RELATED SECTIONS

A. Plumbing piping insulation: Section 22 0719.

1.3 REFERENCES

A. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials

B. NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Materials

C. UL 723: Standard for Test for Surface Burning Characteristics of Building Materials

1.4 DEFINITIONS

A. Concealed insulation shall include work:

1. Above ceilings.
2. Where furred in and in pipe chases.

B. Exposed insulation shall include work:

1. In all rooms and areas.
2. In mechanical equipment rooms, penthouses, or other similar utility spaces.
3. In storage rooms.

C. Unconditioned areas: Areas outside of the insulated envelope.

D. Finished spaces: Areas of the building accessible to the public and to building occupants other than service personnel.

1.5 QUALITY ASSURANCE

A. Perform work in strict accordance with the building, fire and safety codes of the state, county or city in which the work is performed.

B. Insulation, including fittings and butt strips, jackets, facings, and accessories such as adhesives, mastics, cements, tapes and cloth, shall have a fire and smoke hazard rating and label as tested by ASTM E84, NFPA 255, and UL 723, not exceeding Flame Spread 25, Fuel Contributed 50, Smoke Developed 50.

C. All insulation and accessories shall be free of asbestos.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation and accessory products in manufacturers' wrapping or cartons, identified on the exterior and bearing labels showing conformance to flame and smoke rating requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to sections listed in “Related Sections.”

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 22 0719

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Plumbing piping insulation for the interior piping systems listed in the minimum insulation thickness schedule at the end of this section.

B. Plumbing piping insulation for the exterior piping systems.

C. Work of this section includes:

1. Insulation for new piping installed under this contract.
2. Patching existing insulation where removed to make connections to existing piping.
3. Patching existing insulation damaged during demolition and construction.

1.2 RELATED SECTIONS

A. Firestopping: Division 07.

B. Painting: Division 09.

C. Definitions and general insulation requirements: Section 22 0700.

D. Pipe hangers and protection shields: Section 22 0529.

1.3 REFERENCES

A. American Society of Testing and Materials

1. Standards for mineral fiber insulation materials

a. ASTM C 449: Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
b. ASTM C 547: Mineral Fiber Pipe Insulation.
c. ASTM C 553: Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
d. ASTM C 1136: Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

2. Standards for flexible elastomeric insulation materials

a. ASTM C 534: Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

3. Standards for all insulation materials

a. ASTM C 450: Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.
b. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials

4. Standards for field applied jackets and accessories

   a. ASTM D 1784: Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

1.4 SUBMITTALS

A. Material list: Each type of insulation and accessory, with manufacturer's name and material name and number. Identify locations for use, thickness of material, type of jacket, vapor barrier, and method of application.

B. Product data: Sufficient to show that the product meets the specified requirements for materials, composition, and performance.

C. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

D. Installer qualifications.

1.5 QUALITY CONTROL SUBMITTALS

A. Manufacturer's instructions: Recommended accessory materials and products; installation instructions.

1.6 QUALITY ASSURANCE

A. Installers shall be mechanics skilled in this trade, employed with a firm that has a minimum of five years of experience installing mechanical insulation.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. The listed manufacturers and particular products are intended to set a standard for materials, composition, and performance. Products of other manufacturers may be proposed as permitted by the provisions of Division 01 and the article "Product Options" in Section 22 0101.

B. Mineral fiber insulation:

1. CertainTeed Corporation.
2. Johns Manville
3. Knauf Fiber Glass GmbH
4. Owens-Corning
5. Or approved equal.

C. Flexible elastomeric insulation:

1. Aeroflex USA
2. Armacell LLC
3. K-Flex USA
4. Rubatex
5. Or approved equal.

D. Coatings, adhesives, and fabrics:

1. Childers
2. Foster
3. Manville Building Materials Group
4. Rock Wool Manufacturing Company
5. Trimac
6. Or approved equal.

2.2 MINERAL FIBER INSULATION MATERIALS

A. Mineral fiber preformed pipe insulation: Glass fibers bonded with a thermosetting resin, ASTM C 547 Type I, with factory-applied ASJ-SSL jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

B. ASJ-SSL jacket:

1. All service jacket with self-sealing lap.
2. White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
3. Complying with ASTM C 1136, Type I.

C. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, pressure sensitive, complying with ASTM C 1136; 3 inch (75 mm) width. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

D. Mineral fiber blanket insulation: Glass fibers bonded with a thermosetting resin, ASTM C 553, Type IV, without facing. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

E. Mineral fiber preformed fitting and valve covers: Glass fibers bonded with a thermosetting resin, made from the same material and density as adjacent pipe insulation, meeting ASTM C 450 requirements for dimensions used in forming insulation to cover valves, elbows, tees, flanges, strainers, and unions. Provide with preformed PVC field-applied jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

F. Mineral fiber insulation adhesive:

1. Solvent free, low VOC, water-based adhesive designed for bonding mineral fiber insulation to steel or aluminum surfaces, and compatible with service temperatures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Basis of design: Foster 85-60 “Quick-Tack”.

G. Mineral fiber insulation vapor barrier mastic:

1. Vapor barrier coating for use over ASJ jackets to give a vapor barrier seal at joints, laps and punctures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Basis of design: Foster 30-65 “Vapor-Fas”.

H. Insulating cement: Mineral fiber cement with a hydraulic-setting binder, conforming to ASTM C 449. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

2.3 FLEXIBLE ELASTOMERIC INSULATION MATERIALS

A. Flexible elastomeric preformed pipe insulation: Closed-cell, sponge- or expanded-rubber, ASTM C 534, Type I for tubular materials. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

B. Flexible elastomeric preformed fitting and valve covers: Closed-cell, sponge- or expanded-rubber, made from the same material and density as adjacent pipe insulation, meeting ASTM C 450 requirements for dimensions used in forming insulation to cover valves, elbows, tees, flanges, strainers, and unions. Provide with preformed PVC field-applied jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

C. Flexible elastomeric insulation adhesive:

1. Water resistant contact cement designed especially suited for bonding two impermeable surfaces and recommended for rubber foam, steel, or aluminum surfaces, and compatible with service temperatures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Basis of design: Foster 85-75 “Drion”.

D. Flexible Elastomeric Tape: Black, closed cell, self-adhering, elastomeric thermal insulation tape for insulating pipes and fittings, 0.125 inch (3 mm) thick, 2 inches (50 mm) wide, ASTM C 534, Type I — Grade 1. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

E. Flexible elastomeric insulation vapor barrier coating:

1. Water-based latex enamel coating for use over flexible elastomeric insulation, providing a moisture-resistant protective finish suitable for both indoor and outdoor applications. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Basis of design: Armacell “WB Armaflex” latex enamel.

2.4 FASTENERS

A. Aluminum bands: ASTM B 209, 0.75 inches (19 mm) wide and 0.020 inches (0.4 mm) thick.

2.5 FIELD-APPLIED JACKETS

A. Polyvinyl chloride (PVC) jacket:

1. Jacket material: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Color: White
3. Adhesive: As recommended by jacket material manufacturer. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
4. Fitting covers: Manufacturer’s factory-fabricated fitting covers made from the same material, finish, and thickness as the jacket, suitable to the size of fittings and thickness of insulation. Provide factory fabricated fitting covers for elbows, tees, flanges, unions, reducers, end caps, valves, and other fittings. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

5. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket and fitting covers with acrylic adhesive; suitable for indoor and outdoor applications, 2 inch (50 mm) width, 6 mil (0.15 mm) thickness. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Fabric-reinforcing mesh:

1. Woven Glass-Fiber Fabric: Approximately 2 ounces per square yard (68 grams per square meter) for covering pipe and pipe fittings.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide interior piping insulation in accordance with the Minimum Insulation Thickness Schedule for Interior Applications at the end of this section, as modified by specifications for each location and type.

B. Provide field applied jackets in accordance with the Field-Applied Jacket Schedule at the end of this section, as modified by specifications for each location and type.

C. Provide mineral fiber insulation unless otherwise indicated.

D. Apply insulation in a neat and workmanlike manner and in accordance with manufacturer's printed instructions.

E. Maintain a continuous vapor barrier on systems that convey fluid at below-ambient temperatures, including the following applications:

1. Domestic cold water piping
2. Air-conditioning condensate piping

F. Where a continuous vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

G. Installation at pipe hangers:

1. Insulation shall be continuous through hangers for all piping systems.
2. Install pipe covering protection shields with thickness of structural insulation inserts equal, under load, to that of adjoining insulation.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
5. Shields and structural insulation inserts are specified in Section 22 0529, Hangers and Supports for Plumbing Piping and Equipment.

H. Where insulated piping systems pass through sleeves or openings in partitions and floors, the insulation shall be continuous through the sleeves and openings. See Firestopping specifications for coordinating insulation and firestopping.

I. Do not insulate chrome-plated piping connections to plumbing fixtures, except wheelchair-accessible lavatories shall be insulated with special insulation and finish assemblies specified in Section 22 4200.

J. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

K. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

L. Install insulation with longitudinal seams at top and bottom of horizontal runs.

M. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

N. Install insulation with least number of joints practical.

O. Finish installation with systems at operating conditions. Repair separations and cracking caused by thermal movement.

3.2 INSTALLING MINERAL FIBER INSULATION

A. Install insulation with factory-applied jackets as follows:

1. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive.
2. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
3. Cover circumferential joints and longitudinal seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
4. Where a continuous vapor barrier is indicated, apply vapor-barrier mastic on longitudinal seams and circumferential joints and at ends adjacent to pipe flanges and fittings.
5. Repair damaged insulation jackets by applying same jacket material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere and seal patches.

B. Installation on fittings, valves, strainers, flanges, and unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate using mineral fiber preformed fitting and valve covers whenever possible. Install preformed fittings with adhesive.
3. Where mineral fiber preformed fitting and valve covers are not available, insulate using mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining pieces and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation. Coat with mastic. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
4. Valves: Insulate up to and including the bonnets, stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
5. Strainers: Insulate so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover.

6. Flanges and unions: Install preformed pipe insulation to outer diameter of flange or union. Make width of insulation section same as overall width of union or flange and bolts, plus twice the thickness of pipe insulation. Fill voids between inner circumference of flange or union insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
7. Install fitted PVC cover. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

C. Installation of floor drain bodies that receive air-conditioning condensate and roof drain bodies:

1. Provide mineral fiber blanket insulation, 1 inch thick minimum, adhered to drain body.
2. Coat with mastic.
3. Finish with two coats of lagging finish coating with glass cloth and tape embedded between coats.

3.3 INSTALLING FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and circumferential joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Installation on fittings and flanges:

1. Install insulation over fittings and flanges with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate using flexible elastomeric preformed fitting covers whenever possible. Install preformed fittings with adhesive. Tape and seal with vapor barrier coating.
3. Where flexible elastomeric preformed fitting covers are not available, insulate using mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining pieces and bonded with adhesive. Tape and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Seal with vapor barrier coating.
4. Flanges: Install pre-formed pipe insulation to outer diameter of pipe flange. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation. Secure insulation to flanges and tape and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Seal with vapor barrier coating.
5. Install fitted PVC cover. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

3.4 INSTALLING FIELD-APPLIED JACKETS

A. Installing PVC jacket:

1. Provide jacket tight to insulation.
2. Provide with 1-inch (25-mm) overlap at longitudinal seams and circumferential joints.
3. For horizontal applications, install with longitudinal seams along top and bottom of pipes.
4. Seal with manufacturer’s recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under the jacket lap and another finish bead along each seam and joint edge.
5. Seams and joints shall completely prevent the entrance of water.

3.5 INSTALLING EXTERIOR PIPING INSULATION

A. Locations: Provide insulation for piping systems exterior of building heated space, including but not limited to attics.

B. Insulation: Material as specified for interior systems unless otherwise indicated, minimum 2 inches (50 mm) thick, or 0.5 inches (13 mm) thicker than scheduled for interior insulation on similar system, whichever is greater.

C. Start insulation 30 inches (760 mm) below grade, 30 inches (760 mm) below roof or 30 inches (760 mm) inside exterior wall. Secure insulation with aluminum bands on 12-inch (305-mm) centers.

3.6 SCHEDULES

A. Minimum insulation thickness schedule for interior applications:

MINIMUM INSULATION THICKNESS SCHEDULE FOR INTERIOR APPLICATIONS (3)		
Application	Fluid Temperature Range	All Pipe Sizes
Domestic Hot Water Piping (2)	105F to 140F (40C to 60C)	1.5-inch (38 mm)
Domestic Cold Water Piping (1)	--	1-inch (25 mm)
Air-conditioning Condensate Piping, Gravity and Pumped (1)	--	1-inch (25 mm)
(1) - Contractor's Option within partitions only: 0.5-inch (13mm) flexible elastomeric insulation. (2) - Contractor's Option within partitions only: 1-inch (25 mm) flexible elastomeric insulation for piping NPS 1.25 (DN 32) and smaller. (3) - See additional specified thickness requirements for exterior applications.		

B. Field-applied jacket schedule:

FIELD-APPLIED JACKET SCHEDULE	
Application	PVC Jacket
Exterior applications	X
Pipe insulation exposed in mechanical rooms, penthouses, and other service areas not accessible to the public.	X

END OF SECTION

SECTION 22 1116

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Domestic cold water piping.

B. Domestic hot water piping.

1.2 RELATED SECTIONS

A. Piping installation and testing: Section 22 0500.

B. Trenching: Section 22 0501.

1.3 REFERENCES

A. American Society of Mechanical Engineers

1. ASME B 16.18: Cast Copper Alloy Solder Joint Pressure Fittings
2. ASME B 16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
3. ASME B16.24: Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500

B. American Society of Mechanical Engineers/American National Standards Institute

1. ASME/ANSI B16.5: Pipe flanges and flanged fittings

C. American Society of Testing and Materials

1. ASTM B 75: Standard Specification for Seamless Copper Tube
2. ASTM B 88: Standard Specification for Seamless Copper Water Tube
3. ASTM B 584: Standard Specification for Copper Alloy Sand Castings for General Applications

D. National Sanitation Foundation/American National Standards Institute

1. NSF/ANSI 61: Drinking Water System Components – Health Effects
2. NSF/ANSI 372: Drinking Water System Components – Lead Content

1.4 DEFINITIONS

A. Domestic water system: Potable water system for general human use, including hot and cold water supply and return.

1.5 SUBMITTALS

A. Product data: Each type of pipe and fitting included in the project.

1. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

B. Certifications: Disinfection test report

C. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

1.6 QUALITY ASSURANCE

A. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61, NSF/ANSI 372 with requirements for "lead-free" plumbing as defined by state laws and U.S. Safe Drinking Act.

B. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements.

C. Product specifications herein may not necessarily meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

D. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label directly on the pipe, indicating compliance.

PART 2 - PRODUCTS

2.1 AVAILABLE SUPPLIERS

A. Disinfection of domestic water system:

1. ARC Water Treatment Company, Inc.
2. Ecolab
3. Water Chemical Services, Inc.
4. Olin Water Services
5. Or approved equal.

2.2 ABOVE GROUND PIPE

A. Copper: ASTM B 88, Type L hard drawn.

2.3 ABOVE GROUND FITTINGS

A. Cast or wrought fittings for copper pipe:

1. General: Solder joint, cast brass, ASME B16.18; or wrought copper, ASME B16.22.
2. Flanges: Bronze, solder type, ASME B16.24, Class 150.

B. Dielectric nipples:

1. Standard: IAPMO PS 66.
2. Electroplated steel nipple complying with ASTM F 1545.
3. Pressure Rating and Temperature: 300 psig (2,070 kPa) at 225 degrees F (107 degrees C).
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

2.4 UNDERGROUND PIPE AND FITTINGS

A. Copper Type K pipe and fittings:

1. Pipe: Copper tubing, ASTM B 88, Type K, hard drawn, plain end.

2. Fittings: Solder joint, cast brass, ASME B16.18, or wrought copper, ASME B16.22.

B. Abutments: Concrete, not less than three pipe diameters wide and two pipe diameters high.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install domestic water piping as shown on the drawings and in accordance with the provisions of Section 22 0500, Common Work Results for Plumbing.

B. Install piping in accordance with the Schedule of Pipe Systems, Sizes, and Materials at the end of this section.

C. Provide drain valves at low points of domestic water system for drainage.

3.2 INSTALLING DIELECTRIC ISOLATION

A. Provide dielectric flanges with isolation sleeves for bolts and isolation washers on each side of flanged connection at flanged points of connection between ferrous piping and copper piping.

B. Provide dielectric nipples at connections between existing ferrous piping and copper piping.

3.3 INSTALLING UNDERGROUND PIPE AND FITTINGS

A. General installation:

1. Provide electrical continuity in water service pipe joints. Provide conductivity strips, wedges, or other approved methods where required.
2. Provide a shutoff valve at the point of water service entrance.

B. Ductile iron pipe installation:

1. Prevent injury to the pipe coating.
2. Install abutments at each change in pipe direction, resting on and transmitting thrust to undisturbed earth.
3. Anchor pipe at the point of building entrance with clamps or special fittings.

3.4 TESTING OF DOMESTIC WATER SYSTEM

A. When domestic water piping is completed, and before strainer baskets are installed, pressure test at the pressure shown in Piping Test Table in Section 22 0500.

3.5 CLEANING OF DOMESTIC WATER SYSTEM

A. Flushing of building systems:

1. Flush domestic cold water, domestic hot water, recirculated hot water, and tempered water piping before using. Unless prescribed otherwise by the county or state health department, the method of flushing shall be as follows:
2. Do not allow flushing water for piping to travel through plumbing equipment. Isolate equipment by closing isolation valves and opening bypass valves or by leaving piping disconnected from equipment.
3. Flush new piping segments as the work progresses.

4. Provide temporary domestic water and drain piping as needed. Remove when flushing is complete.
5. Drain water from the segment low point to a safe location and replace water at the same rate.
6. Continue until drain water is free from sediment, scale, rust and other foreign substances.
7. Flush every new branch of piping, for a minimum of 15 minutes after running clean.
8. Install strainer baskets.
9. Disinfect piping as described below.

B. Disinfection of building systems:

1. Disinfect domestic cold water, domestic hot water, recirculated hot water, and tempered water piping before using. Unless prescribed otherwise by the county or state health department, the method of flushing shall be as follows:
2. Provide temporary domestic water and drain piping as needed. Remove when disinfection is complete.
3. Through a NPS 0.75 (DN 20) hose connection in the main downstream of the backflow preventer, pump in sodium hypochlorite to produce a free available chlorine residual of not less than 200 ppm. Provide plumbing connections and power for pumping chlorine into the system.
4. Fill all piping systems with chlorinated water.
5. Proceed downstream from the point of chlorine application, opening each water source for each faucet and outlet until chlorine is detected at a concentration of 200 ppm. Close each water source for each faucet and outlet when chlorine is evident at the required concentration.
6. Energize domestic water recirculation systems or provide another means of filling domestic hot water return piping with chlorinated water at a concentration of 200 ppm.
7. Retain this water in the system for at least three hours, but no more than 3.5 hours.
8. At the end of the retention period, verify that no less than 100 ppm of chlorine are present at the most remote end of the system.
9. Open all faucets and outlets and flush all piping until the chlorine residual in the water is less than 1 ppm.
10. Obtain a representative water sample from the system for analysis by a recognized bacteriological testing laboratory.
11. If the sample tested for coliform organisms is negative, the testing organization shall submit a letter and laboratory report to the Contractor, certifying successful completion of the disinfection. Submit the letter and report.
12. If any samples tested indicate the presence of coliform organisms, repeat the entire disinfection procedure.

3.6 SCHEDULE OF PIPE SYSTEMS, SIZES AND MATERIALS

A. Pipe schedules apply to domestic cold water, domestic hot water, domestic hot water return, and domestic temper water piping.

B. Above ground piping:

	Copper Type L cast or wrought fittings
NPS 2.5 (DN 65) and smaller	X

C. Above ground water service entrance or combination fire and water service entrance piping:

	Copper Type L cast or wrought fittings
NPS 2.5 (DN 65) and smaller	X

D. Below ground piping:

	Copper Type K cast or wrought fittings
NPS 2.5 (DN 65) and smaller	X

END OF SECTION

SECTION 22 1119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Backflow preventers.

B. Strainers.

C. Water hammer arresters (shock absorbers).

D. Thermostatic water temperature controllers.

1.2 RELATED SECTIONS

A. Domestic water piping: Section 22 1116.

B. Insulation: Section 22 0719.

1.3 SUBMITTALS

A. Product data: Each specialty device or equipment, with installation instructions.

B. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

1.4 QUALITY ASSURANCE

A. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61, NSF/ANSI 372 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.

B. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements.

C. Minimum working pressure for domestic water specialties: 125 psig (860 kPa) unless otherwise indicated.

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTERS

A. Available Manufacturers

1. Ames
2. Febco
3. Watts Industries
4. Zurn-Wilkins
5. Or approved equal.

2.2 STRAINERS

A. Available Manufacturers

1. Keckley
2. Mueller Steam Specialty
3. Spirax Sarco Inc.
4. Tate Andale, Inc. “Guardian”
5. Watts Industries, Inc.
6. Or approved equal.

B. Minimum pressure rating: 125 psi (860 kPa)

C. Y-type strainers: Include with plugged blow-down connections and stainless steel strainers with maximum 0.045-inch (1.2-mm) perforations.

1. Pipe sizes NPS 2.0 (DN 50) and smaller: Brass body, threaded ends.

a. Basis of design: Watts Series LF777SI.

2.3 WATER HAMMER ARRESTORS

A. Available Manufacturers:

1. MIFAB, Inc.
2. Josam Company
3. Jay R. Smith Manufacturing Company
4. Wade
5. Watts Drainage
6. Zurn Plumbing Products
7. Or approved equal.

B. ASSE 1010 or PDI-WH 201 certified:

1. Construction: Metal bellows or copper tube with piston.
2. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.4 THERMOSTATIC WATER TEMPERATURE CONTROLLERS

A. Available manufacturers:

1. Powers Regulator Company
2. Lawler Manufacturing Company, Inc.
3. Leonard Valve Company
4. Symmons Industries, Inc.
5. Or approved equal.

B. General:

1. Provide units of sizes, capacities, and piping arrangements as indicated on the drawings.
2. Construction: Copper or bronze body with corrosion-resistant interior components.
3. Minimum pressure rating: 125 psi.
4. Paraffin-based thermal actuation technology to sense and adjust outlet temperature with vandal-resistant locking mechanism to secure temperature setting.

5. 10 psi maximum water pressure drop at design flow rate.
6. Set units for the discharge temperatures specified below unless otherwise indicated on the drawings.

C. Lavatory thermostatic tempering valves.

1. ASSE 1070 listed.
2. Integral checks and screen strainers at inlets and union end connections.
3. Discharge temperature adjustment range: 80 degrees F - 120 degrees F. Set at 110 degrees F.
4. Capacity of valve: 12.0 gpm at 45 psi differential.
5. Perform to a minimum flow of 0.5 gpm.
6. Basis of design: Powers Regulator Company “Hydroguard” Series LFLM 495.

PART 3 - EXECUTION

3.1 INSTALLING BACKFLOW PREVENTERS

A. Install backflow preventers in the building water supply, each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

B. Mount 48-inches (120 mm) above the floor unless otherwise noted on the drawings. Strainers may be deleted with backflow preventers at the water service entrance if a strainer is included at the water entrance valving assembly.

C. Install drains for backflow preventers with atmospheric-vent drain connections with air-gap fitting, and pipe as indicated on the drawings.

D. Do not install bypass piping around backflow preventers.

3.2 INSTALLING STRAINERS

A. Install Y-pattern strainers where indicated on the drawings.

3.3 INSTALLING WATER HAMMER ARRESTORS

A. Size and locate water hammer arrestors as recommended by the Plumbing and Drainage Institute Standard PDI-WH 201 or ASSE 1010.

1. Install water hammer arrestors in each branch domestic water pipe (hot and cold) which feeds either a battery of fixtures or a single fixture.
2. Install water hammer arrestors upstream of quick-closure valves.
3. Install water hammer arrestor in accessible locations.

3.4 INSTALLING WATER TEMPERATURE CONTROLLERS

A. Install and connect controllers as shown on the drawings and in compliance with the manufacturer’s recommendations.

B. Adjust controllers to specified supply temperatures or as indicated on the drawings.

END OF SECTION

SECTION 22 1316

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sanitary piping

1.2 RELATED SECTIONS

A. Piping installation and testing: Section 22 0500.

B. Sanitary waste piping specialties: Section 22 1319.

1.3 REFERENCES

A. Cast iron piping standards

1. ASTM A 74: Standard Specification for Cast Iron Soil Pipe and Fittings
2. ASTM C 564: Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
3. ASTM C1540: Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings
4. CISPI 301: Standard Specification for hubless cast iron soil pipe and fittings for sanitary and storm drain, waste, and vent piping applications

B. Copper (DWV) piping standards

1. ANSI/ASME B16.29: Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fitting: DWV
2. ASME/ANSI B16.23: Cast Copper Alloy Solder Joint Drainage Fittings: DWV
3. ASTM B 306: Standard Specification for Copper Drainage Tube (DWV)

1.4 SUBMITTALS

A. Product data: Each specified material and product.

B. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

1.5 QUALITY ASSURANCE

A. Cast iron pipe and fittings shall be marked with the collective trademarks of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.

B. Prior to any new piping installation, the Contractor shall verify the inverts of all piping to which new work is to be attached. The Contractor shall demonstrate to the satisfaction of the DGS Project Manager, that the connections to existing sanitary pipes meet the intent of the contract.

C. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label, directly on the pipe, indicating compliance.

D. The Contractor shall rod, clean, and flush existing sanitary piping as necessary to maintain gravity flow.

E. Prior to beginning the addition construction or work in any phase, the Contractor shall inspect via video camera and digitally record, for turnover to the Government, all existing underground sanitary pipes sized 3 inches in diameter or above. The Contractor shall notify the DGS Project Manager immediately of any clogged, broken, or collapsed piping which is to remain or any conditions preventing free gravity flow.

F. Upon completion of the addition or each phase, the Contractor shall re-inspect via video camera and digitally record, for turnover to the Government, all existing underground sanitary pipes sized 3 inches in diameter or above.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Install each type of pipe and fittings in locations required or permitted in Part 3, including the Pipe Installation Schedule at the end of the section.

B. Cast-iron hub and spigot pipe and fittings:

1. Pipe: ASTM A 74 service class
2. Neoprene gaskets joints:

a. Lifetime ASTM C 564 neoprene gasket joints
b. Basis of design: Fernco “Multi-Tite”, Tyler Pipe “Ty-seal”, or Mission Rubber “Mission-Tite.”

C. Cast-iron no-hub pipe and fittings:

1. Pipe and fittings: Cast Iron Soil Pipe Institute Standard 301.
2. Joints: Use one of the no-hub coupling options below

a. Option 1 (for use in any location):

(1) ASTM C 564 neoprene gaskets and two-piece cast-iron housing clamps and stainless-steel bolts and nuts.
(2) Basis of design: Products of MG Piping Products Company.

b. Option 2 (for use in any location):

(1) Corrugated 304 stainless-steel shields with four or six clamps and holding bolts conforming to ASTM C 1540 and rubber gasket sealing sleeves conforming to ASTM C 564
(2) Basis of design: Husky “Series 4000” coupling or Mission "Heavy Weight Series CHW" coupling.

c. Option 3 (for use only where readily accessible, concealed from view, and in buildings that are 40 feet (12 meters) or less in height):

(1) ASTM C 564 neoprene gaskets and 24-gauge Type 304 stainless-steel housing, two stainless-steel bolted clamps.

3. Pipe and fitting restraints:

a. Provide for piping NPS 5 (DN 125) and larger

b. Factory fabricated pipe and fitting restraint assemblies rated to prevent pipe separation under fluid thrust forces up to 50 feet of head in conformance with CISPI 301.
c. Basis of design: Holdrite No. 117 No-Hub Pipe and Fitting Restraint.

D. Copper tube (DWV) pipe and fittings:

1. Pipe: copper tubing Type DWV, ASTM B 306
2. Fittings: Wrought copper drainage fittings and soldered joints conforming to ASME/ANSI B16.29 or cast-brass fittings conforming to ASME/ANSI B16.23.

PART 3 - EXECUTION

3.1 PREPARATION

A. Connect piping as shown on the drawings. Check elevations of connection points before installing new work.

3.2 INSTALLATION, GENERAL

A. Use suitable tools and appliances for the safe and convenient handling and laying of pipe. Examine each section of pipe for defects. Do not lay any piece that is known to be defective. If any defective piece should be discovered after having been laid, remove and replace it at no change to the contract price.

B. Install piping in accordance with the Pipe Installation Schedule at the end of this section, as indicated on the drawings, and in accordance with Section 22 0500, Common Work Results for Plumbing. Materials and work shall conform to local plumbing codes and health department regulations.

C. Thoroughly clean all pipe and fittings before installing them, and keep them clean until the acceptance of the completed work. Cap or plug ends of lines to prevent debris from entering during construction.

D. Make changes in direction of sanitary piping with approved sanitary fittings, Y branches, 1/8 or 1/16 bends.

E. In soil, waste, and vent stacks where branches occur that are smaller than stacks, provide properly sized reducing fittings.

F. Install all sanitary piping at a 2 percent minimum downward slope in the direction of flow unless otherwise indicated.

G. Install vent piping at a 1 percent slope down toward vertical fixture vent or toward vent stack.

3.3 INSTALLING CAST-IRON PIPING

A. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings." Install restraint assemblies at pipe couplings and fittings for piping NPS 5 (DN 125) and larger.

3.4 INSTALLING COPPER PIPING

A. Install aboveground copper tubing according to Copper Development Association, Inc. (CDA) "Copper Tube Handbook."

3.5 CONNECTING TO EXISTING PIPING

A. Clean the inside of existing piping at connections to new piping using a water blasting device.

B. Blasting device: Flexible high pressure hose with self-propelling nozzle which blasts to front, sides, and rear (propulsion).

C. Operation: Blasting device is operated with water at 15,000 psi (10^7 kPa). The piping system being cleaned is not pressurized.

D. Clean from the connection point to at least 5 feet (1.5 m) outside the exterior building wall.

3.6 SCHEDULES

A. Sanitary pipe installation schedule.

SANITARY PIPE INSTALLATION SCHEDULE Contractor has option where more than one x appears on a line			
MATERIAL TYPE			
Application	Cast-iron hub and spigot	Cast-iron no-hub	Copper tube (DWV)
Sanitary, exterior or below slab on earth	X		
Sanitary, concealed within walls, partitions, or ceiling space		X	X
Sanitary, interior exposed		X	X
All information in this schedule is subject to local plumbing code and health department requirements.			

END OF SECTION

SECTION 22 1319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cleanouts.

B. Flashing material.

1.2 RELATED SECTIONS

A. Piping: Section 22 1316.

1.3 SUBMITTALS

A. Product data: Each specialty device or equipment, with installation instructions.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. General: Model numbers are provided in the articles below to set a standard for materials, quality of construction, options and details, and performance. Provide named products, or equal products by the available manufacturers listed.

B. Cleanouts:

1. Josam Company
2. Jay R. Smith Manufacturing Company
3. MIFAB, Inc.
4. Wade
5. Watts Drainage
6. Zurn Plumbing Products
7. Or approved equal.

2.2 FLEXIBLE FLASHING

A. Polyvinyl chloride sheet, flexible, waterproof, unreinforced, 40 mil minimum thickness, intended for use as a drain flashing.

2.3 CLEANOUTS

A. Cleanouts: Those installed in slab on grade and in slab above crawl spaces do not require membrane flashing device. All others shall have flashing devices.

B. In sanitary lines:

1. Concealed piping:

a. Coated cast-iron cleanout tee with bronze cleanout plug and polished bronze cover.
b. Basis of design: Zurn ZB-1446.

C. In underfloor sanitary lines: (See Floor Finish Schedule) All units complete with adjustable floor cleanout, coated cast-iron body, and bronze threaded plug.

1. In exposed areas with plain or painted concrete floors: Polished nickel bronze light-duty top.

a. Basis of design: Zurn ZN-1400.

2. In resilient tile floors: Polished nickel bronze light-duty square top recessed for 1/8-inch tile.

a. Basis of design: Zurn ZN-1400-TX.

3. In ceramic tile floors: Polished nickel bronze light-duty square top.

a. Basis of design: Zurn ZN-1400-T.

4. In terrazzo floors: Corrosion resistant ductile-iron cover with severe and heavy-duty service.

a. Basis of design: Zurn Z-1400-DC.

PART 3 - EXECUTION

3.1 INSTALLING CLEANOUTS

A. Install cleanouts at base of each vertical, soil, waste, and vent stack, in the vertical piping.

B. Cleanouts shall be the same size as the pipe into which they are installed, except no cleanout shall be larger than NPS 4 (DN 100).

C. Install cleanouts in horizontal piping where indicated on drawings. Where cleanouts occur directly below a floor, the cleanout shall terminate with top flush with floor. Provide for the floor finish to be installed on the cleanout cover, and separated from surrounding material. Install carpet markers after carpet installation is completed. Install ceramic tile and terrazzo per manufacturer's instructions.

END OF SECTION

SECTION 22 1413

STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Air-conditioning condensate drain.

1.2 RELATED SECTIONS

A. Piping installation and testing: Section 22 0500.

1.3 REFERENCES

A. Copper Type L and M piping standards

1. ASME/ANSI B 16.18: Cast Copper Alloy Solder Joint Pressure Fittings
2. ASME/ANSI B 16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
3. ASTM B 88: Standard Specification for Seamless Copper Water Tube

B. PVC (DWV) piping standards

1. ASTM D 1785: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
2. ASTM D 2321: Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
3. ASTM D 2564: Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
4. ASTM D 2665: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

1.4 SUBMITTALS

A. Product data: Each specified material and product.

B. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

1.5 QUALITY ASSURANCE

A. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label, directly on the pipe, indicating compliance.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Install each type of pipe and fittings in locations required or permitted in Part 3, including the Pipe Installation Schedule at the end of the section.

B. Copper Type L and M pipe and fittings:

1. Pipe: ASTM B 88, Type L or M, hard drawn.

2. Fittings: Solder joint, cast brass, ASME B16.18; or wrought copper, ASME B16.22.

C. PVC (DWV) pipe and fittings:

1. Pipe: PVC, Schedule 40, ASTM D 1785.
2. Fittings: PVC, DWV, ASTM D 2665.
3. Solvent cement: PVC, ASTM D 2564.

PART 3 - EXECUTION

3.1 PREPARATION

A. Connect piping as shown on the drawings. Check elevations of connection points before installing new work.

3.2 INSTALLATION, GENERAL

A. Use suitable tools and appliances for the safe and convenient handling and laying of pipe. Examine each section of pipe for defects. Do not lay any piece that is known to be defective. If any defective piece should be discovered after having been laid, remove and replace it at no change to the contract price.

B. Install piping in accordance with the Pipe Installation Schedule at the end of this section, as indicated on the drawings, and in accordance with Section 22 0500, Common Work Results for Plumbing. Materials and work shall conform to local plumbing codes and health department regulations.

C. Thoroughly clean all pipe and fittings before installing them, and keep them clean until the acceptance of the completed work. Cap or plug ends of lines to prevent debris from entering during construction.

D. Make changes in direction of storm water piping with approved sanitary fittings, Y branches, 1/8 or 1/16 bends.

E. Install all storm water piping at a 2 percent minimum downward slope in the direction of flow unless otherwise indicated.

F. Seal air-conditioning condensate drain where it passes through outside wall and provide splash block if required.

3.3 INSTALLING COPPER PIPING

A. Install aboveground copper tubing according to Copper Development Association, Inc. (CDA) "Copper Tube Handbook."

3.4 INSTALLING PVC (DWV) PIPING

A. Install aboveground PVC piping according to ASTM D 2665.

B. Install underground PVC piping according to ASTM D 2321.

C. Provide listed plastic pipe penetration protection at penetrations of fire-rated floors and assemblies.

D. PVC piping is not permitted in ceiling plenums or shafts used to convey HVAC system air.

3.5 INSTALLING AIR CONDITIONING CONDENSATE PIPING

A. Above ground piping: Brace piping at changes in direction.

3.6 SCHEDULES

A. Storm water pipe installation schedule.

STORM WATER PIPE INSTALLATION SCHEDULE		
MATERIAL TYPE		
Application	Copper Type L or M	PVC (DWV)
Air conditioning condensate, interior NPS 1 (DN 25) and smaller	X	
Air conditioning condensate, exterior		X
All information in this schedule is subject to local plumbing code and health department requirements.		

END OF SECTION

SECTION 22 3300

ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Commercial, storage electric water heaters.

1.2 RELATED SECTIONS

A. Equipment foundation: Section 22 0529.

1.3 SUBMITTALS

A. Product data: Each type and size water heater. Include nominal capacity and pressure rating; shipping, installed, and operating weights; and specialties and accessories furnished for this project. Indicate dimensions, wall thicknesses, required clearances, method of assembly, and piping connections.

1. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

B. Shop drawings: Diagram power, signal, and control wiring.

C. Include product data which verifies compliance with the energy performance requirements of ASHRAE 90.1, or provide certified performance ratings by a qualified independent testing agency.

D. Include operation and maintenance instructions and parts list for each type of water heater.

1.4 QUALITY ASSURANCE

A. Each water heater shall meet the energy performance requirements of ASHRAE 90.1.

B. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASME compliance: Fabricate and label water heater, hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code.

D. UL label and local testing (if required): As specified in Section 22 0500, Common Work Results for Plumbing.

E. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with the NSF/ANSI 61, NSF/ANSI 372 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.

F. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements.

G. Product specifications herein may not necessarily meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Scheduled units are the basis for design of the Project. If units by other manufacturers should be proposed, verify that they meet requirements specified in Division 01 and the article "Product Options" in Section 22 0101, and submit shop drawings as specified in the "Submittals" article above.

B. Electric water heaters:

1. A.O. Smith Corporation
2. Hubbell
3. PVI
4. State Industries, Inc.
5. Or approved equal.

2.2 ELECTRIC TANK WATER HEATER

A. Model, capacity, and electrical characteristics scheduled on the drawings, rated at maximum working pressure of 150 psi (1035 kPa), listed and labeled in accordance with UL 174.

B. Tank: Internal surfaces exposed to water lines with glass. Insulation: Foam. Jacket: Steel, containing full-size control compartments for service and maintenance through front. Finish: Manufacturer's standard baked enamel.

C. Equipment:

1. Inlet carries entering cold water to bottom of tank.
2. Tank-mounted, replaceable, magnesium anode.
3. Combination thermostat and high-temperature-limit control.
4. 0.75-inch top opening for field installation of relief valve.
5. Relief valve: ASME-rated temperature and pressure relief valve for field installation. Include relieving capacity at least as great as heat input, and pressure setting less than heater working pressure rating.
6. Drain valve: Non-metal ball valve with positive on-off and full flow capacity, mounted on front of tank.

B. Basis of design: A.O. Smith EJC.

2.3 WATER HEATER SPECIALTIES

A. Vacuum relief valve: Designed for vacuum relief in hot water tanks and heaters, ANSI Z21.22, brass body, high-heat-resisting disk.

1. Working pressure: At least 200 psi.
2. Temperature rating: At least 250 degrees F.
3. Operation: Closes under pressure and opens on vacuum of not more than 0.5 inches of mercury.
4. Basis of design: Watts No. LFN36.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide each heater with ASME rated temperature and pressure relief valves.

3.2 INSTALLING DOMESTIC WATER HEATER

A. Set heater on an equipment foundation (housekeeping pad). Plug all unused tappings.

B. Install level and plumb, according to drawings and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so that controls and devices are accessible.

C. Anchor water heaters to substrate.

D. Install and connect water heaters in accordance with applicable code for electric water heaters.

E. Install temperature and pressure relief valves. Extend relief valve outlet with water piping in continuous downward pitch and discharge to closest floor drain.

F. Install vacuum relief valves.

3.3 MANUFACTURER'S FIELD SERVICE

A. Provide manufacturer's startup and adjustment for water heaters.

3.4 OPERATING INSTRUCTIONS

A. As specified in Section 22 0500, provide operating instructions.

END OF SECTION

SECTION 22 4200

INSTITUTIONAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Institutional grade plumbing fixtures and trim, faucets, other fittings, and related components.

1.2 RELATED SECTIONS

A. Piping:

1. Domestic water piping: Section 22 1116.
2. Sanitary waste and vent piping: Section 22 1316.
3. Storm drainage piping: Section 22 1413.

B. Valves: Section 22 0523.

C. Plumbing specialties:

1. Domestic water piping specialties: Section 22 1119.
2. Sanitary waste piping specialties: Section 22 1319.

1.3 SUBMITTALS

A. Product data: For each type of plumbing fixture specified, including fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details, dimensions of components, and finishes.

1. Certification that products comply with NSF/ANSI 61 and NSF/ANSI 372.

C. Shop drawings:

1. Provide a schedule of fixtures and trim proposed for use, in the same order as the lists in the specification.
2. Wiring diagrams for field-installed wiring of electrically operated units.

1.4 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 22 0500, Common Work Results for Plumbing.

B. Fixtures shall be of the best commercial grade of their respective kinds, free from flaws, cracks, craze or other imperfections, complete with fittings and connections. Residential grade fixtures shall not be acceptable. Fixtures manufactured by acceptable manufacturers are acceptable provided they are equal and similar to those specified.

C. Fixtures and trim where required to be accessible to disabled people, identified in this section as “for disabled,” shall comply with requirements of the Americans with Disabilities Act (ADA) Regulations, as applicable to each type of fixture or its use.

1. Trim must meet requirements for force of operation at water pressures up to 80 psi.

2. Water closet models must be selected and installed so that flush controls will be on the fixture's open side.

D. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61, NSF/ANSI 372 with requirements for "lead-free" plumbing as defined by state laws and U.S. Safe Drinking Act.

E. Acceptance product marking: NSF®-61 and NSF®-372 (or NSF®-61-G) or other accepted certifier marks demonstrating third party certification with these requirements.

F. Product specifications herein may not necessarily meet all regulations for the limits on lead content. The Contractors and product suppliers shall be responsible to provide products that comply with NSF/ANSI 61 and NSF/ANSI 372 for domestic water systems.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide specified or scheduled products, or comparable product by one of the following.

1. Fixtures:

a. Acorn Engineering Co.
b. American Standard
c. Bradley Corporation
d. Commercial Enameling Co.
e. Crane Co.
f. Eljer
g. Elkay Manufacturing Co.
h. Haws Corp.
i. Just Co.
j. Kohler Co.
k. Zurn Plumbing Products
l. Or approved equal.

2. Faucets:

a. Chicago Faucet Co.
b. American Standard
c. T & S Brass and Bronze Works, Inc.
d. Or approved equal.

3. Supplies, traps, and miscellaneous trim:

a. Acorn Engineering Co.
b. Bradley Corporation
c. Brass-Craft Manufacturing Co.
d. Chicago Faucet Co.
e. Elkay Manufacturing Co.
f. Engineered Brass Co.
g. Guy Gray; IPS Corporation
h. Haws Corp.
i. McGuire Manufacturing Co.
j. T & S Brass and Bronze Works, Inc.

k. Or approved equal.

4. Toilet seats:
   a. Bemis
   b. Beneke Corp.
   c. Church Seats
   d. Olsonite Co.
   e. Sperzel Co.
   f. Or approved equal.

5. Fixture supports and carriers:

   a. Josam Mfg. Co.
   b. J.R. Smith
   c. Zurn Plumbing Products
   d. Or approved equal.

2.2 FIXTURES

A. Model numbers are intended to describe complete fixtures. Furnish all parts and fittings regularly required such as tailpieces for lavatory faucets, escutcheons, and appurtenances, including low-voltage devices and wiring for fixtures which require them to operate.

B. Fixtures shall be white except where another color is specified for a particular fixture.

C. Water closet models specified or noted to be accessible in accordance with ADA requirements: Select models such that flush controls will be on the fixture's open side when fixtures are installed.

2.3 WATER CLOSETS

A. F-1 water closet, tank type: Kohler pressurized "Wellworth Pressure Lite" K-3505.

1. Material: Vitreous china.
2. Bowl type: Elongated.
3. Passageway: 2.25 inches (57 mm).
4. Mounting: Freestanding, floor-mounted.
5. Tank type: Pressure-assist flushing system.
6. Consumption: No more than 1.6 gallons (6.0) per flushing cycle.
7. Trim:

   a. Seat: No. 1
   b. Supply: No. 23
   c. Bolt caps: Two, No. 115

2.4 LAVATORIES

A. F- 2 lavatory: Kohler "Hudson" K-2812

1. Material: Cast iron with acid-resisting enamel.
2. Lavatory type: Rectangular, front overflow, single hole faucet centers.
3. Dimensions: 20 by 18 inches (508 by 457 mm).
4. Mounting: Wall-mounted, 32 inches (813 mm) rim to floor. Include cast-iron carrier fitting to connect to support specified in the article "Support for Wall-Mounted Fixtures" below.
5. Trim:

a. Faucet: No. 51
b. Tailpiece: Two No. 24
c. Supply: Two No. 22
d. Nipple: Two No. 62
e. Drain: No. 80
f. Trap: No. 106

2.5 TRIM

A. Exposed trim shall be chrome-plated.

B. Faucets: Equal to the named model shall mean similar in appearance, function, and design. Internal parts are not required to be interchangeable.

C. Trim numbers listed in the fixture descriptions above represent the descriptions in the article "Trim Schedule" at the end of the section.

2.6 SUPPORTS FOR WALL-MOUNTED FIXTURES

A. Lavatories mounted on shafts or partitions where there is no floor on the opposite side: Equal to Zurn Z-1259 plate carriers.

1. Single lavatory: The plate carrier shall have a backup plate of 10-gauge steel, at least 6 inches (152 mm) high by 38 inches (965 mm) long.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish, provide rough-in for, and set fixtures to extent and number indicated on drawings. The fixtures shall be left in first class condition, properly adjusted, cleaned and ready for satisfactory operation.

1. Where water closets are specified or noted to be accessible in accordance with ADA requirements, ensure that flush controls are installed on the fixture's open side.
2. Coordinate elevations of water closet flush valve rough-ins with rough-ins for grab bars and other wall-mounted items.

B. Protect plumbing fixtures and board them over so that they cannot be used until final acceptance of the work.

3.2 SETTING OF FIXTURES

A. In locations where fixtures are set against walls, seal crack between wall and fixture with silicon sealant.

B. Set floor outlet fixtures on floor flanges with gaskets and cement-grout them to rest firmly and evenly on floors. Water closets shall be secured with two bolts attaching to the floor flanges and the base shall be sealed to the floor using a clear silicone caulk. The fixtures shall be secured over these bolts with Trim No. 115 bolt caps.

C. Securely attach wall hung fixtures to wall using specified supports.

D. After installation, paint undersides of cast-iron lavatories and service sinks. Paint galvanized traps with two coats of white enamel.

E. Maximum length of risers shall be 8 inches.

3.3 TRIM SCHEDULE

Trim No.	Description
1	Seat: Church No. 295 SSCT white solid plastic, elongated, open front; stainless-steel hinge posts with combination self-sustaining and check hinge.
22	Rigid supply and stop: Chicago No. 1010-1003-3ABCP angle stop fitting with supply tube and loose key, with slow compression operating cartridge. Chrome-plated brass construction with 0.375-inch female threaded inlet and slip wall flange with set screw. Rigid supply riser with reducer for 0.25-inch female threaded outlet.
23	Water closet supply: Brass Craft No. SR1712DLX C 0.375-inch OD tube riser, 0.5-inch threaded inlet by 0.375 compression outlet multi-turn stop valve with loose key, 0.5-inch by 3 inch long brass nipple, shallow escutcheon, chrome plated assembly.
24	Tailpiece, straight: Brass Craft No. 56825X C complete with coupling nut.
51	Faucet: Kohler “Taut” single-hole commercial faucet with 0.5 gpm (1.9 lpm) maximum flow rate, water-saving vandal resistant aerator, and high-temperature limit setting.
62	Nipples: Brass Craft triple-plated polished chrome of length and size as required.
80	Drain: McGuire No. 155 A, non-removable open grid strainer, 1.25 by 6 inch tailpiece.
106	P trap: McGuire No. 8090, 1.25 by 1.5 inch IPS outlet, cast-brass, ground joint, swivel type, with cleanout and complete with McGuire No. 2127, NPS 1-1/2 (DN 40) brass nipple with cast set screw escutcheon.
115	Bolt caps: Chrome-plated acorn nuts, size as required.

END OF SECTION

SECTION 23 0100

OPERATION AND MAINTENANCE OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Service for heating, ventilating, and air conditioning equipment required for the work as indicated on the drawings, including the items listed in “Related Sections”.

1.2 RELATED SECTIONS

A. Operating manuals: Division 01 and Section 23 0101.

B. General project warranty: General Conditions.

C. Ductless split-system units: Section 23 8127.

D. Air-source heat pump units: Section 23 8143.

1.3 DESIGN REQUIREMENTS

A. The products specified, scheduled, and shown on drawings are the basis of the design of this project.

B. For requirements affecting use of optional manufacturers, or substitutions, see Division 01 and Section 23 0101, HVAC General Provisions, and Section 23 0500, Common Work Results for HVAC.

1.4 SUBMITTALS

A. Shop drawings:

1. Refrigeration service organization: Name and address of proposed agency.
2. Proposed service or test agreement of each type included in the project, showing conformance to specifications. Include detailed list of work to be performed at each visit.

B. Certifications:

1. Qualifications of refrigeration installation and service agency.
2. Each installation and service organization: A list of at least ten projects, similar to this project in type, size, and components, which have been operating satisfactorily for at least two heating and cooling seasons.
3. Include evidence of each requirement specified in the article below for qualifications of each service and maintenance agency.

C. Field test reports: Test and inspection reports for refrigeration equipment.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with the plumbing, electrical, building, fire and safety codes of the state, county or city in which the work is performed.

B. UL label and local testing (if required): As specified in Section 23 0500, Common Work Results for HVAC.

C. HVAC equipment shall meet the energy performance requirements of ASHRAE 90.1 Energy Efficient Design of New Buildings Except Low-rise Residential Buildings.

1.6 QUALIFICATIONS OF EACH SERVICE AND MAINTENANCE AGENCY

A. Regularly engaged in performing installation, startup, and service work for equipment and systems of the types included in this project.

B. Located in the Baltimore/Washington, DC, metropolitan area.

C. Staff factory-trained by the manufacturer of the equipment included in this project.

D. Provides emergency service on call 24 hours a day.

E. Maintains an adequate stock of manufacturer's genuine or approved parts to service this equipment.

F. Has service contracts available, which can meet requirements specified for the equipment and systems of this project.

1.7 REFRIGERATION EQUIPMENT WARRANTY AND SERVICE

A. Manufacturer's authorized and factory-trained startup and service organization will be responsible for starting, adjusting, and servicing the complete refrigeration system during the term of the correction period of this contract.

B. Ascertain that piping installation, wiring, control installation, and appurtenances of each refrigeration unit are in accordance with the recommendations of the manufacturer. Upon initial startup, operate and adjust the unit to obtain the performance specified by the manufacturer.

C. Special warranties shall cover the replacement of all parts and components for no less than the time of the general project correction period, starting from the date of substantial completion.

D. Compressors shall have an additional extended parts-only warranty for a total of five years including the general correction period.

E. Refrigerant circuits of self-contained units shall have an additional extended parts-only warranty for a total of five years including the general correction period.

F. Supply emergency service promptly upon call during correction period with no extra charge to the Government.

G. Maintenance in addition to repair: In addition to the repair service required during the correction period, provide maintenance by the manufacturer's authorized factory-trained local agent including a visit to the project near the end of the first full cooling season. The planned maintenance program shall include:

1. Inspect complete refrigerant circuit for refrigerant leaks with approved halide or electronic leak detector.
2. Replace defective parts and refrigerant at no addition to the contract sum.
3. Tighten belts, nuts, screws, and terminal wiring connections as required.

4. Clean evaporator-condenser coils as needed.
5. Lubricate moving parts as needed.
6. Adjust, align, and replace belts where needed.
7. Check for oil or refrigerant leaks and correct as necessary.
8. Check for blockage of condensate elimination system and correct as required.
9. Check and record unit starting and running amperage.
10. Check and record power voltage and control voltage.
11. Check and record operating temperatures and pressure. (Pressure not required on hermetic circuits.)
12. Check and record thermostatic expansion valve super heat.
13. Check temperature and pressure controls and adjust as required.
14. Check for proper operation of limit switches and safety controls.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 ELECTRIC WIRING FOR MOTORS, STARTERS, AND CONTROLS

A. Furnish and install and in most cases factory-wire motor starters specified under each technical section in this division. Furnish and install under Division 26 starters not specifically specified with equipment. Unless specified otherwise, automatic control devices for equipment are furnished with the equipment.

B. Unless explicitly specified otherwise, mount and completely wire under Division 26 all starters and automatic control devices, except those which are factory-mounted on equipment.

C. Unless specified otherwise, motor disconnects, manual starters, pushbutton stations, and pilot lights are specified in Division 26, Electrical. Equipment specified in Division 23 shall be suitable for operation in conjunction therewith.

D. Unless specified otherwise in a particular section, electric motors shall comply with the requirements of Section 23 0513.

3.2 IDENTIFICATION

A. Identify equipment as required in Section 23 0500, Common Work Results for HVAC.

B. Thermometers, gauges, and control devices shall be identified.

3.3 TESTING MECHANICAL EQUIPMENT

A. Check and adjust all heating and cooling equipment installed.

B. Operate heating and cooling equipment and check controls including high and low limit controls.

C. Mechanical equipment shall be proven to function properly by actual operation prior to final acceptance.

3.4 EQUIPMENT LUBRICATION

A. Bearings of equipment shall be provided with adequate facilities for lubrication. Oiling devices shall be accessible. Lubricate bearings upon completion of work prior to startup of the equipment. Lubricants shall be as specified by equipment manufacturers.

END OF SECTION

SECTION 23 0101

HVAC GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for all HVAC work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers.

B. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 23.

B. Visit the site and study all aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of all labor, equipment and materials, and the performance of all operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for, including all necessary signatures and paperwork, all permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Government.

E. HVAC work of this project includes, as a brief general description, the following:

1. Removal of existing through wall air conditioning units and electric baseboard heaters
2. Installation of a new split system heat pump unit and associated ductwork, air devices, and piping to serve the Registration Station.
3. Installation of two new ductless split systems to serve the pay booths.

F. See Division 01 for requirements related to Government's occupancy of the premises, limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 23 specifications.

B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for all coordination and additional costs as specified in the article "Substitutions," below for substitutions.

C. Products specified by reference standards or by description only: Any product meeting those standards or description.

D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance, and shall not be construed as limiting competition. Contractor may use products of any manufacturer, which meet the specifications.

E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 23 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to the Government.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse the Government for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project, and of representative manufacture. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. All equipment, construction and installation must meet requirements of local, state and federal governing codes.

C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

1. Furnish: Supply item
2. Install: Mount and connect item
3. Provide: Furnish and install.

E. All materials and equipment shall be installed and completed in a first class and workmanlike manner and in accordance with the best modern methods, practice and manufacturers' instructions. Any work which shall not present an orderly and neat or workmanlike appearance shall be removed and replaced with satisfactory work when so directed in writing by the DGS Project Manager.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall workmanship.

G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the DGS Project Manager will determine sizes to be utilized.

H. In all cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the DGS Project Manager of said uncertainty, doubt, or conflict and obtain a decision as to the intent before starting any work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the DGS Project Manager and await a written decision.

B. Plan and coordinate all work to proceed in an orderly and continuous manner without undue delay, and in conformance with project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate HVAC work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of all piping, ductwork, light fixtures, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor's responsibility to bring this to the attention of the DGS Project Manager prior to initiation of work. Correct improperly coordinated installation at no additional cost.

E. The Contractors' assistants shall include a competent foreman, who shall be on the premises at all times to check, lay out, coordinate and superintend the installation of work. The foreman shall establish all grades and lines relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers' and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for all equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of shop drawings and product data for every item of equipment. Shop drawings or product data will not be considered until manufacturers' lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor's name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.
3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.
4. All exclusively electrical items furnished as items associated with mechanical items but not specifically described in the mechanical item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the mechanical item by identification specification paragraph.
5. Product data sheets shall be 8.5-inches by 11-inches cut sheets for operating and maintenance manual.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of Government's representative, and project type and size.

E. After the work is completed, submit all required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the Government prior to final acceptance of the work.

1.10 SPECIALIST

A. The term “Specialist” as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer’s direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:

   a. Contract drawings.
   b. Specifications.
   c. Addenda.
   d. Change orders and other modifications to the Contract.
   e. Reviewed shop drawings, product data, and samples.

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:

   a. Manufacturer’s name and product model and number.
   b. Product options, substitutions, or alternates utilized.
   c. Changes made by addenda and modifications.

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:

   a. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
   b. Field changes of dimension and detail.
   c. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.
2. Lubrication charts: Prepare lubrication charts for each piece of mechanical equipment that requires grease or oil.

   a. Include the following:

      1) Types of lubricants required.

2) Locations of lubrication points.
3) Frequency of lubrication.

b. Provide one extra set of lubrication charts mounted in plastic covers, besides those required in Operating and Maintenance Manuals.

3. Binders: Three-ring binders with vinyl-covered hard covers. Provide large enough binders, and sufficient quantity, that the required contents can be easily turned, removed, and reinserted.
4. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," and title of project. Print on spine of binder "O & M INSTRUCTIONS." If more than one binder is required, print covers and spines with volume numbers. Include in the front of every binder an index to all binders.
5. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
6. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.
7. Part 1: Directory, listing names, addresses, and telephone numbers of mechanical engineers; Contractor; mechanical subcontractors; and major mechanical equipment suppliers.
8. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

a. Significant design criteria, including pump and fan curves and similar performance charts.
b. List of equipment, including operating weight of each piece.
c. Parts list for each component, including recommended spare parts list.
d. Operating instructions.
e. Maintenance instructions for equipment and systems.
f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
g. Valve charts, including locations of flow fittings.

9. Part 3: Project documents and certificates, including the following:

a. Shop drawings and product data.
b. Air balance reports.
c. Photocopies of certificates.
d. Photocopies of warranties and guarantees.
e. Test reports: Copies of the results of all tests required under all sections of specifications.

10. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.
11. Submit final volumes revised, within ten days after final inspection.

1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The plumbing, mechanical, electrical, building, fire, and safety codes of the state and county or city in which the work is being performed.
2. The National Electric Code, NFPA 70 (NEC).
3. The National Fire Protection Association Code. (NFPA).
4. International Energy Conservation, Fire, Fuel Gas, Mechanical, and Plumbing Codes (ICC).

1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply. Products shall be certified by manufacturers to meet the requirements of referenced standards.

1. Federal Specifications (FS)
2. Military Specification (MS)
3. Military Standards (Mil. Std.)
4. Air Conditioning and Refrigeration Institute (ARI)
5. Air Movement and Control Association (AMCA)
6. Associated Air Balance Council (AABC)
7. American Association State Highway and Transportation Officials (AASHTO)
8. American National Standards Institute (ANSI)
9. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
10. ASME International (ASME)
11. American Society for Testing and Materials (ASTM)
12. American Society of Sanitary Engineering (ASSE)
13. American Water Works Association (AWWA)
14. International Code Council (ICC)
15. Manufacturer's Standardization Society of the Valve and Fittings Industry Inc. (MSS)
16. National Electrical Code, NFPA 70 (NEC)
17. National Electrical Manufacturer's Association (NEMA)
18. National Fire Protection Association (NFPA)
19. National Fuel Gas Code, NFPA 54
20. National Sanitary Foundation (NSF)
21. National Standard Plumbing Code (NSPC)
22. The Occupational Safety and Health Act (OSHA)
23. Piping and Drainage Institute (PDI)
24. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
25. Underwriters Laboratory Inc. (UL)
26. Maryland Occupational Safety and Health Act (MOSHA)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for all contents within these areas. Provide all security measures necessary for this area.

B. Area shall be maintained and shall be returned to original condition at the completion of the project.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.
5. Protect areas occupied by Government personnel or equipment.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair all damage or soiling to the complete satisfaction of the DGS Project Manager; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, all at no addition to the Contract Sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer's recommended temperatures.

E. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.16 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.17 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in "Cutting and Patching" below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the DGS Project Manager in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.18 WARRANTY

A. All work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties specified in individual sections.

B. During the correction period, the Contractor shall begin correcting any work found to be not in accordance with the requirements of the Contract Documents within 4-hours of receiving written notice from the DGS Project Manager. Provide detailed schedule for completion of work within 24-hours of receiving written notice from the DGS Project Manager and revise schedule based on any Government comments generated. Except as otherwise required in General Conditions and Division 01, the correction period is one year after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

1. Service reports for warranty work shall be provided to the Government.

C. When use of the permanent equipment has been permitted for temporary heating or ventilation of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Government.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers' standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of pipes, ducts and appurtenances. Close superfluous openings and remove all debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the DGS Project Manager.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and all materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.3 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or DGS Project Manager finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, and the DGS Project Manager shall each be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

END OF SECTION

SECTION 23 0500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to more than one section of Division 23.

B. Basic material and equipment required for the HVAC piping work.

C. Identification of HVAC systems and equipment.

D. Cleaning and painting.

E. Treated wood lumber.

F. Operating instructions.

G. Piping tests.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 23 0101.

B. Operation and Maintenance Manuals: Division 01 and Section 23 0101.

C. Painting: Division 09.

1.3 REFERENCES

A. American Society of Mechanical Engineers

1. ASME Boiler and Pressure Vessel Code
2. ASME A 13.1: Scheme for the Identification of Piping Systems
3. ASME B 31.1: Power Piping
4. ASME B 31.9: Building Services Piping

B. American Society of Testing and Materials

1. ASTM A 234: Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
2. ASTM B 32: Standard Specification for Solder Metal
3. ASTM B 88: Standard Specification for Seamless Copper Water Tube
4. ASTM B 813: Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
5. ASTM D 635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
6. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials
7. ASTM E 548: Standard Guide for General Criteria Used for Evaluating Laboratory Competence

C. American Welding Society

1. AWS D1.1: Structural Welding - Steel
2. AWS D10.9: Specification for Qualification of Welding Procedures and Welders for Piping and Tubing
3. AWS QC1: Specification for AWS Certification of Welding Inspectors

1.4 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

C. DN: Dimension Nominale, nominal pipe size in millimeters, in accordance with the metric system for construction, Systeme Internationale (SI).

D. NPS: Nominal pipe size in inches, in accordance with standard U.S. designations for manufactured pipe. Pipe sizes do not change when projects are designed and built in metric units; each size has a consistent name (nominal dimension) in each system.

1.5 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed based on the use of the particular manufacturer’s products specified and scheduled on the drawings.

B. Products of other manufacturers that are listed under the article "Available Manufacturers," or permitted as "equal," are permitted provided:

1. Product shall meet the specifications.
2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that render their use impractical, or cause functional fit, access, or connection problems.

1.6 SUBMITTALS

A. Shop drawings:

1. Schedule of welding and brazing procedures proposed for each piping system in the project.
2. Shop drawings of backboards for piping specialties.

B. Certifications: Proof of operator and testing agency personnel qualifications as required for welding and brazing in the article "Quality Assurance" below.

C. Test reports: Field test results for each piping system as specified in Part 3 below.

1.7 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the plumbing, mechanical, electrical, building, fire, health and safety, and other applicable codes and regulations of the state, county or city in which the work is performed.

B. Welding procedures and operator qualifications for structural welding: AWS D1.1, Structural Welding Code Steel, electric arc process.

C. Welding, brazing, and soldering procedures and operator qualifications for building systems piping:

1. AWS D10.9, Qualification of Welding Procedures and Welders for Piping and Tubing.
2. ASME B31.9, Building Services Piping.
3. Copper Development Association "Copper Tube Handbook."

D. Electrical control panels, equipment, materials and devices provided or installed as work of Division 23 shall bear UL label or, if UL label is not available, the item shall be tested and labeled by a qualified testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70 (NEC). Provide testing, if required, without addition to the contract sum.

E. VOC content: Field-applied adhesives and sealants, limits per South Coast Air Quality Management District (SCAQMD), Rule No. 1168.

F. Products shall contain no urea-formaldehyde content.

PART 2 - PRODUCTS

2.1 GENERAL

A. Piping techniques, testing, identification, painting, and operating instructions specified in this section apply to products specified in other sections of Division 23.

B. Equipment that uses or processes date and time data in order to perform its function shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

2.2 PIPING MATERIALS

A. Weldolets and thredolets: Fittings designed for installing branches on piping, with either welded or threaded connection to branch; conforming to ASTM A 234.

B. Soldering materials:

1. Solder: Free of lead, antimony, and zinc and meeting the requirements of ASTM B 32. No solder containing lead is permitted.

a. Tin 95.5 percent, copper 4 percent, and silver 0.5 percent.

(1) Equal to “Silvabrite 100” manufactured by Engelhard Corporation.

b. Tin, copper, bismuth, and silver.

(1) Equal to "Oatey Silver" manufactured by Oatey.

2. Flux:

   a. Meeting the requirements of ASTM B 813 and NSF 61 certified.
   b. Equal to Oatey H-20^{95}.

2.3 IDENTIFICATION DEVICES AND MATERIALS

A. Stenciling materials:

1. Stencils: Manufactured standard stencils prepared for required applications, conforming to ASME A 13.1 for color and size of legend letters, including arrows showing direction of flow.
2. Paint: Exterior type enamel, colors conforming to ASME A 13.1, or black.

B. Equipment identification tags:

1. Laminated plastic with adhesive back, white core and black outer layers, which, when engraved, will produce white letters and numerals on a black background.
2. Tags installed on curved surfaces shall be aluminum or brass.

C. Valve tags: Brass, 1.5 inch (40 mm) in diameter with black-filled numbers not less than 0.25 inch (6 mm) high, complete with brass attachment chains.

D. Ceiling identification tags: Laminated plastic with adhesive back, engraved black letters on white background, minimum 0.5 inch (15 mm) wide and length as required for 0.375 inch (10 mm) high letters for name of concealed device and number.

2.4 TREATED WOOD LUMBER

A. Wood-preservative-treated lumber: Treated by pressure process, AWPA C2, with chemicals acceptable to authorities having jurisdiction, and marked with treatment quality mark of an inspection agency approved by ALSC Board of Review.

PART 3 - EXECUTION

3.1 GENERAL

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify DGS Project Manager if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

B. The contract drawings are diagrammatic and do not indicate all fittings or offsets in pipe and ductwork, all access panels, or all specialties required. Provide required fittings, offsets, access panels, and specialties to coordinate the work.

C. No pipe or duct shall be run below the head of a window or door.

D. Equipment, ducts, and pipes installed in areas without a suspended ceiling shall be as tight to structure as possible, but at least above a height of 6'-8", unless otherwise noted.

E. Items which require access for operation or maintenance shall be easily accessible. Do not cut or form hand holes for operation or maintenance of appliances through walls or ceilings.

3.2 PIPE INSTALLATION

A. Install pipe exposed to view parallel to building lines and as close to walls, columns, and ceilings as may be practical, maintaining proper clearances for access at all parts requiring servicing.

B. Install pipe a sufficient distance from other work to permit a clearance of not less than 0.5 inch (15 mm) between its finished covering and adjacent work.

C. Remove burrs resulting from cutting pipe or from any other operation.

D. Thoroughly clean pipe and fittings before they are installed, and keep them clean until the acceptance of the completed work. Cap or plug the ends of the lines so as to prevent earth and other debris from entering during construction.

E. Install unions or flanges in the piping at each item of equipment, control valve, and appliance, so as to provide easy removal of the equipment, valve, or appliance, and to provide for easy removal of coils.

F. Interface with other products:

1. Where pipe is provided through walls, provide finished, permanent, waterproof installation complete with inserts, sleeves, supports or hangers, seals, and other appurtenances as required. Do not pierce, cut, or notch any footing or other structural member.
2. Waterproofing and dampproofing of the building shall be unharmed by the installation of the work. Where pipe has to pierce waterproofing or dampproofing, including outside walls, the penetration shall be made watertight. Waterproofing damaged or destroyed shall be repaired or replaced with new waterproofing.

G. Thoroughly clean pipe and fittings before they are installed, and keep them clean until the acceptance of the completed work. Cap or plug the ends of the lines so as to prevent earth and other debris from entering during construction.

H. Copper tubing installation:

1. Cut pipe with a tubing cutter or fine-tooth saw. Cuts made with a saw shall be true and square, and the end shall be filed smooth with a fine-tooth file. Remove all marks and burrs with sandpaper.
2. Solder joints for copper tubing: Clean ends of tubing and inside of fitting ends thoroughly with emery cloth before applying flux.
3. Provide dielectric fittings between copper and steel piping to prevent electrolysis.
4. Follow the techniques for soldering and brazing pipe, fittings, and valves as recommended by the manufacturer.

3.3 IDENTIFICATION

A. General: Do not apply identification until insulation and finish painting work is complete.

B. Equipment:

1. Stencil equipment with minimum two-inch (50-mm) -high letters or provide identification tags. Clearly indicate equipment designation and area served.
2. Firmly fasten each identification tag to its appropriate piece of equipment with drive screws, sheet metal screws, or rivets. Do not interfere with operation of, or damage the item being marked.

C. Piping:

1. Mark by stenciling.
2. Mark to identify service with arrows showing direction of flow. Apply markings near building walls where pipes enter or leave an accessible space and in intermediate locations so that markings are no more than 30 feet (9 m) apart. They shall be readily visible to a person standing on the floor.
3. Fully identify all piping installed as work of the project.
4. Mark pipe with letters of height and with colors as required by OSHA and conforming to ASME A 13.1.
5. Identify every thermometer, gauge, and control device.
6. Provide valve tags for all valves except shutoff valves on individual fixtures or equipment where their function is obvious, or where the fixture or equipment is immediately adjacent. Numbers shall correspond to those shown on the Valve Chart. Attach tags to valve shaft.

D. Ductwork: Stencil ductwork after insulation is applied, if required, with minimum two-inch (50-mm)-high letters, clearly identifying service (supply, return, exhaust) and showing direction of flow with arrows. Mark ducts near the building walls where they enter or leave a space, and at intervals of not more than 30 feet (9 m). Identification shall be visible to a person standing on the floor.

E. Ceiling identification tags: Provide on the access door or, in suspended ceilings, on the ceiling support adjacent to the unit.

1. Valves: Identify with the same number shown on the valve tag.
2. Terminal units above ceilings: Identify with unit description and number.

3.4 CLEANING AND PAINTING

A. Cleaning: Clean all piping and equipment. Where items are to be painted, clean ready for painting.

B. Painting: Coordinate painting with requirements of Division 09. Paint the items identified below to be painted. Use paint materials and systems specified in Division 09.

C. Items to be painted:

1. Items furnished with manufacturer's prime coat.
2. Mechanical rooms (including but not limited to boiler, chiller, and air-handling unit rooms):

   a. Insulation and uninsulated steel: Piping, pumps, tanks, and vessels.
   b. Hangers and supports.

3. Inside ducts behind registers, grilles, and diffusers.

D. Items not to be painted: Copper, stainless steel, and equipment furnished with manufacturer's finish.

E. Painting inside ducts behind registers, grilles, and diffusers: Matte black, compatible with substrate and suitable for the temperatures at which the duct will operate, extending from the duct opening to a depth such that no unpainted surface will be visible to a person standing on the floor or adjacent balconies.

3.5 TREATED WOOD LUMBER

A. Provide wood-preservative-treated lumber where wood members are required as detailed on the drawings and in the following applications:
   1. Cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.
   2. Sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
   3. Framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
   4. Framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.

3.6 OPERATING INSTRUCTIONS (DEMONSTRATION)

A. Furnish the necessary technicians, skilled workers, and helpers to operate all the HVAC systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Government's designated personnel in operation, maintenance, lubrication, and adjustment of all systems and equipment.

   1. Instructions by manufacturer's technical representative for each type of equipment shall include the performance of the recommended preventive maintenance procedures for that equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions, for use by instructors and Government personnel.

E. Schedule the general and specialized instruction periods for a time agreed upon by the DGS Project Manager.

3.7 PIPING TESTS

A. Refrigerant pipe testing: Test as specified in Section 23 2300.

END OF SECTION

SECTION 23 0502

SLEEVES AND PLATES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sleeves and escutcheon plates for piping systems.

B. Mechanical seals for piping penetrations.

1.2 SUBMITTALS

A. Product data: Sleeves, plates, sealants, and mechanical penetration seals.

PART 2 - PRODUCTS

2.1 SLEEVES, PLATES, AND ACCESSORIES

A. Steel sleeves: Schedule 40 black steel pipe, ASTM A 53.

B. Sealing compound in walls and floors:

1. Bare and insulated pipes carrying fluids 150 degrees F (65 degrees C) and below:

   a. High-performance, moisture cured, 1-component, polyurethane-based, non-sag, elastomeric sealant. Use a primer for applications required by the manufacturer.
   b. Basis of design: Sika Corporation “Sikaflex - Ia.”

2. Bare and insulated piping carrying fluids 151 degrees F (66 degrees C) and above:

   a. One-part RTV silicone, neutral-cured, architectural grade sealant. Use a primer for applications required by the manufacturer.
   b. Basis of design: Dow Corning Corporation “790 Silicone.”

C. Floor, wall, and ceiling plates for new piping: Stamped or cast brass with chrome finish and set screw.

D. Mechanical penetration seals:

1. Seals shall be modular mechanical type, consisting of interlocking synthetic links shaped to continuously fill the annular space between the pipe and wall opening. Bolt and nut fasteners for the seals shall be stainless steel for units used in penetrations below grade.
2. Basis of design: PSI “Link-Seal Modular Seals” or Calpico Sealing Link “LINX”.

PART 3 - EXECUTION

3.1 INSTALLING SLEEVES

A. Install sleeves for piping, or piping with insulation continuous through sleeve, passing through walls, partitions, beams, or slabs.

B. Do not cut, drill, or burn structural steel for installation of piping without specific instructions from the DGS Project Manager.

C. Locations in nonfire-rated construction:

1. Install steel sleeves for penetrations of insulated piping.

D. Install sleeves through walls and partitions flush with finished surfaces.

E. Sleeves for insulated piping with vapor barrier shall be large enough to pass piping and insulation.

F. Seal spaces between sleeves and pipe, or pipe insulation, in nonrated walls, with mineral wool.

G. Penetrations in exterior masonry or concrete walls and foundations:

1. Sleeves: Cast iron, or in cast concrete may be core drilled.
2. Above grade: Mechanical penetration seal, at outside face of wall.

3.2 INSTALLING PLATES

A. Exposed piping passing through interior walls, partitions, floors, and ceilings shall be fitted with plates of size and depth to conceal sleeves. Secure plates firmly in place with set screws.

END OF SECTION

SECTION 23 0504

HVAC DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Extent and location of demolition are shown on the drawings.

1.2 RELATED SECTIONS

A. Demolition: Division 02.

1.3 REFERENCES

A. ANSI/ASHRAE Standard 147: Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems.

1.4 QUALITY ASSURANCE

A. Demolition shall be carried out as expeditiously as possible in accordance with accepted practice and applicable building code provisions.

1.5 PROJECT CONDITIONS

A. If, in the course of the work, workers encounter a material they suspect to be asbestos, to contain lead or PCBs, or to present some other hazard:

1. Promptly notify the DGS Project Manager in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

B. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.

C. Locate, identify, and protect mechanical and electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before beginning to remove equipment which contains refrigerants, remove refrigerants.

1. Following the recommendations of ANSI/ASHRAE Standard 147 and requirements of local authorities having jurisdiction, and using approved equipment, recover refrigerants.

2. Store each type of refrigerant in a separate container which meets requirements for refillability.
3. Handle and store following the recommendations of ANSI/ASHRAE Standard 147.

3.2 DEMOLITION

A. Comply with demolition and disposal requirements of Division 02.

B. Perform removal work neatly with the least possible disturbance to the building.

C. Provide temporary barriers, danger signals, and appurtenances for protection of personnel and equipment during removal operations.

D. Demolish, remove, demount, and disconnect inactive and obsolete piping, fittings and specialties, equipment, ductwork, controls, fixtures, and insulation.

1. Piping and ducts embedded in floors, walls, and ceilings may be abandoned in place if they do not interfere with new installations. Cut back to at least one inch below finished surface.
2. Remove materials above accessible ceilings.
3. Drain and cap items to remain behind finished surfaces.
4. Patch and repair surface materials as required in Division 01 and Section 23 0101 article, “Cutting and Patching.”

E. Remove anchors, bolts, and fasteners associated with piping and equipment to be removed.

3.3 DISPOSAL

A. Dispose of equipment and materials removed, and rubbish and waste material, as work progresses. Do not allow demolition debris to accumulate on site. Remove products of demolition from the building daily.

3.4 PROTECTION

A. Provide adequate and positive protection to existing building and equipment that is to remain, particularly to prevent entry of either dust or water. Ensure weathertightness at all times. Keep standby patching materials on hand to patch and maintain protection as required.

END OF SECTION

SECTION 23 0513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Unless otherwise specified in a particular section or required for a particular application, motors shall conform to the following requirements, whether factory-installed or field-installed.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Motor capacitors: Section 26 0521, Wiring Connections.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Ductless split-system units: Section 23 8127.

B. Air-source heat pump units: Section 23 8143.

C. HVAC fans: Section 23 3400.

1.4 REFERENCES

A. NEMA MG 1: Motors and Generators.

B. NEMA MG 10: Energy Management Guide for Selection and Use of Polyphase Motors.

C. NEMA MG 11: Energy Management Guide for Selection and Use of Single-Phase Motors.

D. UL 508: Industrial Control Equipment.

1.5 DEFINITIONS

A. Energy efficient motor: Motor meeting the nominal and minimum efficiency levels listed for its horsepower and speed in Table 12-10 of NEMA MG 1.

B. Nominal efficiency: Efficiency as defined in Table 12-8, Efficiency Levels, in NEMA MG 1, and identified on the motor nameplate.

1.6 SUBMITTALS

A. Product data:

1. Motors and drives not provided with equipment: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lugs, and coatings.
2. Motor capacitors.

B. Wiring diagrams required for the proper installation of mechanical equipment.

C. Submit product data which verifies compliance with ASHRAE 90.1 or provide certified performance ratings by a qualified independent testing agency.

D. Certifications:

1. Actual motor power factor for each motor, certified test results for each motor proposed for use on this project.
2. Field test showing corrected power factor, if required.

1.7 QUALITY ASSURANCE

A. Actual motor power factor shall be tested and certified by an independent testing laboratory.

B. UL label and local testing (if required): As specified in Section 23 0500, Common Work Results for HVAC.

C. HVAC equipment shall meet the energy performance requirements of ASHRAE 90.1.

1.8 REGULATORY REQUIREMENTS

A. Motors shall conform to the requirements of NEMA MG1 and applicable portions of the National Electric Code (NEC, NFPA 70).

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Motors:

1. Baldor Electric Co.
2. Marathon
3. Rockwell
4. Siemens
5. A.O. Smith
6. Toshiba International
7. Or approved equal.

B. Motor capacitors:

1. ABB Power Distribution
2. Commonwealth Sprague
3. General Electric
4. Or approved equal.

2.2 BASIC MOTOR REQUIREMENTS

A. Capacity: Each motor shall have sufficient capacity and torque to start, accelerate, and operate the machine it drives without exceeding the motor nameplate rating at the speed specified, or at any speed and load which may be obtained by the drive actually furnished.

B. Starting: Each automatically controlled motor shall be capable of starting as frequently as the control sequence may demand. Motors not automatically controlled shall be capable of making no fewer than 4 starts per hour.

C. Loads: Belt-connected motors shall be equipped with shafts and bearings designed to withstand both the normal connected loads of the drive furnished, and momentary loads imposed during acceleration.

D. Ratings: Motors shall be rated for continuous duty at 100 percent of rated capacity, and temperature rise shall be based on ambient temperature of 40 degrees C.

E. Phase: Unless otherwise indicated, motors one-half horsepower and larger shall be polyphase and motors smaller than one-half horsepower shall be single-phase motors.

F. Motor construction:

1. Motors for fans, and air handling units, unless specified otherwise in the equipment section, shall be open drip-proof NEMA design B construction.
2. Motors where indicated or specified, motors mounted outdoors, shall be totally enclosed, fan-cooled (TEFC) extra severe-duty. Motors outdoors inside weather-tight enclosures may be open drip-proof type.

G. Efficiency: The term “energy efficient” is defined in the article “Definitions” in Part 1 above.

1. Single-phase motors, alternating-current fractional horsepower, rated 1/20 to 1 horsepower, 250 volts or less: NEMA MG 11, types and efficiencies selected for their applications.
2. Polyphase motors, medium alternating-current, squirrel-cage, 1 to 500 horsepower, 600 volts or less: NEMA MG 10, energy-efficient types selected for their application. Nominal full-load efficiencies shall meet or exceed ratings of Table 12-10 of NEMA MG 1.
3. Motors for packaged hermetic and semi-hermetic refrigeration compressors need not comply with these efficiency requirements but they shall comply with the requirements indicated for power factor and power consumption.

2.3 SINGLE-PHASE MOTORS

A. Permanent split-capacitor or split-phase type.

B. Bearings: Sealed, prelubricated ball-bearing type.

2.4 ELECTRONICALLY COMMUTATED MOTOR (ECM)

A. Brushless direct current (DC) variable speed motor supplied with alternating current, with a permanent magnet with near zero rotor losses, permanently-lubricated ball bearings, electronic commutation, designed for synchronous rotation, and at least 70 percent efficient at all operating speeds.

B. As a minimum, the motor shall include the following features:

1. Integrated controller / invertor that operates the wound stator and senses rotor position to electronically commutate the stator.
2. Thermal overload protection.
3. Built-in soft start and soft speed change ramps.
4. Inductors to minimize harmonic distortion and line noise.
5. Designed to overcome reverse rotation without affecting life expectancy.
6. Motor speed shall be controllable down to 20 percent of full speed. Speed shall be controlled by either a potentiometer with manual adjustment on the motor or by a 0-10Vdc analog signal from a remote source, as required by other sections of Division 23 specifications.
7. Software for motor control shall be as indicated or described in other Division 23 specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount direct-connected motors securely and in accurate alignment. The drive shall be free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

B. Provide each belt-connected motor with a securely mounted adjustable base to permit installation and adjustment of belts.

C. Mount capacitors shipped separately beside motor connection box as required. Connect in accordance with the requirements of Division 26, Electrical.

1. Test units at full rated load after the installation of the motor capacitors, and submit reports.

3.2 OPERATING INSTRUCTIONS

A. As specified in Section 23 0500, provide operating instructions.

END OF SECTION

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe hangers and supports.

B. Trapeze pipe hangers.

C. Metal framing systems.

D. Insulation protection.

E. Fasteners.

F. Equipment foundations and supports.

1.2 RELATED SECTIONS

A. Vibration control supports: Section 23 0548.

B. HVAC Piping Insulation: Section 23 0719

C. Duct supports: Section 23 3113.

1.3 REFERENCES

A. American Society of Mechanical Engineers

1. ASME B31.1: Power Piping.
2. ASME B31.9: Building Services Piping.

B. ASTM International

1. ASTM A 36: Standard Specification for Carbon Structural Steel
2. ASTM A 53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A 307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
4. ASTM A 563: Standard Specification for Carbon and Alloy Steel Nuts ASTM A 1064: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
5. ASTM C 533: Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
6. ASTM C 552: Standard Specification for Cellular Glass Thermal Insulation
7. ASTM F 594: Standard Specification for Stainless Steel Nuts
8. ASTM F 3125: Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated

C. American Welding Society

1. AWS-D.1.1: Structural Welding – Steel

D. Metal Framing Manufacturer's Association

1. MFMA-4: Metal Framing Standards Publication
2. MFMA-103: Guidelines for the Use of Metal Framing

E. Manufacturer's Standardization Society

1. MSS SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

1.4 DEFINITIONS

A. High Temperature Hot Systems: Operating temperatures 200 degrees F (93 degrees C) and above.

B. Hot Systems: Operating temperatures 120 degrees F (49 degrees C) to 200 degrees F (93 degrees C).

C. Ambient Systems: Operating temperatures 60 to 119 degrees F (16 to 48 degrees C).

D. Cold Systems: Minimum operating temperatures 59 degrees F (15 degrees C) and below.

1.5 SUBMITTALS

A. Product data:

1. Provide manufacturer's literature showing compliance with specifications for each type of hanger, framing system, support, fastener and accessory materials.
2. Provide a schedule of piping types and sizes and associated pipe hanger types.
3. Provide a schedule of building attachment types and associated attachment hardware.
4. Provide a schedule of pipe types and sizes and proposed hanger spacing and support rod diameters.
5. Provide manufacturer's recommended pipe hanger spacing criteria for plastic piping.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Qualifications of welders: As specified in Section 23 0500, Common Work Results for HVAC.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Pipe hangers:

1. Anvil International
2. Carpenter and Paterson, Inc.
3. Cooper Industries
4. National Pipe Hanger Corporation
5. PHD Manufacturing, Inc.
6. PHP Systems/Design
7. Or approved equal.

B. Metal framing systems:

1. Anvil International
2. Cooper Industries
3. Hydra-Zorb
4. PHD Manufacturing, Inc.
5. PHP Systems/Design
6. Unistrut
7. Or approved equal.

C. Pipe covering protection shields:

1. Anvil International
2. Carpenter and Patterson, Inc.
3. Cooper Industries
4. National Pipe Hanger Corporation
5. PHD Manufacturing, Inc.
6. Pipe Shields, Inc.
7. Rilco Manufacturing Co., Inc.
8. Or approved equal.

2.2 PIPE HANGERS AND SUPPORTS

A. General: Comply with requirements of MSS SP-58.

B. Hangers and clamps:

1. Typical interior applications: Galvanized steel or factory painted.
2. Exterior and corrosive applications: Stainless steel.

C. Supplemental materials:

1. Threaded rod: Continuously threaded.

a. Zinc-plated or galvanized carbon steel for indoor applications.
b. Stainless steel for outdoor and corrosive applications.

2. Nuts and washers: Provide the same material used for threaded rods (ASTM A 563 for steel, ASTM F 594 for stainless steel).
3. Structural carbon-steel shapes: ASTM A 36.
4. Steel pipe: ASTM A 53, Grade B, Type E (electric resistance welded), Schedule 40, black and galvanized steel.

D. Metal framing systems:

1. Description: Shop- or field-fabricated, pipe-support assembly made of channels, nuts, bolts, structural connections, accessories, fittings, and other manufactured components.
2. Standard: Comply with MFMA-4 for factory-fabricated components for field assembly.
3. Channels: Continuous slotted galvanized steel channel with inturned lips, width selected for applicable load criteria.
4. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Metal framing system pipe clamps:

a. Galvanized steel clamp pipe support with elastic stop nut, and hex head machine screw, and manufactured to connect to metal framing system channels.

b. For insulated piping: Clamp shall have friction tape on inside of clamp surface, manufactured to connect to pipe clamp insulating insert over pipe.
c. For uninsulated piping: Clamp shall have an integral molded thermoplastic elastomer clamping insert on inside of clamp surface, manufactured to connect to uninsulated pipe.

E. Insulation protection:

1. Pipe covering protection shield:

a. Shield: Galvanized steel, meeting the requirements of MSS SP-58 Type 40. Provide with alignment ridges when used in conjunction with pipe hanger.
b. Structural insulation insert: Structural insulation insert to form the insulation for the lower half of, or the entire pipe circumference. Provide ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength; or ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength. Insert thickness shall match adjacent piping insulation thickness.

2. Combination insulating insert and insulation protection shield:

a. Insulating insert material for cold and ambient system piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength and vapor barrier. Insert thickness shall match adjacent piping insulation thickness.
b. Insulating insert material for hot system piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength; or ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength. Insert thickness shall match adjacent piping insulation thickness.
c. Insulation protection shield: Galvanized steel.
d. Insulating insert and insulation protection shield shall cover entire circumference of pipe.
e. Insulating insert length: Extend 2 inches minimum (50 mm) beyond insulation protection shield.

3. Pipe covering protection saddle:

a. Saddle: Steel, meeting requirements of MSS SP-58 Type 39
b. Insulation insert: Insulating material located in the space between saddle and pipe.

4. Pipe clamp insulating insert:

a. Insulating insert material: Closed-cell, sponge or expanded rubber, ASTM C 534, Type I for tubing material, with integral supports constructed from non-compressive closed cell material, single piece construction with self-adhesive closure strips. Insert thickness shall match adjacent piping insulation thickness. If insulation thickness is not available, provide maximum available thickness and seal insulation vapor barrier at thickness transition.
b. Insulation protection jacket: Aluminum or stainless steel, bonded to insulation insert.
c. Insulating insert and jacket shall cover entire circumference of pipe.
d. Equal to Armacell “Armafix” insulating inserts.

2.3 FASTENERS

A. Mechanical expansion anchors:

1. Self-drilling type expansion shields or machine bolt drop-in anchors for drilled holes. Fasteners to floor slabs shall be vibration and shock resistant. Load applied to fasteners shall not exceed 25 percent of manufacturer's stated load capacity in 3500 psi (24,000 kPa) concrete. Provide zinc-coated anchors for indoor applications and stainless-steel anchors for outdoor applications.
2. Basis of design: ITT Phillips Anchors "Red Head."

B. Fasteners to drywall or cavity wall construction:

1. Toggle bolts with hollow wall drive anchors or nylon anchors as required.
2. Basis of design: ITT Phillips Anchors "Red Head" toggle bolts.

C. Fasteners to wood construction: Lag bolts.

D. Bolts, nuts, and washers: ASTM A 307, or ASTM F 3125 where high strength is required.

2.4 CONCRETE AND GROUT

A. Concrete:

1. Concrete shall be no less than 3000-psi (25,000 kPa) strength.
2. Reinforcement: 6 by 6 inch (150 by 150 mm) welded steel wire fabric, ASTM A 1064.

B. Grout:

1. Premixed, non-shrink grout consisting of non-metallic aggregate, cement, and water-reducing and plasticizing agents; capable of developing minimum compressive strength of 7,000 psi (48,000 kPa) in 28 days.
2. Provide grout by one of the following manufacturers:

a. Sonneborn-Rexnord "Sonogrout"
b. L&M Construction Chemical Company "Crystex"
c. US Grout Corporation "Five-Star Grout"

PART 3 - EXECUTION

3.1 GENERAL

A. Provide hangers and supports in accordance with schedules at the end of this section, as modified by specifications for each location and type.

B. Comply with MSS SP-58. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

C. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Where required, provide structural steel shapes or metal framing system channels and hardware to transfer load from a hanger location to multiple locations in the structure in order to get support from an appropriate location or to increase the strength of the connection to the structure.

E. Support horizontal piping from above with hangers and threaded rod where possible, unless otherwise indicated.

F. Support pipe risers through floor slabs with riser clamps.

G. Provide hanger sizes to allow for continuous insulation for insulated piping systems.

H. Fabricate wall-mounted and floor-mounted supports using metal framing systems or structural steel where required.

I. Support groups of small piping along a structural wall using a metal framing system secured to the wall.

J. Trim threaded rods with a maximum excess length of 1 inch (25 mm). Provide protective rubber red end caps on the ends of threaded rods exposed and within 8 feet (2.4 meters) of the floor, roof, or grade below.

K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Coordinate with requirements for hangers that require vibration control. See Section 23 0548.

P. Metal framing systems: Provide where required for grouping of parallel runs of piping, and support together on field-assembled strut systems. Comply with MFMA-103 for metal framing system selections and applications.

3.2 BUILDING ATTACHMENTS

A. Attaching to structural walls:

1. Provide a minimum of two 0.375 inch (9.5 mm) minimum screw-type fasteners for attaching brackets and a minimum of three 0.5 inch (13 mm) minimum bolt-type fasteners for attaching structural supports.

B. Attaching to concrete slabs and composite slabs:

1. Obtain approval from the structural engineer and confirm allowable loads prior to supporting pipe from concrete slabs or composite slabs. Where approved, provide mechanical expansion anchors and steel bolts or rods.

C. Attaching to wood construction:

1. Trusses: Follow roof truss manufacturers' recommendations for attachment locations, loads, spacing, and methods of attachment.
2. Joists: Provide MSS SP-58 Type 34 side beam connectors.

3.3 INSTALLING EQUIPMENT FOUNDATIONS AND SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor. Provide lateral bracing, to prevent swaying.

B. Provide minimum four-inch (100-mm) -high concrete foundations (housekeeping pads) or as indicated on drawings, reinforced with welded-wire fabric, for floor-mounted equipment and where indicated. Anchor concrete foundations by dowels inserted into the floor slab.

C. Unless otherwise specified, provide concrete foundations, bolts, sleeves, and appurtenances as work of the section where the supported equipment is specified and in accordance with the requirements of Division 03.

D. Equipment shall be properly aligned and leveled, and grouted where necessary. Support piping independently of equipment and so as not to cause a strain or thrust.

E. Coordinate exact size, configuration and location of equipment, foundations, and supports using approved shop drawings of equipment.

3.4 PIPING HANGER AND SUPPORT SCHEDULES

A. Refrigerant piping applications:

HANGERS & SUPPORTS FOR REFRIGERANT PIPING APPLICATIONS		
MSS SP-58 Classification	Description	Piping applications
Hung from Above		
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	All sizes.
Supported from Below		
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	All sizes.
Risers		
Type 8	Riser clamp.	All sizes

B. Minimum threaded rod sizes: Provide at least the following minimum rod diameters for single rods supporting a single pipe hanger.

PIPE SIZE	MINIMUM ROD DIAMETER
NPS 2 (DN 50) and below	0.375 inches (10 mm)

END OF SECTION

SECTION 23 0548

VIBRATION CONTROL SUPPORTS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Vibration control supports for HVAC equipment.

1.2 RELATED SECTIONS

A. Hangers and supports: Section 23 0529.

B. Flexible duct connections: Section 23 3300.

1.3 SUBMITTALS

A. Product data: For each type of vibration control support included in the work.

1. For Specification D hanger, include scaled drawing showing degrees of hanger rod swing.

B. Shop drawings: Custom-fabricated supports.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the specified Mason Industries product, or comparable product by one of the following:

1. Amber/Booth Company, Inc.
2. Kinetics Noise Control
3. Mason Industries
4. Vibro-Acoustics
5. Vibration Eliminator Company, Inc.
6. Vibration Mountings and Controls, Inc.
7. Or approved equal.

2.2 VIBRATION CONTROL SUPPORTS

A. Provide engineered supports for equipment and locations shown on drawings and specified in Part 3 below. The units shall prevent the transmission of vibration and mechanically transmitted sound to the building structure.

1. Select units in accordance with the weight distribution of the equipment, so as to produce reasonably uniform deflection. Deflections shall be as specified.
2. Units installed on exterior shall be galvanized.

B. Specification A:

1. Double-deflection neoprene type. All metal surfaces shall be covered with neoprene and have friction pads both top and bottom. Provide bolt holes for mounting. Provide steel rails where necessary to compensate for equipment overhang.
2. Basis of design: Mason Industries ND.

C. Specification B: Free-standing spring isolators, laterally stable without housing, and with 0.5-inch-(13-mm) thick neoprene pads between baseplate and support.

1. Mountings shall have leveling bolts rigidly bolted to equipment.
2. Springs: Spring diameters shall not be less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal of 50 percent of the rated deflection.
3. Basis of design: Mason Industries SLFH.

D. Specification D: Hangers, combination spring and minimum 0.3-inch (8-mm) deflection neoprene in series.

1. Neoprene element: Molded with a rod isolation bushing that passes through the hanger box.
2. Spring diameters and hanger box lower hole sizes: Large enough to permit the hanger rod to swing through a 30-degree arc before contacting the edges of the hole.
3. Springs shall have a minimum additional travel to solid equal to 50 percent of rated deflection.
4. Basis of design: Mason Industries Type 30N.

E. Specification E: Hangers, combination spring and minimum 0.3-inch (8-mm) deflection neoprene in series with adjustment to transfer load to spring while holding supported object at fixed elevation. Include spring deflection indicator.

1. Neoprene element: Molded with a rod isolation bushing that passes through the hanger box.
2. Spring diameters and hanger box lower hole sizes: Large enough to permit the hanger rod to swing through a 30-degree arc before contacting the edges of the hole.
3. Springs shall have a minimum additional travel to solid equal to 50 percent of rated deflection.
4. Basis of design: Mason Industries Type PC30N.

F. Specification X: Horizontal thrust restraint, consisting of a spring element in series with a neoprene pad as described in Specification B with the same deflection specified for the mountings or hangers.

1. Spring element: Contained within a steel frame and designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 0.25 inch (6 mm) movement at start and stop.
2. Furnish the assembly with one rod and angle brackets for attachment to both the equipment and ductwork or the equipment and the structure.
3. Horizontal restraints: Attached at the centerline of thrust and symmetrically on either side of the unit.
4. Basis of design: Mason Industries WB.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Adjust vibration control supports as recommended by manufacturer to eliminate transmission of vibration to building structure or other systems.

B. Replace springs that become permanently deformed with new springs.

C. Provide 0.25-inch (6-mm) structural plate sized as required between isolator and equipment.

3.2 FAN VIBRATION CONTROL

A. Suspended from structure: Provide Specification D hanger, selected for weight, with minimum 1.0 inch static deflection.

3.3 AIR-HANDLING UNIT VIBRATION CONTROL

A. Isolators for air handling units may be provided as part of the unit (internal isolation) as specified in the section, Air Handling Units with Coils, but shall meet the requirements of this section.

B. On floors above grade and on roofs: Provide number of Specification B mountings, having at least 1.75 inch (45 mm) static deflection, required to properly support unit and its accessories as recommended by the air-handling unit manufacturer.

1. Unit with fan section isolated from coil and filter section:

a. Provide the Specification B mounting under fan and motor only, bolted to equipment support (housekeeping pad).
b. Provide Specification X mounts on each side between fan and coil section to control fan section thrust upon fan start-up.

C. Suspended from structure: Provide Specification D hanger, selected for weight, with minimum 1.0 inch static deflection.

3.4 REFRIGERATION COMPRESSOR VIBRATION CONTROL

A. Refrigeration compressors and equipment with self-contained refrigeration compressors:

1. Refrigeration compressors, condensing units, and other rotating equipment mounted on floor slab on earth: Specification A mountings having at least 0.35 inch (89 mm) static deflection.

3.5 VIBRATION CONTROLS ON PIPING

A. Piping: Provide Specification E vibration control supports in first three hangers at both the suction and discharge of compressors, and condensing units, and for the first three hangers on pipes connected to air handling units. The static deflection shall be the same as specified for the mountings under the connected equipment.

1. If piping is connected to equipment mounted on slab on grade and hangs from structure under occupied spaces, the first three hangers shall have at least 0.75 inch (19 mm) deflection for pipe sizes up to and including NPS 3 (DN 80), 1.5 inch (38 mm) deflection for pipe sizes up to and including NPS 6 (DN 150) and 2.5 inch (64 mm) deflection thereafter.
2. Other hangers and mounts shall have a minimum spring deflection of 0.75 inch (19 mm).
3. Locate vibration control supports in hanger rods as close to the overhead supports as practical. On supports with double rods, use two vibration control supports.

END OF SECTION

SECTION 23 0593

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The Contractor shall engage and the DGS Project Manager shall approve an independent balancing and testing subcontractor.

B. This section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC equipment.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
6. Reporting results of the activities and procedures specified in this section.

1.2 RELATED SECTIONS

A. Testing and adjusting requirements unique to particular systems and equipment are included in the sections that specify those systems and equipment.

B. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment sections.

1.3 PERFORMANCE REQUIREMENTS

A. Select and obtain approval of the testing and balancing subcontractor at the earliest possible time and before beginning ductwork installation.

B. The testing and balancing subcontractor shall visit the job site periodically, beginning with the initial stages of construction of the mechanical systems, and shall ensure that the necessary devices are properly installed so that specified testing and balancing can be performed.

1.4 SUBMITTALS

A. Submit qualifications of testing and balancing subcontractor, as required in article “Quality Assurance” below.

B. Submit certified balance report. In addition to general requirements for submittals, submit three copies of final reports and certificates, bound into a booklet.

1.5 QUALITY ASSURANCE

A. Testing and balancing subcontractor qualifications:

1. Current certified member of the Associated Air Balance Council, or certified by National Environmental Balancing Bureau for air and hydronic systems testing and balancing.
2. Has successfully completed at least five projects of similar size and scope.

3. Not affiliated with any other subcontractor participating in this project. Work performed by the subcontractor shall be limited to testing, adjusting, and balancing HVAC systems.

B. Testing and balancing work shall comply with one of the following standards:

1. National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning Systems, published by the Associated Air Balance Council.
2. Procedural Standards for Testing Adjusting Balancing of Environmental Systems, published by the National Environmental Balancing Bureau.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Instruments: Approved and properly calibrated.

B. Pyrometer surface temperature measurements may be used for piping system water temperatures where thermometer wells are not provided in the piping.

PART 3 - EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Before beginning balancing, ascertain that systems are ready. Verify that filters for regular service are in place, as required in Section 23 4100, Particulate Air Filtration.

3.2 PREPARATION

A. Witness air duct leakage tests required in Section 23 3113, Metal Ducts, and advise and approve the methods and instruments used.

B. Using bench-calibrated instruments, field-calibrate pressure gages and dial-type duct thermometers.

3.3 BALANCING OF SYSTEMS, GENERAL

A. Tabulate settings of temperature control devices and ascertain that thermostats, controllers, and valves are set at specified or approved positions. Verify and certify that the sequence of operation for each system is as shown on drawings, specified, or approved.

B. Provide all labor and devices necessary for the testing and balancing work.

3.4 AIR SYSTEMS BALANCING

A. Balance all air distribution, supply, return, exhaust, and outdoor air systems and equipment.

B. Test and adjust fans to deliver design airflow at lowest possible speed. Adjust air-handling equipment to deliver the required air volumes. Note that air quantities scheduled on drawings do not include allowances for duct leakage. Preliminary adjustments of fan speed should be slightly in excess of scheduled airflow delivery. Make adjustments by adjusting adjustable sheaves, changing sheaves and associated belts, changing wiring connections of motors, or adjusting speed controller.

C. Test and adjust system to design airflow requirements to the greatest extent possible. Manual volume dampers in ducts shall be adjusted to obtain required airflow rates at grilles, registers, and diffusers. Dampers integral to airflow devices should be fully open or minimally closed for airflow fine adjustments.

D. Make pitot tube traverse of main supply, return, and outdoor air ducts to obtain total airflow for fan or air-handling unit.

E. Adjust rooms or zones to design airflow (supply, return, and exhaust).

F. Adjust general HVAC systems to design airflow within the following tolerances:

1. Total system supply, return, and exhaust: (design to plus 10 percent).
2. Outdoor air: (minus 5 percent to plus 5 percent).
3. Total supply, return, and exhaust for a room or space: (minus 5 percent to plus 5 percent).
4. Grilles, registers, and diffusers:

    a. One per room or space: (minus 5 percent to plus 5 percent).
    b. Two or more per room or space: (minus 10 percent to plus 10 percent).

G. Grilles, registers, and diffusers:

1. Identify each grille, register, and diffuser as to location and area. List manufacturer, type, and size.
2. Identify type of testing equipment used.
3. Test and adjust each grille, register, and diffuser to design airflow. List (design-actual) cfm (cubic meters per minute) and (design-actual) velocity in fpm (meters per second) when applicable.
4. Adjust diffusers, grilles, and registers to minimize drafts. Adjust blades in supply diffuser straightening grids to ensure uniform air distribution across diffuser.
5. Adjust linear slot diffusers to provide throw direction as indicated on the drawings. Unless otherwise noted, discharge pattern shall be horizontal. Where two-way throw is indicated, divide the number of slots equally for each direction.

H. Test and record the following data, as applicable, for air-handling equipment:

1. Manufacturer and model number.
2. Total airflow (design-actual).
3. Return air airflow (design-actual).
4. Outdoor air airflow (design-actual).
5. Total and external static pressure (design-actual). Include static pressure at suction, discharge, and between unit coil and filter components.
6. Entering air temperatures (db heating, db and wb cooling).
7. Leaving air temperatures (db heating, db and wb cooling).
8. Motor horsepower (rated-actual).
9. Voltage and phase (rated-actual).
10. Fan speed, rpm (rated-actual).
11. Amperage (rated-actual).

I. In cooperation with the control manufacturer's representative, set adjustments of automatically operated dampers to operate as specified.

J. Submit a certified report listing the specification requirements and the operating conditions of these items as follows:

1. DX coil:

    a. Suction pressure
    b. Suction line temperature
    c. Entering air - D.B.
    d. Entering air - W.B.
    e. Leaving air - D.B.
    f. Leaving air - W.B.
    g. Outdoor air temperature - D.B.
    h. Outdoor air temperature - W.B.

3.5 MARKING OF SETTINGS

A. Following final balance procedures, permanently mark the settings of valves, splitters, dampers, and other adjustment devices, so that adjustment can be restored if disturbed at any time. Set memory stops on balancing valves. Return and make required adjustments after submittal and approval of the Certified Balance Report.

END OF SECTION

SECTION 23 0700

HVAC INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Definitions and general requirements applicable to the insulation systems specified in “Related Sections.”

1.2 RELATED SECTIONS

A. HVAC piping insulation: Section 23 0719.

B. Duct insulation: Section 23 0713.

1.3 REFERENCES

A. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials

B. NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Materials

C. UL 723: Standard for Test for Surface Burning Characteristics of Building Materials

1.4 DEFINITIONS

A. Ceiling space: The space between the ceiling and the floor of an air-conditioned space above.

B. Roof space: The space between the ceiling and the roof, where building insulation is located at the roof level or the space between the ceiling and the floor of a non-air conditioned space above.

C. Attic space: The space between the ceiling and the roof, where building insulation is located at the ceiling level.

D. Air-conditioned areas or spaces: Areas or spaces where the occupied room temperature is maintained between 65 and 80 degrees F (18.3 and 26.7 degrees C).

E. Concealed insulation shall include work:

1. Above ceilings.
2. Where furred in and in pipe chases.

F. Exposed insulation shall include work:

1. In all rooms and areas.
2. In mechanical equipment rooms, penthouses, or other similar utility spaces.
3. In storage rooms.

G. Unconditioned areas: Areas outside of the insulated envelope.

H. Finished spaces: Areas of the building accessible to the public and to building occupants other than service personnel.

1.5 QUALITY ASSURANCE

A. Perform work in strict accordance with the building, fire and safety codes of the state, county or city in which the work is performed.

B. Insulation, including fittings and butt strips, jackets, facings, and accessories such as adhesives, mastics, cements, tapes and cloth, shall have a fire and smoke hazard rating and label as tested by ASTM E84, NFPA 255, and UL 723, not exceeding Flame Spread 25, Fuel Contributed 50, Smoke Developed 50.

C. All insulation and accessories shall be free of asbestos.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation and accessory products in manufacturers' wrapping or cartons, identified on the exterior and bearing labels showing conformance to flame and smoke rating requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to sections listed in "Related Sections."

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 23 0713

DUCT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Duct insulation as with the thickness and R-value indicated in the schedule at the end of this section.

B. Work of this section includes:

1. Insulation for new ductwork installed under this contract.
2. Patching existing insulation where removed to make connections to existing ductwork.
3. Patching existing insulation damaged during demolition and construction.

1.2 RELATED SECTIONS

A. Painting: Division 09.

B. Definitions and general insulation requirements: Section 23 0700.

1.3 REFERENCES

A. American Society of Testing and Materials

1. ASTM C 553: Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
2. ASTM C 612: Standard Specification for Mineral Fiber Block and Board Thermal Insulation
3. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials

1.4 SUBMITTALS

A. Material list: Each type of insulation and accessory, with manufacturer's name and material name and number. Identify locations for use, thickness of material, type of jacket, vapor barrier, and method of application.

B. Product data: Sufficient to show that the product meets the specified requirements for materials, composition, and performance.

C. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

D. Installer qualifications.

1.5 QUALITY CONTROL SUBMITTALS

A. Manufacturer's instructions: Recommended accessory materials and products; installation instructions.

1.6 QUALITY ASSURANCE

A. Installer qualifications: Installers shall be mechanics skilled in this trade, employed with a firm that has a minimum of five years of experience installing mechanical insulation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store rigid insulation products so as to protect them from breakage.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. The listed manufacturers and particular products are intended to set a standard for materials, composition, and performance. Products of other manufacturers may be proposed as permitted by the provisions of Division 01 and the article "Product Options" in Section 23 0101.

B. Mineral fiber insulation:

1. CertainTeed Corporation.
2. Johns Manville.
3. Knauf Fiber Glass GmbH.
4. Owens-Corning.
5. Or approved equal.

C. Coatings, adhesives, and fabrics:

1. Childers
2. Foster
3. Manville Building Materials Group
4. Rock Wool Manufacturing Company
5. Trimac
6. Or approved equal.

2.2 MINERAL FIBER INSULATION MATERIALS

A. Flexible mineral fiber insulation: ASTM C 553, Type I, nominal density at least 1 pound per cubic foot (16 kg per cubic meter), k-factor of 0.27 at 75 degrees F (k(SI) of 0.037 at 24 degrees C) mean temperature, of thickness as specified in Part 3 below, with foil-scrim-kraft vapor-barrier jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

1. Minimum R-value of R-4.5 (RSI-0.79) with 1.5 inches (38 mm) of thickness in the installed condition with 25% compression.
2. Minimum R-value of R-6 (RSI-1.06) with 2 inches (50 mm) of thickness in the installed condition with 25% compression.

B. Rigid mineral fiber insulation: ASTM C 612, Types IA-IB, nominal density at least 6 pounds per cubic foot (96 kg per cubic meter), with k-factor of 0.22 at 75 degrees F (k(SI) of 0.032 at 24 degrees C) mean temperature, of thickness as specified in Part 3 below, with factory-applied jacket composed of a reinforced white kraft and aluminum-foil laminate with the white kraft facing out. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

1. Minimum R-value of R-6.8 (RSI-0.79) with 1.5 inches (38 mm) of thickness.
2. Minimum R-value of R-9.1 (RSI-1.06) with 2 inches (50 mm) of thickness.

C. Mineral fiber insulation accessories:

1. Mechanical fasteners: Adhesively attached, minimum 12-gauge zinc-plated steel pin welded to a 2 inch by 2 inch, 22 gauge minimum galvanized steel perforated baseplate and self-locking retaining washer. Pin length as required. Comply SMACNA HVAC Duct Construction for Mechanical Fasteners. Provide adhesive recommended by fastener manufacturer. Peel and press (self-sticking) type fasteners are not acceptable.
2. Tape for flexible mineral fiber insulation: Self-adhesive foil-scrim-kraft vapor-barrier tape with removable backing and pressure-sensitive acrylic adhesive, 3" (75 mm) wide minimum. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
3. Tape for rigid mineral fiber insulation: Self-adhesive foil faced vapor-barrier tape with removable backing and pressure-sensitive acrylic adhesive, 2" (50 mm) wide minimum. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
4. Mineral fiber insulation vapor barrier mastic:

    a. Vapor barrier coating for use over ASJ jackets to give a vapor barrier seal at joints, laps and punctures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
    b. Basis of design: Foster 30-65 "Vapor-Fas".

5. Corner Angles: Aluminum, 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm).
6. Trapeze hanger support inserts: Calcium silicate insulation, ASTM C 533, Type I.

2.3 FIELD-APPLIED JACKETS

A. Canvas jacket:

1. Jacket material: 8 ounces per square yard (270 grams per square meter), fire-retardant treated.
2. Lagging adhesive:

    a. Polyvinyl acetate water-based adhesive and coating used indoors to adhere and size canvas, glass cloth or other lagging fabric over pipe insulation, and able to be top coated with solvent-based paints. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
    b. Basis of design: Foster 81-42W "Lagfas".

3. Lagging finish coating:

    a. Washable, abrasion-resistant, indoor insulation coating for canvas. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
    b. Basis of design: Foster 30-36 "Sealfas".

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Apply insulation in a neat and workmanlike manner and in accordance with manufacturer's printed instructions.

B. Tape and seal terminations of insulation with vapor barrier mastic.

C. Provide continuous insulation and jacket through trapeze hanger supports. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

D. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

E. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

G. Install insulation with longitudinal seams at top and bottom of horizontal runs.

H. Install multiple layers of insulation with longitudinal and end seams staggered.

I. Install insulation with least number of joints practical.

J. Stagger joints.

K. Install insulation continuously around hangers.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

3.2 INSTALLATION INSIDE BUILDINGS

A. Install in accordance with the Minimum Insulation Thickness and R-Value Schedule at the end of this section.

B. Concealed ducts: Provide flexible mineral fiber insulation.

1. Mechanical fasteners: On ducts more than 24 inches (610 mm) wide, secure insulation on the underside with mechanical fasteners as required to prevent sagging, 16" (406 mm) maximum on center and 3" (75 mm) maximum from joints. Secure insulation in place with washers firmly embedded in insulation. Cut excess portion of pins extending beyond washers. Cover exposed pins and washers with tape.
2. Transverse joints and longitudinal seams: Butt insulation with facing overlapping at least 2 inches (50 mm). Staple and seal with tape.
3. Seal breaks and punctures with tape.

C. Exposed ducts: Provide rigid mineral fiber insulation.

1. Mechanical fasteners: Fastened with mechanical fasteners. Fasteners shall be spaced 16" (406 mm) on center with a minimum of two rows per side of duct and 3" (75 mm) maximum from joints. Secure insulation in place with washers firmly embedded in insulation. Cut excess portion of pins extending beyond washers. Cover exposed pins and washers with tape.
2. Transverse joints and longitudinal seams: Provide a continuous unbroken vapor barrier. Create a facing lap by removing 2 inches (50 mm) from one edge and one end of insulation segments. Secure laps to adjacent insulation section with staples, 6 inches (150 mm) on center maximum. Seal seams and joints with tape.
3. Seal breaks and punctures with tape.
4. Apply corner angles to all outside corners and straight edges.
5. For curved surfaces, such as exposed elbows, score or cut insulating board in narrow strips as necessary for snug and neat fit.
6. Installing canvas jacket: Adhere canvas jacket with lagging adhesive. Finish with lagging finish coating, ready for painting.

D. Ductwork which transmits air that may be either cooled or heated, or untempered air, shall be insulated as specified below for cooling systems.

E. Where necessary to conceal the standing seams and reinforcing angles on exposed ducts, increase insulation thickness to 2 inches (50 mm).

F. Casings and headers of reheat coils shall be insulated with the same thickness as adjacent ductwork.

G. Installation on dedicated outdoor air ductwork.

1. Conditioned outdoor air or supply air ducts from dedicated outdoor air systems shall be insulated as specified for supply air ducts for cooling systems.
2. Return or exhaust air ducts from dedicated outdoor air systems shall be insulated as specified for return air ducts for cooling systems.

3.3 SCHEDULES

(See schedule, next page)

Minimum Insulation Thickness and R-Value for Duct Insulation Inside Buildings			
	Default Unless Otherwise Noted[1]	Ceiling, Chase, or Shaft Space in Air Conditioned Area	Attic Space and other Unconditioned Space
Outside Air and Exhaust Air			
Outdoor air	1.5 inch (38 mm)	Default	Default
Exhaust air from air-conditioned areas	Not required	Default	1.5 inch (38 mm) R-4.5 (RSI 0.79)
Exhaust air and pressure relief between exterior connection and ATC damper, but not less than 10 feet (3 meters)	1.5 inch (38 mm)	Default	Default
Cooling Systems			
Supply air	1.5 inch (38 mm)	Default	2 inch (50 mm) R-6 (RSI 1.06)
Pre-insulated round or oval supply air	1.5 inch (38 mm)	Not required	2 inch (50 mm) R-6 (RSI 1.06)
Return air and transfer	1.5 inch (38 mm)	Not required	2 inch (50 mm) R-6 (RSI 1.06)
Pre-insulated round or oval return air and transfer	Not required	Default	1.5 inch (38 mm) R-4.5 (RSI 0.79)[2]
Heating Systems			
Supply air	1.5 inch (38 mm)	Default	2 inches (50 mm) R-6 (RSI 1.06)
Pre-insulated round or oval supply air	Not required	Default	2 inches (50 mm) R-6 (RSI 1.06)
Return air and transfer	Not required	Default	2 inches (50 mm) R-6 (RSI 1.06)
Pre-insulated round or oval return air and transfer	Not required	Default	2 inches (50 mm) R-6 (RSI 1.06)

Notes:
1: Default insulation thickness shall be increased to 2 inches (50 mm) where necessary to conceal standing seams and reinforcing angles on exposed ducts.
2: Insulation R-value added to the R-value of lined or pre-insulated duct exceeds R-6 (RSI 1.06)

END OF SECTION

SECTION 23 0719

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. HVAC piping insulation for the interior piping systems listed in the minimum insulation thickness schedule at the end of this section.

B. HVAC piping insulation for the exterior piping systems.

C. Work of this section includes:

1. Insulation for new piping installed under this contract.
2. Patching existing insulation where removed to make connections to existing piping.
3. Patching existing insulation damaged during demolition and construction.

1.2 RELATED SECTIONS

A. Firestopping: Division 07.

B. Painting: Division 09.

C. Definitions and general insulation requirements: Section 23 0700.

D. Pipe hangers and protection shields: Section 23 0529.

E. Pre-insulated refrigerant tubing system: Section 23 2300.

1.3 REFERENCES

A. American Society of Testing and Materials

1. Standards for flexible elastomeric insulation materials

a. ASTM C411: Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
b. ASTM C 534: Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

2. Standards for all insulation materials

a. ASTM C 450: Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.
b. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials

3. Standards for field applied jackets and accessories

a. ASTM C 1729: Standard Specification for Aluminum Jacketing for Insulation.
b. ASTM D 1784: Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
c. ASTM B 209: Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

1.4 SUBMITTALS

A. Material list: Each type of insulation and accessory, with manufacturer's name and material name and number. Identify locations for use, thickness of material, type of jacket, vapor barrier, and method of application.

B. Product data: Sufficient to show that the product meets the specified requirements for materials, composition, and performance.

C. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

D. Installer qualifications.

1.5 QUALITY CONTROL SUBMITTALS

A. Manufacturer's instructions: Recommended accessory materials and products; installation instructions.

1.6 QUALITY ASSURANCE

A. Installers shall be mechanics skilled in this trade, employed with a firm that has a minimum of five years of experience installing mechanical insulation.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. The listed manufacturers and particular products are intended to set a standard for materials, composition, and performance. Products of other manufacturers may be proposed as permitted by the provisions of Division 01 and the article "Product Options" in Section 23 0101.

B. Flexible elastomeric insulation:

1. Aeroflex USA*
2. Armacell LLC*
3. K-Flex USA
4. Rubatex
5. Or approved equal.

C. Coatings, adhesives, and fabrics:

1. Childers
2. Foster
3. Manville Building Materials Group
4. Rock Wool Manufacturing Company
5. Trimac
6. Or approved equal.

2.2 FLEXIBLE ELASTOMERIC INSULATION MATERIALS

A. Flexible elastomeric preformed pipe insulation: Closed-cell, sponge- or expanded-rubber, ASTM C 534, Type I for tubular materials. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

B. Flexible elastomeric preformed fitting and valve covers: Closed-cell, sponge- or expanded-rubber, made from the same material and density as adjacent pipe insulation, meeting ASTM C 450 requirements for dimensions used in forming insulation to cover valves, elbows, tees, flanges, strainers, and unions. Provide with preformed PVC field-applied jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

1. Where flexible elastomeric insulation is used on hot gas piping in VRF applications, insulation shall be tested in accordance with ASTM C411 at 250 degrees F (121 degrees C) for a 96 hour time period and shall meet an ASTM E 84 surface burning characteristic (flame spread/smoke developed) rating less than 25/50 at 2 inches (50 mm) of thickness.

C. Flexible elastomeric insulation adhesive:

1. Water resistant contact cement designed especially suited for bonding two impermeable surfaces and recommended for rubber foam, steel, or aluminum surfaces, and compatible with service temperatures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Basis of design: Foster 85-75 “Drion”.

D. Flexible Elastomeric Tape: Black, closed cell, self-adhering, elastomeric thermal insulation tape for insulating pipes and fittings, 0.125 inch (3 mm) thick, 2 inches (50 mm) wide, ASTM C 534, Type I — Grade 1. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

E. Flexible elastomeric insulation vapor barrier coating:

1. Water-based latex enamel coating for use over flexible elastomeric insulation, providing a moisture-resistant protective finish suitable for both indoor and outdoor applications. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Basis of design: Armacell “WB Armaflex” latex enamel.

2.3 FASTENERS

A. Aluminum bands: ASTM B 209, 0.75 inches (19 mm) wide and 0.020 inches (0.4 mm) thick.

2.4 FIELD-APPLIED JACKETS

A. Polyvinyl chloride (PVC) jacket:

1. Jacket material: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Color: White.
3. Adhesive: As recommended by jacket material manufacturer. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
4. Fitting covers: Manufacturer’s factory-fabricated fitting covers made from the same material, finish, and thickness as the jacket, suitable to the size of fittings and thickness of insulation. Provide factory fabricated fitting covers for elbows, tees, flanges, unions, reducers, end caps, valves, and other fittings. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

5. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket and fitting covers with acrylic adhesive; suitable for indoor and outdoor applications, 2 inch (50 mm) width, 6 mil (0.15 mm) thickness. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide interior piping insulation in accordance with the Minimum Insulation Thickness Schedule for Interior Applications at the end of this section, as modified by specifications for each location and type.

B. Provide field applied jackets in accordance with the Field-Applied Jacket Schedule at the end of this section, as modified by specifications for each location and type.

C. Provide flexible elastomeric insulation for refrigerant piping

D. Apply insulation in a neat and workmanlike manner and in accordance with manufacturer's printed instructions.

E. Maintain a continuous vapor barrier on systems that convey fluid at below-ambient temperatures, including the following applications:

1. Refrigerant piping

F. Where a continuous vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

G. Installation at pipe hangers:

1. Insulation shall be continuous through hangers for all piping systems.
2. Install pipe covering protection shields with thickness of structural insulation inserts equal, under load, to that of adjoining insulation.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
5. Shields and structural insulation inserts are specified in Section 23 0529, Hangers and Supports for HVAC Piping and Equipment.

H. Where insulated piping systems pass through sleeves or openings in partitions and floors, the insulation shall be continuous through the sleeves and openings. See Firestopping specifications for coordinating insulation and firestopping.

I. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

J. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

K. Install insulation with longitudinal seams at top and bottom of horizontal runs.

L. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

M. Install insulation with least number of joints practical.

N. Finish installation with systems at operating conditions. Repair separations and cracking caused by thermal movement.

O. Return piping systems shall be insulated to meet the temperature demands of supply piping systems. There shall be no reduction of insulation thickness for anticipated temperature change between supply and return.

3.2 INSTALLING FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and circumferential joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Installation on fittings and flanges:

1. Install insulation over fittings and flanges with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate using flexible elastomeric preformed fitting covers whenever possible. Install preformed fittings with adhesive. Tape and seal with vapor barrier coating.
3. Where flexible elastomeric preformed fitting covers are not available, insulate using mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining pieces and bonded with adhesive. Tape and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Seal with vapor barrier coating.
4. Install fitted PVC cover. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
5. Flanges: Install pre-formed pipe insulation to outer diameter of pipe flange. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation. Secure insulation to flanges and tape and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Seal with vapor barrier coating.

3.3 INSTALLING FIELD-APPLIED JACKETS

A. Installing PVC jacket:

1. Provide jacket tight to insulation.
2. Provide with 1-inch (25-mm) overlap at longitudinal seams and circumferential joints.
3. For horizontal applications, install with longitudinal seams along top and bottom of pipes.
4. Seal with manufacturer’s recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under the jacket lap and another finish bead along each seam and joint edge.
5. Seams and joints shall completely prevent the entrance of water.

3.4 INSTALLING EXTERIOR PIPING INSULATION

A. Locations: Provide insulation for piping systems exterior of building heated space, including but not limited to attics and unheated parking garages.

B. Insulation: Material as specified for interior systems unless otherwise indicated, minimum 2 inches (50 mm) thick, or 0.5 inches (13 mm) thicker than scheduled for interior insulation on similar system, whichever is greater.

C. Start insulation 30 inches (760 mm) below grade, 30 inches (760 mm) below roof or 30 inches (760 mm) inside exterior wall. Secure insulation with aluminum bands on 12-inch (305-mm) centers.

3.5 SCHEDULES

A. Minimum insulation thickness schedule for interior heat pump refrigeration applications:

MINIMUM INSULATION THICKNESS SCHEDULE FOR INTERIOR HEAT PUMP REFRIGERATION APPLICATIONS (1)			
Application	Fluid Temperature Range	NPS 1.25 (DN 32) & Smaller	NPS 1.5 (DN 40) & Greater
Refrigerant Liquid	61F to 140F (16.1C to 60C)	1-inch (25 mm)	1.5-inch (38 mm)
Refrigerant Suction/Hot Gas (2)	61F to 140F (16.1C to 60C)	1-inch (25 mm)	1.5-inch (38 mm)
Refrigerant Hot Gas (3)	105F to 140F (40.6C to 60C)	1-inch (25 mm)	1.5-inch (38 mm)
(1) - See additional thickness requirements for exterior applications. (2) – For heat pump applications where piping may be either hot gas or refrigerant suction depending on the mode of operation, insulate the piping to meet the more demanding requirements of refrigerant hot gas. (3) – Hot gas may be required for split system hot gas reheat applications.			

B. Field-applied jacket schedule:

FIELD-APPLIED JACKET SCHEDULE	
Application	PVC Jacket
Exterior applications	X
Pipe insulation exposed in mechanical rooms, penthouses, and other service areas not accessible to the public.	X

END OF SECTION

SECTION 23 2300

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Refrigerant piping and accessories for equipment in related sections.

1.2 RELATED SECTIONS

A. Piping materials and methods: Section 23 0500.

B. Piping hangers and supports: Section 23 0529.

C. Piping insulation: Section 23 0719

D. Equipment:

1. Ductless split-system units: Section 23 8127.
2. Air-to-air packaged heat pump units: Section 23 8143.

1.3 REFERENCES

A. Air Conditioning, Heating, and Refrigeration Institute

1. AHRI 495: Performance Rating of Refrigerant Liquid Receivers
2. AHRI 730: Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers
3. AHRI 750: Thermostatic Refrigerant Expansion Valves
4. AHRI 760: Performance Rating of Solenoid Valves for Use with Volatile Refrigerants

B. American Society of Testing and Materials

1. ASTM B 280: Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
2. ASTM C 1427-07: Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form

C. American Society of Mechanical Engineers/American National Standards Institute

1. ASME/ANSI B16.22: Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

D. American Society of Refrigerating and Air-Conditioning Engineers

1. ASHRAE Standard 15: Safety Standard for Refrigeration Systems
2. ASHRAE Standard 34: Designation and Classification of Refrigerants
3. ASHRAE Standard 147: Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems

E. American Welding Society

1. AWS A5.8/A5.8M: Specification for Filler Metals for Brazing and Braze Welding

F. Society of Automotive Engineers

1. SAE J533: Flares for Tubing

G. UL

1. UL 429: Standard for Safety Electrically Operated Valves

1.4 DESIGN REQUIREMENTS

A. Refrigerant piping shall be sized by the manufacturer of the refrigeration compressor, as specified in sections describing refrigeration equipment.

B. Design pressures: Calculated in accordance with "System Design Pressure" in ASHRAE Standard 15.

1.5 SUBMITTALS

A. Product data:

1. Piping, fittings, brazing filler metal, brazing flux, and pipe joint compound.
2. Each type of valve, including materials, classifications, arrangement, dimensions and required clearances, and installation instructions.
3. Each type of device and accessory.

B. Shop drawings:

1. Pre-insulated tubing, including sizes and approximate lengths of lines.
2. Built-up system piping diagram, including sizes, details, and accessories.
3. Submit system design pressures for use in testing system. In accordance with the International Mechanical Code, "Field Test" for refrigeration systems, including the pressures listed on the condensing unit, compressor, or compressor unit nameplate, and the settings of pressure relief devices.

C. Certifications: Provide certificate of field tests in a form acceptable to the authority having jurisdiction, as part of the permit and inspection records. Certificate shall include no less than:

1. Name of refrigerant.
2. Field test pressure applied to high and low sides of the system.
3. Signature and printed name of the installer.

1.6 QUALITY ASSURANCE

A. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label, directly on the pipe, indicating compliance.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Refrigerant: R-410A.

2.2 PIPING (PRE-INSULATED TUBING)

A. Refrigerant pipe:

1. Pre-insulated Type L soft drawn seamless copper tubing, ASTM B 280. Provide complete with factory-applied, closed-cell insulation and jacketing in accordance with ASTM C 1427-07, Type I, Grade I, suitable for a maximum operating temperature of 250 degrees F, and meeting the minimum insulation thickness requirements of Section 23 0719.
2. Basis of design: H Max pre-insulated copper line sets.

2.3 PIPE AND FITTINGS (BUILT-UP SYSTEMS)

A. Refrigerant pipe: ASTM B 280 Type ACR hard-drawn seamless copper tubing.

B. Fittings: Wrought copper, solder-joint type, ANSI B16.22.

C. Brazing Filler Metals: AWS A5.8/A5.8M.

1. Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
2. Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

D. Brazing Flux: Non-corrosive.

E. Threaded pipe joint compound: Pipe joint compound recommended by the manufacturer for use at the temperature and pressure of the system.

F. Threaded pipe joint tape: Polytetrafluoroethylene (PTFE) pipe thread tape, "Teflon."

2.4 ACCESSORIES (BUILT-UP SYSTEMS)

A. System: Provide the listed accessories as a minimum on each built-up system, in accordance with approved shop drawings and as recommended by the refrigeration equipment manufacturer. Accessories provided by the equipment manufacturer with the equipment are acceptable.

B. Isolation valves:

1. Forged brass body ball valve.
2. Full port.
3. Extended copper connections suitable for brazing.
4. Brass ball.
5. Polytetrafluoroethylene PTFE seals, “Teflon”.
6. Vented ball cavity.
7. Blow out proof stem.
8. Double O-ring stem seals.
9. Positive shut-off in both directions.
10. Factory tested.
11. UL listed.
12. Working Pressure Rating: 500 psig (3450 kPa).
13. Maximum Operating Temperature: 275 degrees F (135 degrees C).

C. Check valves:

1. Body: Forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. End Connections: socket or threaded.
6. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
7. Working Pressure Rating: 500 psig (3450 kPa).

8. Maximum Operating Temperature: 275 deg F (135 deg C).

D. Service valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig (3450 kPa).

E. Solenoid Valves:

1. Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory.
2. Body and Bonnet: Plated steel.
3. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and a coil compatible with the control signal and available power.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 240 degrees F (116 degrees C).

F. Safety Relief Valves:

1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by a National Recognized Testing Laboratory.
2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
3. Piston, Closing Spring, and Seat Insert: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 240 degrees F (116 degrees C).

G. Thermostatic Expansion Valves:

1. Comply with AHRI 750.
2. Body, Bonnet, and Seal Cap: Forged brass or steel.
3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
4. Packing and Gaskets: Non-asbestos.
5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
6. Suction Temperature: 40 degrees F (4.4 degrees C).
7. Superheat: Adjustable.
8. Provide reverse-flow option for heat-pump applications.
9. End Connections: Socket, flare, or threaded.
10. Working Pressure Rating: 500 psig (3450 kPa).

H. Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig (3450 kPa).

6. Maximum Operating Temperature: 275 degrees F (135 degrees C).

I. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in parts per million (ppm).
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 240 degrees F (116 degrees C).

J. Filter Dryers:

1. Comply with AHRI 730.
2. Replaceable-core.
3. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
4. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
5. Desiccant Media: Activated alumina and activated charcoal.
6. Provide units designed for reverse flow for heat-pump applications.
7. End Connections: Socket.
8. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
9. Maximum Pressure Loss: 2 psig (14 kPa).
10. Working Pressure Rating: 500 psig (3450 kPa).
11. Maximum Operating Temperature: 240 degrees F (116 degrees C).

K. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch-(180-mm-) long assembly.
4. Working Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
5. Maximum Operating Temperature: 250 degrees F (121 degrees C).

L. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig (3450 kPa).
4. Maximum Operating Temperature: 275 degrees F (135 degrees C).

M. Receivers:

1. Comply with AHRI 495.
2. Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
3. Comply with UL 207; listed and labeled by an NRTL.
4. Body: Welded steel with corrosion-resistant coating.
5. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
6. End Connections: Socket or threaded.
7. Working Pressure Rating: 500 psig (3450 kPa).

8. Maximum Operating Temperature: 275 degrees F (135 degrees C).

N. Liquid Accumulators:

1. Comply with AHRI 495.
2. Body: Welded steel with corrosion-resistant coating.
3. End Connections: Socket or threaded.
4. Working Pressure Rating: 500 psig (3450 kPa).
5. Maximum Operating Temperature: 275 degrees F (135 degrees C).

PART 3 - EXECUTION

3.1 INSTALLATION (GENERAL)

A. Install piping as indicated on the drawings and in accordance with provisions of Section 23 0500 and the piping system application article at the end of Part 3.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Actual size and configuration of refrigerant piping shall be in conformance with the recommendations of the refrigeration equipment manufacturer.

C. Install refrigerant piping according to ASHRAE Standard 15.

D. Hang horizontal piping NPS 2 (DN 50) and smaller using a metal framing system, clamps, and insulation inserts in accordance with Section 23 0529. For pre-insulated tubing systems, remove section of factory-applied insulation at metal framing system and provide specified clamps and insulation inserts. Seal ends of piping insulation and inserts in accordance with manufacturer's instructions.

E. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

H. Install piping adjacent to machines to allow service and maintenance.

I. Install piping free of sags and bends.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment.

M. Install valves and specialties in accessible locations to allow for service and inspection.

N. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.

2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

3.2 INSTALLATION (PRE-INSULATED TUBING)

A. Install piping and seal ends of piping insulation as shown on drawings and in accordance with manufacturer's instructions and approved shop drawings.

3.3 INSTALLATION (BUILT-UP SYSTEM)

A. Install piping as shown on drawings and in accordance with manufacturer's instructions and approved shop drawings.

B. Brazed joints:

1. Install piping with brazed joints where possible.
2. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation. To permit flow and to avoid pressure build-up, make sure one end of the pipe is open.

C. Flared fittings:

1. Install piping with flared joints where required for connections.
2. Flare joints shall conform to SAE J533.

D. Threaded joints:

1. Install piping with threaded joints where required for connections.
2. Make threaded connections with pipe joint compound approved for the service, or "PTFE" tape.

E. Isolation valves:

1. Provide isolation valves in suction and discharge lines of compressors.
2. Provide isolation valves on inlet and outlet side of filter dryers. Provide an additional isolation valve and pipe and fittings to bypass the filter dryer.

F. Check valves: Install a check valve at the compressor discharge.

G. Service valves:

1. Provide service valves to enable pressure testing, refrigerant charging, and system evacuation.
2. Provide service valves between isolation valves and compressor suction connections if they not an integral part of the isolation valves or compressor equipment.
3. Provide service valves for gage taps at inlet and outlet of strainers if they are not an integral part of valves and strainers.

H. Solenoid valves:

1. Provide solenoid valves upstream from each expansion valve.
2. Provide solenoid valves in horizontal lines with coil at top.

I. Safety relief valves:

1. Install safety relief valves where required by the ASME Boiler and Pressure Vessel Code.
2. Vent safety relief valves to the atmosphere in accordance with ASHRAE Standard 15 and ASHRAE Standard 34.

J. Thermostatic expansion valves:

1. Provide thermostatic expansion valves as close as possible to distributors on evaporators.
2. Install valve so diaphragm case is warmer than bulb.
3. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
4. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

K. Strainers: Provide strainers upstream from and adjacent to solenoid valves and thermostatic expansion valves, unless they are furnished as an integral assembly for the device being protected.

L. Moisture/Liquid Indicators: Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

M. Filter driers: Provide filter dryers in liquid line between compressor and thermostatic expansion valve.

N. Flexible connectors: Provide flexible connectors at compressor connections.

O. Muffler: Provide muffler on the discharge side of the compressor, between the flexible connector and the condenser.

P. Receivers: Provide receivers sized to accommodate pump-down charge.

Q. Liquid accumulators: Provide liquid accumulator at compressor suction.

3.4 LEAK TEST

A. After the refrigeration systems have been installed, perform a leak test before evacuating the systems.

1. The cylinder of oil-pumped nitrogen shall be equipped with a shutoff valve, pressure reducing valve, cylinder pressure gauge, line pressure gauge, and bleed valve.

B. Remove controls or relief valves which could be damaged by test pressures.

C. Separate the high side from the low side and bleed in enough refrigerant to raise the system pressure to 12 to 15 psig (83 to 103 kPa). Then, using oil-pumped dry nitrogen, raise the pressures to the test pressures established as required in "Submittals" in Part 1 above.

D. Test the entire system for leaks.

E. Bleed off the pressure into cylinders, in accordance with ASHRAE Standard 147, and repair leaks. Do not attempt to repair a leak while the system is under pressure. Do not repair bad joints by remelting and adding more brazing material. Take joint apart, thoroughly clean, and remake as a new joint.

F. Retest the system if a leak is found.

G. When tests and repairs are complete, replace valves or controls removed for protection.

H. Submit test certificate required in "Submittals" in Part 1 above.

3.5 EVACUATION

A. To evacuate the system, use a vacuum pump capable of producing at least 1 mm (0.039 inches) mercury absolute vacuum. Proceed as follows:

1. Connect an accurate high vacuum gauge (Micron), such as a Stoke's or Zimmerli gauge, to the system. Do not use compound gauges.
2. Connect the vacuum pump to both the high and low sides of the system. Leave the compressor suction and discharge valves closed. Evacuate the system to 2.5 mm (0.098 inches) mercury absolute. Keep ambient air temperatures above 60 degrees F (15.6 degrees C) during the evacuation process.
3. Break the system vacuum with oil-pumped dry nitrogen. Open the compressor suction and discharge service valves and re-evacuate the system to 2.5 mm (0.098 inches) mercury absolute.
4. After the system has been double evacuated to 2.5 mm (0.098 inches) mercury absolute, close the vacuum-pump suction valve and stop the pump. Allow the system to stand under a vacuum a minimum of 12 hours and recheck the vacuum. Notify the DGS Project Manager in time for him to verify the test pressure at beginning and end of time limit, before proceeding to charge the system.

3.6 CHARGING

A. Charge the system with refrigerant through the liquid-line charging valve. Use a clean strainer-drier in the charging line, along with a pressure gauge and shut-off valve to control pressures. Before starting the compressor, ascertain that the oil sight glass, if provided, is 75 percent full, and suction and discharge valves back-seated.

3.7 FINAL START-UP PROCEDURE

A. Check out operating and safety controls in accordance with the compressor manufacturer's recommendations.

B. Recheck the oil level in the sight glass at frequent intervals. It should not drop below 50 percent level.

C. Adjust compressor suction unloaders, if provided, for proper evaporator-compressor balance to maintain the scheduled minimum discharge temperature.

D. Reinspect the system after it has been in normal operation for at least 72 hours. At this time, instruct the Government's designated personnel in the operation and maintenance of the equipment, as required in the equipment section.

3.8 LUBRICATION

A. If it becomes necessary to add oil to the system, use only the oil recommended by the compressor manufacturer.

3.9 PIPING SYSTEM APPLICATIONS

A. Provide built-up piping or pre-insulated piping for the following equipment as indicated:

1. Equipment:

a. Air-to-air packaged heat pump units
b. Ductless split-systems

2. Piping NPS1 (DN 25) and larger shall be built-up piping.
3. Piping smaller than NPS 1 (DN 25) may be built-up piping or pre-insulated tubing.

END OF SECTION

SECTION 23 3113

METAL DUCTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. HVAC metal supply, return, and exhaust ductwork and plenums in pressure classes from -2 to +10 inches w.g. (-500 to +2490 Pa).

B. Shop-fabricated or factory-fabricated ducts and fittings: Single-wall round duct.

C. Joint and sealing materials.

D. Air duct leakage testing.

1.2 RELATED SECTIONS

A. Duct identification: Section 23 0500.

B. Balancing: Section 23 0593.

C. Insulation: Section 23 0713.

D. Duct hanging: Section 23 3114.

E. Duct accessories: Section 23 3300.

F. Flexible ducts: Section 23 3346.

1.3 REFERENCES

A. ACGIH-01: American Conference of Governmental Industrial Hygienists

1. Industrial Ventilation: A Manual of Recommended Practice.

B. ASHRAE

1. ASHRAE Handbook of Fundamentals.

C. ASTM

1. ASTM C 423: Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
2. ASTM C 1071: Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
3. ASTM D 1330: Rubber Sheet Gaskets.
4. ASTM E2336: Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems
5. ASTM G 21: Determining Resistance of Synthetic Polymeric Materials to Fungi.
6. ASTM G 22: Determining Resistance of Synthetic Polymeric Materials to Bacteria.

D. SMACNA

1. HVAC DCS: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
2. RIDCS: SMACNA Round Industrial Duct Construction Standards.

3. HVAC Air Duct Leakage Test Manual.

E. UL 181: Factory-Made Air Ducts and Air Connectors.

1.4 DEFINITIONS

A. Seam: Joining of two longitudinal (parallel to the direction of airflow) edges of duct surface material. All other duct surface connections are joints.

B. Joints: Transverse joints (perpendicular to the direction of airflow); branch and subbranch intersections; duct collar tap-ins; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Do not change the layout or configuration of the duct system except as specifically approved in writing. Accompany requests for modifications with calculations showing that the proposed design will provide the original design results without increasing system total pressure.

1.6 SUBMITTALS

A. Shop drawings:

1. Schedule of duct systems with applicable pressure classes and leakage classes.
2. Fabrication, assembly, and installation for each duct system: Indicate duct dimensions, sheet metal thickness, reinforcement spacing, and seam and joint construction; and components and attachments to other work.
3. Calculations required as specified in the article “System Performance Requirements” above.
4. Include layout drawings for the entire ductwork system, drawn at the same scale as the contract drawings, except no smaller than 0.125 inch equals one foot.
5. Schedule of sealing methods for each type of seam and joint.

B. Product data:

1. Factory-fabricated ducts and fittings.
2. Joint and sealing materials.
3. Manufacturer’s installation instructions.

C. Test reports: Air Duct Leakage Test Summary: Submit data on forms as indicated in the SMACNA HVAC Duct Leakage Test Manual. (See sample form at end of section.)

1.7 QUALITY ASSURANCE

A. Specified and scheduled duct construction exceeds SMACNA requirements. Comply with specifications and schedules, and for materials or methods not specified or scheduled, comply with SMACNA HVAC DCS and RIDCS.

B. Comply with NFPA 90A and 90B.

C. Where shop-fabricated ductwork and fittings are permitted, products shall meet or exceed the quality of material, quality of construction, and performance of the basis of design factory-fabricated product.

D. Where shop-fabricated ductwork and fittings are proposed, contractor shall provide a listing of ten comparable projects completed within the last five years using shop-fabricated ductwork and fittings of the type proposed as evidence of quality and performance.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide specified or noted products, or comparable product by one of the following:

1. Factory-fabricated ducts and fittings:

a. Eastern Sheet Metal
b. Hamlin Sheet Metal
c. LaPine Metal Products
d. Linx Industries
e. McGill Airflow Corp.
f. MKT Metal Manufacturing
g. Phoenix Metals
h. Semco Mfg. Inc.
i. SPIRAmir
j. Or approved equal.

2. Manufactured joint connectors:

a. Ductmate Industries
b. C.L. Ward & Family Inc.
c. Or approved equal.

B. Special use ducts and fittings: Scheduled manufacturers and named products are intended to set a standard for materials, quality of construction, and performance.

2.2 MATERIALS

A. Metal sheets:

1. Galvanized steel sheets: Lock-forming quality, ASTM A 653/A 653M, coating designation G90 (Z275).

B. Tie rods: Galvanized steel, minimum diameter 0.25 inch (6 mm) for ducts up to 36 inches (900 mm); 0.375 inch (9 mm) for ducts over 36 inches (900 mm).

2.3 SHOP-FABRICATED OR FACTORY-FABRICATED DUCTS AND FITTINGS

A. Single-wall, rectangular duct and fittings:

1. Fabricate according to SMACNA HVAC DCS.

B. Single-wall, flat lock longitudinal-seam round duct and fittings:

1. Fabricate according to SMACNA HVAC DCS.
2. Seam: Flat lock; snap-lock seam not permitted.

C. Single-wall, spiral round duct and fittings for concealed applications: Provide the following construction unless otherwise indicated for special applications,

1. Material: Galvanized steel.
2. Seams: Spiral lock seam.
3. Joint basis of design: Round fittings, McGill Airflow "Uni-Seal" fittings, lap and riveted/screwed and sealed.
4. Fittings for branch connections shall be conical type.
5. Centerline radius of elbows shall be 1.5 times the diameter.
6. Duct access door basis of design: Type AR-W.
7. Basis of Design: McGill Airflow "Uni-Seal" spiral duct with "Uni-form" fittings.

2.4 JOINT AND SEALING MATERIALS

A. Flexible joint material for connections to vibrating equipment: Specified in Section 23 3300, Duct Accessories.

B. Duct joint and seam sealants: UL classified, fire-resistive, conforming to NFPA 90A and 90B, high pressure type (up to 10 inches (2490 Pa) SMACNA pressure class), the following products are the basis of design:

1. Indoor application: Hardcast "Iron Grip" (IG-601) brush-on water-based vinyl acrylic sealing mastic.
2. Flange gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

PART 3 - EXECUTION

3.1 COORDINATION

A. Before fabricating ductwork, make field measurements and coordinate layout of ductwork shown on the drawings with building components and work of other trades. Resolve conflicts and obtain written approval for deviations before fabrication or buying ductwork.

B. Provide for and install control dampers, manual volume dampers, backdraft dampers, smoke dampers, thermometers, coils, sound attenuators, duct accessories and similar equipment furnished under this or other sections of the specifications.

C. Coordination with other work:

1. Wall, partition, ceiling, and floor penetrations:

a. Penetrations with fire dampers, smoke dampers, or fire/smoke dampers: Connect ductwork to the damper in accordance with the damper listing after the damper installation is complete. Do not install the ductwork through the wall.
b. Penetrations with fire dampers, smoke dampers, or fire/smoke dampers:

1. Fill void between the architectural element and the duct with mineral wool.
2. Provide metal trim angles around the perimeter of the rectangular duct.
3. Provide a slip on flange around the perimeter of round or flat oval ducts.

2. Exterior wall penetrations: Flash ducts passing through exterior walls as detailed on the drawings.

3. Louvers: Slope ductwork down toward the louver. Provide connections as indicated below:

a. Ductwork connection full size of louver: Provide angles, flanges, or damper collars as required to connect the ductwork to the louver.
b. Ductwork connections smaller than the full size of the louver: Blank off any unused portion of the louver with double-wall insulated metal panels with metal faces constructed of the same material as the connecting duct, and 1.5 inch (38 mm) thick minimum fiberglass insulation. Seal edges of panel insulation with sheet metal channels. Connect ductwork to insulated metal panel with using angles or flanges.
c. Damper connection to louver: Provide metal angle or channel frames as required for mounting ATC dampers and manual dampers to louvers.

4. Electrical panels and equipment:

a. Do not install ductwork over electrical panels and equipment unless otherwise indicated.
b. Where ductwork must be installed over electrical panels and equipment, provide aluminum sheet metal drain troughs under piping with drains piped to a safe location.

5. Accessories with frames: Where ATC dampers and other accessories with frames are mounted in ductwork, connect ductwork to frames in a manner to provide 100 percent free area for air passage. Seal ductwork connections to frames with gaskets or duct sealant. Secure connections with pop rivets or sheet metal screws spaced no more than 3 inches (75 mm) on centers around both sides of entire frame.

3.2 INSTALLING METAL DUCTWORK

A. Dimensions indicated on drawings are outer dimensions of ducts. Dimensions indicated for double-wall ducts are outer dimensions of outer wall.

B. Construct ductwork using the Duct Construction Schedule on the drawings. Schedule includes duct system pressure class requirements, minimum sheet metal gauges, leakage allowances, and maximum reinforcement spacing. These requirements exceed the requirements of SMACNA HVAC DCS. Engineered duct systems using metal gauges or reinforcing less than required in the schedules on the drawings are not acceptable.

C. Material: Construct ductwork of galvanized steel, except where another material is noted on drawings or specified.

D. Joints: Provide one of the following duct joints, except where other criteria are noted on the drawings or specified. Snap-lock or flat-lock seams are not acceptable.

1. Joint connections constructed in accordance with SMACNA HVAC DCS,
2. Manufactured duct connection system basis of design: Ductmate Industries “Ductmate,” selected to assure compliance with leakage factors indicated on the drawings.

E. Where specific materials and seam and joint construction are specified for a specific application, all ductwork carrying any concentration of air for that application, no matter how dilute, shall be constructed according to the requirements of the application.

F. Provide duct systems complete with built-in accessories as specified herein, in other sections of the specifications, as indicated on the drawings, and, where not otherwise indicated, in accordance with SMACNA HVAC DCS.

G. Thoroughly clean duct and duct fittings before they are installed, and keep them clean until the acceptance of the completed work. Use a duct cap cover on all unfinished ends to prevent moisture, dirt particles, dust, and debris from entering the installed ductwork during construction.

H. Install metal ductwork neat in appearance. Interior surfaces shall be smooth and free of obstructions. Duct lines shall be true and smooth.

I. Contractor has the option to eliminate reducing transitions and extend ductwork full size, providing space is available and conflict with work of other trades does not occur.

J. Make bends and turns in ductwork using offsets and curved or square elbows as indicated on the drawings. Provide full radius elbows (centerline radius equals 1.5 times duct width). Provide turning vanes in square elbows. Make 90-degree branch duct connections using 45-degree entry fittings unless otherwise indicated.

K. Generally, it is intended that horizontal ductwork be a minimum of 10 inches (255 mm) above suspended ceiling (where applicable) to allow removal of ceiling panels and ceiling-mounted light fixtures and devices. Coordinate duct installation to achieve that clearance wherever possible.

L. Unless otherwise indicated, exposed ductwork shall be mounted as high as possible.

M. Brace large ductwork connected to fans and air handling units with metal angles to prevent vibration and duct damage, and to reduce noise.

N. Construct gravity duct systems (nonfan-powered), such as pressure relief ducts and transfer ducts, in accordance with SMACNA HVAC DCS minimum one inch pressure class unless otherwise scheduled.

O. Cross break or bead ducts of dimensions of 12 inches (305 mm) and over in pressure classes under 2 inches (500 Pa).

P. Where ducts will be exposed, remove labels and clean surfaces. Where required, prepare surface for painting.

Q. Single-wall plenums, casings, and access doors: Construct in accordance with SMACNA HVAC DCS.

3.3 INSTALLING ROUND DUCT

A. Provide round single-wall and double-wall ductwork where indicated on plans.

B. Assemble spiral round ducts and fittings using duct sealant and sheet metal screws as recommended by the manufacturer.

C. Single-wall ductwork:

1. Exposed: Spiral round duct and fittings unless otherwise indicated.
2. Pressure class 3.0 inches w.g. or greater: Spiral round duct and fittings unless otherwise indicated.
3. Serving other than a single diffusers: Spiral round duct and fittings unless otherwise indicated.
4. Concealed, pressure class of 2.0 inches w.g. or less and serving a single air outlet: Longitudinal-seam duct and fittings.

3.4 SEALING DUCTWORK

A. Seal all longitudinal and transverse joints, seams, and connections with the following exceptions:

1. Sealant may be omitted from welded joints and seams provided duct leakage is within the required tolerance.
2. Sealant may be omitted from locking-type joints and seams (other than snap-lock and button-lock) in ductwork with a pressure class below 2 inches of water column (500 Pa) where permitted by code requirements and provided duct leakage is within the required tolerance.

B. Sealing leakage performance: Seal ductwork to meet duct leakage factors scheduled on the drawings.

C. Sealing procedures:

1. Prior to sealing, ductwork shall be clean and dry, free of oil or grease.
2. Apply sealant in accordance with the manufacturer's recommendations.
3. Allow time for sealant to dry or cure, in accordance with manufacturer's recommendations, before leak testing.

D. Sealant material:

1. Galvanized steel ductwork: Brush-on or pressure sensitive sealant, as applicable.

3.5 AIR DUCT LEAKAGE TESTS

A. Continuously examine ductwork during construction to ascertain that it is sealed properly.

B. General test procedures:

1. Leakage test procedures shall be in accordance with SMACNA Leakage Test Manual.
2. After installation and prior to insulating, test all ductwork for air leakage. Ducts to be tested, test pressures, and leakage factors (maximum volume of leakage per 100 square foot (9.3 square meter) of duct surface area) shall be as scheduled on the drawings.
3. The ductwork quantity to be tested exceeds SMACNA leakage test manual recommendations.
4. Conduct tests before any equipment is connected that would be subject to damage from the test pressure. Provide temporary blank-offs or caps.
5. Notify parties whose presence is necessary for the test; and in all cases, the Architect and testing and balancing subcontractor in writing at least two normal work days prior to the actual test.
6. While system is under test pressure, survey joints for audible leaks. Mark leakage points, shut down blower, and make repairs. Retest after duct sealant has dried or cured.
7. If test duct sections exceed the allotted leakage levels, locate sources of leakage, make repairs and repeat test procedures until acceptable leakage levels are demonstrated.

END OF SECTION
Leakage test form follows Section

PROJECT NAME _____ PROJECT NO. _____ PAGE _____ OF _____

AIR DUCT LEAKAGE TEST SUMMARY

AIR SYSTEM _____
FAN CFM (Q) _____

LEAKAGE CLASS (GL) _____
SPECIFIED TEST PRESSURE (Pt) _____
DUCT CONSTRUCTION PRESSURE CLASS (P_c) _____

DESIGN DATA				FIELD TEST DATA RECORD							
SUBJECT DUCT	SURFACE AREA (FT^2)	ALLOWABLE LEAKAGE		DIAMETER		PRESSURE "W.G."		DATE	PERFORMED BY	WITNESSED BY	ACTUAL CFM
		FACTOR (CFM/100 FT^2)	CFM (TEST SECTION)	ORIFICE	TUBE	DUCT	ACROSS ORIFICE				
TOTAL SYSTEM											
TEST SECTION(S)											

SECTION 23 3114

HANGERS AND SUPPORTS FOR DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Duct hangers and supports.

B. Trapeze duct hangers.

C. Fasteners.

1.2 RELATED SECTIONS

A. HVAC Duct Insulation: Section 23 0713.

1.3 REFERENCES

A. ASTM International

1. ASTM A 307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
2. ASTM F 3125: Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated

B. American Welding Society

1. AWS-D.1.1: Structural Welding – Steel

C. Metal Framing Manufacturer's Association

1. MFMA-4: Metal Framing Standards Publication
2. MFMA-103: Guidelines for the Use of Metal Framing

D. Manufacturer's Standardization Society

1. MSS SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

E. SMACNA

1. HVAC Duct Construction Standards - Metal and Flexible

1.4 SUBMITTALS

A. Product data:

1. Provide manufacturer's literature showing compliance with specifications for each type of framing system, fastener and accessory materials.
2. Provide a schedule of building attachment types and associated attachment hardware and methods.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS

A. General: Comply with requirements of SMACNA's HVAC Duct Construction Standards - Metal and Flexible.

B. Threaded rod: Continuously threaded, size and spacing in compliance with SMACNA's HVAC Duct Construction Standards - Metal and Flexible.

1. Zinc-plated or galvanized carbon steel for indoor applications.
2. Stainless steel for outdoor and corrosive applications.

C. Nuts and washers: Provide the same material used for threaded rods.

D. Straps: Match duct material, size and spacing in compliance with SMACNA's HVAC Duct Construction Standards - Metal and Flexible.

E. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum, or galvanized steel coated with zinc chromate, shapes and plates.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

2.2 FASTENERS

A. Mechanical expansion anchors:

1. Self-drilling type expansion shields or machine bolt drop-in anchors for drilled holes. Fasteners to floor slabs shall be vibration and shock resistant. Load applied to fasteners shall not exceed 25 percent of manufacturer's stated load capacity in 3500 psi (24,000 kPa) concrete. Provide zinc-coated anchors for indoor applications and stainless-steel anchors for outdoor applications.
2. Basis of design: ITT Phillips Anchors "Red Head."

B. Fasteners to wood construction: Lag bolts.

C. Bolts, nuts, and washers: ASTM A 307, or ASTM F 3125 where high strength is required.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible.

B. Provide hangers, supports, fasteners, and attachments as required to properly support ductwork from the building structure.

C. Provide supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Hanger Spacing: Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible for maximum hanger spacing. Provide hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1220 mm) of each branch intersection.

E. Where required, provide structural steel shapes or metal framing system channels and hardware to transfer load from a support location to multiple locations in the structure in order to get support from an appropriate location or to increase the strength of the connection to the structure.

F. Support horizontal rectangular ductwork from above with trapeze hangers and threaded rod or straps where possible, unless otherwise indicated.

1. Ducts 54 inches (1370 mm) wide and under:

a. Support with trapeze hangers or straps.
b. Strap hangers, where used, shall extend down sides of ducts and attach to underside with at least two sheet metal screws per strap.

G. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

H. Fabricate wall-mounted and floor-mounted supports using metal framing systems or structural steel where required.

I. Trim threaded rods with a maximum excess length of 1 inch (25 mm). Provide protective rubber red end caps on the ends of threaded rods exposed and within 8 feet (2.4 meters) of the floor, roof, or grade below.

J. Install lateral bracing to prevent swaying.

K. Install supports so that duct loads not be transmitted to connected equipment.

L. Provide trapeze hangers where required to hang ductwork using threaded rod.

1. Weld steel according to AWS D-1.1.
2. Hang with threaded rods.
3. Design trapeze angers and supports based on supported load plus a 50 percent minimum safety factor.

3.2 BUILDING ATTACHMENTS:

A. Attaching to concrete slabs and composite slabs:

1. Obtain approval from the structural engineer and confirm allowable loads prior to supporting ductwork from concrete slabs or composite slabs. Where approved, provide one of the following as required:

a. Mechanical expansion anchors and steel bolts or rods.
b. Screws designed for attachment to concrete.
c. Powder actuated fasteners.

B. Attaching to wood construction:

1. General: Obtain approval from the structural engineer and confirm allowable loads prior to supporting ductwork from wood beams. Where approved, provide lag bolts.

2. Trusses: Follow roof truss manufacturers' recommendations for attachment locations, loads, spacing, and methods of attachment.
3. Joists: Provide MSS SP-58 Type 34 side beam connectors.

END OF SECTION

SECTION 23 3300

DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Flexible joint fabric.

B. Bird screen.

C. Air turning vanes.

D. Spin-in fittings.

E. Duct access doors.

F. Dampers.

G. Duct clamps.

1.2 RELATED SECTIONS

A. Access doors: Division 08.

B. Diffusers, registers, and grilles: Section 23 3713.

1.3 REFERENCES

A. AMCA 210: Laboratory Methods of Testing Fans for Rating.

B. ASTM E 477: Test for Measurement of Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

C. ASTM E 2016: Standard Specification for Industrial Woven Wire Cloth.

D. NFPA 90A: Installation of Air Conditioning and Ventilating System.

E. NFPA 90B: Installation of Warm Air Heating and Air-Conditioning Systems.

F. NFPA 701: Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

G. SMACNA-05: Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems.

H. SMACNA HVAC DCS: HVAC Duct Construction Standards, Metal and Flexible.

1.4 SUBMITTALS

A. Product data: Each type of duct accessory included in the project.

B. Shop drawings: Detail equipment assemblies and indicate dimensions, loadings, required clearances, method of field assembly, components, locations, and size of each field connection. Detail these accessories:

1. Special fittings and manual and automatic volume damper installations.

C. Certifications: Certified test data for dynamic insertion loss; sound power levels; airflow performance data, and static pressure loss.

1.5 QUALITY ASSURANCE

A. Work of this section shall comply with NFPA 90A and 90B, and SMACNA HVAC DCS.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Manufacturers' names and specific products are described in the articles below to set a standard for materials, quality of construction, options and details, and performance. Provide named products, or equal products by other manufacturers.

2.2 FLEXIBLE CONNECTIONS

A. Flexible joint fabric: Woven glass fabric with coating, complying with NFPA 701 for fire retardance and NFPA 90A for use in duct systems.

1. For use indoors:

a. Coated with polychloroprene (DuPont "Neoprene"), 30 ounces per square yard (850 g per 0.8 square meter).
b. Basis of design: Ventfabrics "Ventglas."

2.3 SCREENS

A. Bird screen: ASTM E 2016, general industrial-use wire cloth, Grade C, medium light or heavier, nominal 0.5-inch (13-mm) mesh and 0.063-inch (1.6-mm) wire diameter, aluminum or stainless steel.

1. Frame: Removable, rewirable, of same material and finish as the duct or accessory to which it is installed.

2.4 MANUFACTURED UNITS

A. Air turning vanes: Double vane type, constructed in accordance with SMACNA HVAC DCS, from the same material as the duct.

B. Spin-in fittings in accordance with SMACNA HVAC DCS are acceptable for a round take-off connection from a rectangular duct, provided they meet the duct pressure classification.

2.5 DUCT ACCESS DOORS

A. SMACNA standard construction. Access doors to fire protection devices shall comply with NFPA 90A.

B. Construction: Door and frame fabricated of 24 gauge galvanized steel, minimum size 16 inches (406 mm) by 16 inches (406 mm), or 16 inches (406 mm) by maximum duct size.

C. Door: Hinged with continuous piano hinge; number of cam latches to suit door size. Insulated doors shall be double pan construction, one inch (25 mm) thick with one inch (25 mm) thick minimum 3.5 pound (56 kg per cubic meter) density fiberglass insulation cut full to require forcing into the pan.

D. Gaskets: Continuous around perimeter, sealing frame to duct and door to frame, neoprene or foam rubber.

E. As an option, provide round access doors, complete with safety holding cable, 12 inches (305 mm) diameter.

F. Basis of design:

1. Square or rectangular access doors: Air Balance, Inc., Model FSA-100-H or equal by Ruskin, Inc., Airstream Products Company, Inc., or Commercial Acoustics.
2. Round access doors: Ventfabrics "Ventlok Twist-In."

2.6 DUCT ACCESS DOORS – ROUND

A. Sandwich style access door, insulated or uninsulated to match ductwork, metal material to match ductwork interior and exterior, rated for operation at pressures up to positive 20 inches w.g. (5,000 Pa) and down to negative 10 inches w.g. (2,500 Pa), threaded fasteners with rotating handles to draw inner and outer pieces of the door together.

2.7 DAMPERS

A. Material

1. Where aluminum duct is required by the specifications, dampers shall be all aluminum construction in lieu of galvanized steel.
2. Where stainless steel duct is required by the specifications, dampers shall be all stainless-steel construction in lieu of galvanized steel.

B. Manual volume dampers:

1. 13 inches (330 mm) and larger in height: Balanced multi-louver, opposed-blade type with maximum blade width of 8 inches (205 mm), with corrosion resistant, molded synthetic sleeve type bearing and 0.375-inch (9.5-mm) square control shaft; and with damper regulators designed with 2-inch-high base for mounting on externally insulated duct.

a. Basis of design:

(1) Damper: Ruskin Model MD 35.
(2) Regulator: Young Regulator Co. Model No. 443B-3/8.

2. 12 inches (305 mm) or less in height: Constructed from 16-gauge metal with hemmed edges, 0.375-inch (9.5-mm) square rod, damper regulator designed with 2-inch high base for mounting on externally insulated duct and end bearing.

a. Basis of design:

(1) Regulator: Young Regulator Co. Model No. 443B-3/8
(2) End bearing: Young Regulator Co. Model No.429 FD.

3. Provide locking regulators.

C. Counterbalanced backdraft dampers:

1. Constructed with galvanized steel channel frame. Blades shall be 16-gauge minimum galvanized-steel with neoprene blade seals and neoprene jamb seals, maximum width 7 inches (178 mm), mounted on a steel shaft with ball bearings. Field adjustable counterbalance. Frame shall have a rust-inhibitive coating applied at the factory.
2. Basis of design: Ruskin Type CBS7.

D. Counterbalanced backdraft dampers for use in fan discharge:

1. Constructed with galvanized steel channel frame. Blades shall be 18-gauge minimum galvanized-steel airfoil type, with EPDM blade seals and neoprene jamb seals, maximum width 7 inches (178 mm), mounted on a steel shaft with ball bearings. Individual blades shall be connected together to work in unison. Field adjustable counterbalance. Frame shall have a rust-inhibitive coating applied at the factory.
2. Basis of design: Ruskin Type CBS8.

2.8 DUCT CLAMPS

A. Duct clamps for flexible duct and flexible fabric connections: Positive locking drawbands able to conform to any shape. Fabricate from a single piece of stainless steel, with hex screw and worm gear.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Duct accessories shall be mounted or installed properly in accordance with the manufacturer's instructions and as indicated on the drawings.

3.2 INSTALLING FLEXIBLE CONNECTIONS

A. Flexible connections: Install using flexible joint fabric where duct connects to motor-driven equipment, and in other locations shown on drawings. Securely clamp flexible connection to duct and collar with duct clamps, providing 1 inch (25 mm) slack. Stitch seams with fiberglass thread.

1. Flexible connections are not required where duct connects to air-handling equipment with internally isolated fans.

3.3 INSTALLING SCREENS

A. Install bird screens in outdoor air and exhaust air connections.

B. Install bird screen at open ended duct terminations and where indicated on mechanical drawings.

3.4 INSTALLING MANUFACTURED UNITS

A. Install necessary devices to balance the air flow to produce air quantities at outlets as indicated on the drawings.

B. Install turning vanes in 90-degree square elbows.

C. Install spin-in fittings as indicated on the drawings. Mechanically fasten to duct main with screws or rivets.

3.5 INSTALLING DUCT ACCESS DOORS

A. Install duct access doors in ductwork for access to control devices, and any other devices, equipment, or components requiring maintenance, service, or adjustment and located inside ducts or adjacent equipment.

3.6 INSTALLING DAMPERS

A. Install dampers at locations indicated on drawings and where required to properly balance the systems and to deliver the air quantities indicated. Each damper shall have substantial operators of proper size with locking facilities.

END OF SECTION

SECTION 23 3346

FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Insulated flexible ducts.

1.2 REFERENCES

A. UL 181: Factory-Made Air Ducts and Air Connectors.

B. NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems

1.3 SUBMITTALS

A. Product data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURED SPECIAL FLEXIBLE DUCTS AND FITTINGS

A. Insulated flexible duct: UL 181, Class 1, factory pre-insulated, complying with NFPA 90A

1. Core: Non-metallic airtight polyester supported by galvanized steel wire helix.
2. Insulation: Fiberglass, R-6 (RSI-1.06) minimum.
3. Vapor barrier: Aluminized and reinforced.
4. Pressure Rating: 10 inches water gauge (2,500 Pa) positive and 1 inch water gauge (250 Pa) negative up to an 18 inch (457 mm) diameter.
5. Maximum Air Velocity: 4,000 feet per minute (20 meters per second)
6. Temperature Range: Minus 20 to plus 210 degrees F (Minus 29 to plus 99 degrees C).

B. Flexible duct connectors:

1. Clamps: Stainless-steel bands with cadmium-plated hex screw to tighten band with a worm-gear action, to suit duct size.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before fabricating ductwork, make field measurements and coordinate layout of ductwork shown on the drawings with building components and work of other trades. Resolve conflicts and obtain written approval for deviations before fabrication.

B. Generally, it is intended that all horizontal ductwork be a minimum of 10 inches (255 mm) above suspended ceiling (where applicable) to allow for removal of ceiling panels and ceiling-mounted light fixtures and devices.

C. Provide insulated flexible duct where shown on drawings:

1. Install ducts fully extended.
2. Do not bend ducts across sharp corners.

3. Lay out bends and turns with the longest practicable radius.
4. Bends of flexible ducting shall not have an inside radius less than one duct diameter.
5. Avoid contact with metal fixtures, water lines, pipes, or conduits.
6. Install flexible ducts in a direct line, without twists, or turns.
7. Lengths shall not exceed 10 feet (3,000 mm).

D. Connections: Coat at least 3 inches inside the end of the flexible duct core with duct sealant, install over the rigid duct, and secure with a duct clamp. After replacing the insulation and vapor barrier, secure with another duct clamp.

E. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches (38 mm) wide or wider and spaced a maximum of 48 inches (1,200 mm) apart. Maximum centerline sag between supports shall not exceed 1/2 inch (13 mm) per 12 inches (300 mm).
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches (1,800 mm) on center.

END OF SECTION

SECTION 23 3400

HVAC FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Centrifugal fans.

B. Exhaust fans.

C. Accessories.

1.2 RELATED SECTIONS

A. Vibration control supports: Section 23 0548.

B. Motors: Section 23 0513.

1.3 SUBMITTALS

A. Shop drawings detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

1. Reports of specified factory tests.

B. Product data: Include rated capacities of each unit, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:

1. Certified fan performance curves with system operating conditions indicated. Include static pressure, brake horsepower, and static efficiency plotted against air volume.
2. Certified fan sound power ratings.
3. Motor ratings and electrical characteristics, and motor and electrical accessories.
4. Material gauges and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.

C. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed and field-installed wiring.

D. Maintenance data as required in Division 01 and Section 23 0101.

E. Submit product data which verifies compliance with ASHRAE 90.1, or provide certified performance ratings by a qualified independent testing agency.

1.4 QUALITY ASSURANCE

A. Fans shall be tested and rated in accordance with the applicable AMCA Standard Test Code and Certified Rating Program and bear AMCA Certified Air Rating Seal.

B. Fan selections shall be made to the right of the peak static pressure point, but not on any “flat” portion of the fan curve. Generally, fan selection shall be in the 50 percent to 80 percent range of wide open volume.

C. HVAC equipment shall meet the energy performance requirements of ASHRAE 90.1.

D. UL label and local testing (if required): Section 23 0500, Common Work Results for HVAC.

1.5 COORDINATION

A. Coordinate the installation of roof curbs, supports, and roof penetrations. Fan installation shall not reduce weathertightness of roof nor violate roof warranty.

B. Coordinate colors selected for roof-mounted fans with colors of other roof-mounted equipment.

1.6 EXTRA MATERIALS

A. Provide adjustments in drives and sheaves and belts as required at time of system balancing to obtain the airflow and static pressure indicated on drawings.

PART 2 - PRODUCTS

2.1 FANS, GENERAL

A. Fan size, capacity, class, arrangement, accessories and discharge shall be as scheduled on the drawings.

B. Motors shall meet the requirements of Section 23 0513, Common Motor Requirements for HVAC Equipment, including power factor and efficiency.

C. Belt drives and exposed rotating shafts shall be provided with guards meeting OSHA and MOSHA requirements.

D. Fans shall have self-aligning, ball-type bearings designed for thrust load, and grease fittings shall be accessible for relubrication. Fans shall be statically and dynamically balanced.

E. Motors for belt-driven units shall have adjustable variably pitched cast iron sheaves to allow a 10 percent increase or reduction in speed. Belts shall be sized for minimum 150 percent brake horsepower (bhp).

1. Include one change in drive sheave for each unit if necessary to obtain correct air quantities at time of testing, adjusting, and balancing.

2.2 CENTRIFUGAL FANS

A. Basis-of-design product: Subject to compliance with requirements, provide the specified Twin City product, or comparable product by one of the following:

1. Aerovent, a Twin City Fan Company
2. Briedert Air Products
3. Carrier Corp.
4. Clarage Fan Co.
5. Greenheck Fans
6. Howden Buffalo Inc.
7. Loren Cook Co.
8. New York Blower Co.
9. Peerless Blowers
10. Penn Barry

11. Trane Co.
12. Twin City Fans and Blowers
13. Or approved equal.

B. Housing: Steel, with seams continuously welded, with angle or channel side support members and motor access plates. Discharge outlet shall conform to AMCA recommended standards. Inlet shall have spun cones to provide streamlined airflow into fan wheel. Fan shall have hinged access door in scroll extended for one-inch-thick insulation.

1. Fans installed outdoors: Weatherproof, including cover for motor and drive.
2. Base-mounted centrifugal fans 30-inch wheel diameter and larger shall have horizontal split housings.

C. Bearings shall be heavy-duty, self-aligning, ball type with a design average life of 200,000 hours or more based on the optimum speed range of the fan's AMCA class and furnished with grease fittings, extended to be accessible from outside of ducts. Bearings shall be rigidly supported on structural supports connected to the structural base member of the fan. Fan shafts shall be of cold-drawn or forged steel, turned, ground, polished and machined to close tolerance, and keyed to fan wheel.

D. Motor, unless scheduled otherwise, shall be 1750 maximum rpm and suitable for voltage noted on drawings. Two-speed motor, where scheduled, shall be dual winding type. Motors shall have adjustable bases.

E. Fans mounted without duct connections shall be provided with inlet screens.

F. Finish:

1. Complete fan assemblies shall have two coats of enamel paint.
2. Fans mounted on the roof shall be painted to match other roof-mounted equipment.

2.3 EXHAUST FANS

A. Basis-of-design product: Subject to compliance with requirements, provide the specified Acme Engineering and Manufacturing product, or comparable product by one of the following:

1. Aerovent, a Twin City Fan Company
2. Acme Engineering and Manufacturing
3. Greenheck Fans.
4. Jenco Fan.
5. Loren Cook, Inc.
6. Penn Barry.
7. Twin City Fans and Blowers.
8. Or approved equal.

B. In-line fan (square): Fan housings, fan wheel and other parts used in the fabrication of the units shall be aluminum or steel of design and gauge standard with the manufacturer. Lubricating tubes shall be provided from the shaft bearings to the housing. Units shall have support brackets for mountings as shown on drawings. Impeller shall be airfoil blades welded to the hub and have non-overloading characteristics. Wheel shall be statically and dynamically balanced. Wheels shall be backward-inclined, non-overloading, with aluminum blades. Inlet cones shall be provided. Directly driven units shall have motors out of air stream and shall be prewired to an external twist-lock receptacle.

2.4 ACCESSORIES

A. Bird screens: Specified in Section 23 3300, Duct Accessories.

B. A disconnecting switch without overload protection shall be included under the weather hood of roof-mounted units, completely factory-wired to motor and mounted independently of the motor. Motors for directly driven units shall be provided with solid-state variable speed control connected downstream on the load side of the disconnecting switch, unless otherwise indicated on the drawings.

C. Provide each unit with self-operating aluminum backdraft damper and frame unless indicated otherwise on the drawings. Damper blades shall operate in unison and shall be counterbalanced or otherwise provided with facilities to positively open under fan suction and to close tight when subject to backdraft.

D. Identification: Each fan shall be identified with a fan number no less than 0.5 inch high, as shown in the fan schedule, on an aluminum strip riveted to hood of roof fans and on the motor side of frame for wall fans.

PART 3 - EXECUTION

3.1 INSTALLATION, EXHAUST FANS

A. Fans shall be installed in compliance with the manufacturer's recommendations. Ventilating and ceiling exhaust fans shall be supported from the building structure, not attached to the ceiling suspension members or discharge grille system.

B. Coordinate with air balancing and provide adjustments, sheaves, and belts as required in Part 1 above to obtain the airflow and static pressure indicated on the drawings.

3.2 OPERATING INSTRUCTIONS

A. As specified in Section 23 0500, provide operating instructions.

B. Provide at least 4 hours of additional instruction time for the equipment specified in this section, consisting of 1 period of 4 consecutive hours.

END OF SECTION

SECTION 23 3713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ceiling- and wall-mounted diffusers, registers, and grilles.

1.2 RELATED SECTIONS

A. Balancing: Section 23 0593.

1.3 REFERENCES

A. NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems.

1.4 SUBMITTALS

A. Product data: Each type of diffuser, register and damper, and grille, including frames and accessories, and performance data.

B. Shop drawings:

1. Schedule, including size, location, function, and finish of each diffuser, register, and grille.
2. For each air control device, provide information required to balance the system. Include the factor for each size and type of device for converting velocity to volume.

    a. Include this information in Operating and Maintenance Manuals.

C. Samples: Manufacturer's complete line of color chips for anodized aluminum linear grilles and diffusers.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Grilles, registers and diffusers:

1. Hart and Cooley Inc.
2. Krueger.
3. Metalaire.
4. Nailor Industries, Inc.
5. Price Company.
6. Titus Products.
7. Or approved equal.

2.2 DIFFUSERS, REGISTERS, AND GRILLES

A. Devices of one of the named manufacturers, with performance data, characteristics, features, and accessories of the model or type specified or indicated on the drawings. Model numbers specified below are Krueger except as noted otherwise.

B. See architectural drawings for type of walls and ceilings where diffusers, grilles, and registers are required. Coordinate margin and frame of each device with the substrate in which it will be installed. Where devices are installed in suspended ceilings, assure that they will fit correctly in the type of suspension supports shown or specified.

C. Materials and finish:

1. Construction:

a. Steel where mounted in ceilings.
b. Either aluminum or steel where mounted in walls near ceiling.
c. Heavy-duty steel where mounted in walls near floor.
d. Welded or mechanically fastened cores in diffusers located in gymnasium.

2. Aluminum devices shall be all aluminum construction, including dampers, where specifications call for aluminum or stainless-steel ductwork.
3. Finish: Manufacturer's standard white enamel, suitable for final finish or for field painting, unless indicated otherwise.

D. Where narrow margin grilles and registers are specified or indicated on the drawings, they shall be provided with mounting frames except where mounted on ductwork.

2.3 SUPPLY DIFFUSERS

A. Throw length is based on performance data of the scheduled or specified manufacturer and model. Select units of other manufacturers whose performance data meet the required conditions. Throw direction of square and rectangular ceiling diffusers shall be four-way unless otherwise indicated on the drawings.

B. Square and rectangular ceiling diffusers: Square, rectangular, or round neck and removable core. Each unit shall have a straightening grid. The grids shall be set at right angles to one another. Basis of design: Krueger Series SH.

1. Frame Style 23 (panel diffuser): Diffusers mounted in nominal 24 by 24-inch (600 by 600-mm) or 24 by 48-inch (600 by 1200-mm) flat steel panels as indicated on the drawings, to lay into suspended ceiling grid of acoustical ceilings.
2. Frame Style 22 (surface mount): Diffuser with flat frame to mount at underside of plaster or gypsum wallboard ceilings.

2.4 SUPPLY GRILLES AND REGISTERS

A. For registers, provide opposed-blade dampers with linkage and adjustment through grille face with a screwdriver or allen wrench.

B. Wall-mounted near ceiling:

1. Grilles and registers, double deflection with horizontal face bars, minimum 1.25-inch (32-mm) overlap margin.
2. Basis of design:

a. Grilles: Krueger 5880H (aluminum).

2.5 RETURN AND EXHAUST GRILLES AND REGISTERS

A. For registers, provide opposed-blade dampers with linkage and adjustment through grille face with a screwdriver or allen wrench.

B. Ceiling-mounted and wall-mounted near ceiling: Grilles and Registers, fixed horizontal face bars set at 35 to 45 degrees deflection, minimum 1.25-inch (32-mm) margin.

1. Basis of design:

a. Grilles: Krueger S-80H (steel); S-580H (aluminum).

PART 3 - EXECUTION

3.1 INSTALLING GRILLES, REGISTERS AND DIFFUSERS

A. Securely attach grilles, registers, and diffusers in place. Do not install the grilles and registers until duct interiors have been painted as specified in Section 23 0500, Common Work Results for HVAC.

B. Install all air control devices complete with the accessories specified, securely attached in position. Make operating devices accessible.

C. Adjust diffuser straightening grids to provide uniform air distribution above diffuser face.

D. Adjust supply register deflectors to provide uniform air distribution to the areas served.

END OF SECTION

SECTION 23 4100

PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 SUMMARY

A. Filters for temporary service during construction, including changes required to meet the requirements of Indoor Air Quality Management in Division 01.

B. Provide 2 sets of filters for every item of equipment requiring filters, as follows:

1. One set of filters for regular service, installed before air balancing.
2. Remaining set of filters for regular service, provided as extra materials for future use.

1.2 RELATED SECTIONS

A. Air-source heat pump units: Section 23 8143.

B. Ductless split-system units: Section 23 8127.

1.3 REFERENCES

A. ASHRAE 52.1: Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices used in General Ventilation for Removing Particulate Matter.

B. ASHRAE 52.2: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

C. ARI 850: Commercial and Industrial Air Filter Equipment.

1.4 DEFINITIONS

A. MERV: Minimum Efficiency Reporting Value as determined by ASHRAE 52.2.

B. Temporary service: Operation of equipment during the construction period, before air balancing.

C. Regular Service: Operation of equipment during air balancing and in normal use during occupancy.

1.5 SUBMITTALS

A. Product data: For filters, include filter ratings, rated flow capacity, and fire classification.

B. Shop drawings: Illustrate assemblies and attachments.

C. Closeout submittals: As required for Operating and Maintenance Manuals in Division 01 and Section 23 0101, provide a schedule of locations of filters, identifying equipment and filter types and sizes, including prefilters and final filters.

1.6 QUALITY ASSURANCE

A. Provide all filters for regular service from a single manufacturer.

B. Test filters by methods described in ASHRAE 52.1 and ASHRAE 52.2.

C. Comply with ARI 850.

1.7 EXTRA MATERIALS

A. Disposable and throwaway filters: For each filter included for regular service, provide 1 extra filter. Identify each filter with its name and intended location and use.

B. Provide filters and media in protective packaging, with identifying labels or markings.

C. Except as otherwise required in Division 01, deliver to location designated by the Government, and shelve or stack as directed.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide specified or scheduled products, or comparable product by one of the following:

1. Filters:

a. AAF International.
b. Airguard; Clarcor Air Filtration Products
c. Camfil Farr
d. Flanders Filters, Inc.
e. Or approved equal.

2. Filter Gauges:

a. Dwyer Instruments, Inc.
b. H.O. Trerice Co.
c. Miljoco Corporation
d. Weksler Instruments
e. Or approved equal.

2.2 FILTERS, GENERAL

A. Coordinate with approved manufacturers of the various approved air handling units and equipment for filter size and thickness required.

B. Thickness: Generally, large air handling units shall have filters 2 inches and thicker. Smaller units such as fan-coil units may be limited to filters 2 inches thick.

C. Filter face areas: As scheduled, or equivalent to one square foot for each 300 cfm.

2.3 THROWAWAY FILTERS

A. FS F-F-310, Type I throwaway frame and media, Grade B high dust holding capacity, of size and thickness to fit units.

2.4 DISPOSABLE FILTERS, MERV 8

A. Class 2, thickness 1 and 2 inches, and size required for each location, disposable.

B. Rating in accordance with ASHRAE 52.1:

1. Average efficiency: 25 to 30 percent.
2. Average arrestance: 90 to 92 percent.

C. Rating in accordance with ASHRAE 52.2: MERV 8.

D. UL 900: Class 2.

E. Medium: Non-woven, reinforced cotton and synthetic fabric, pleated.

F. Medium support grid: Welded wire with an effective open area not less than 96 percent, bonded to medium.

1. Performance: Medium shall not oscillate nor pull away from support grid.
2. Design: Tapered radial pleats, supporting medium both vertically and horizontally.

G. Enclosing frame: High-wet-strength beverage board, with diagonal supports bonded to media pleats. Filter pack continuously bonded to inside of frame so that no air leaks around edges.

H. Basis of design: Camfil Farr “Aeropleat IV.”

2.5 DISPOSABLE FILTERS, MERV 13

A. High-efficiency, mini-pleated, 4-inch deep, disposable type. Each filter assembly shall consist of a high-efficiency filter, medium retainer and holding frame.

B. Medium: Microfine glass media in a close-pleat design bonded into a beverage board holding frame.

C. Rating in accordance with ASHRAE 52.1: Average efficiency 80-85 percent, and average arrestance not less than 98 percent.

D. Rating in accordance with ASHRAE 52.2: MERV 13.

E. The initial resistance to airflow shall not exceed 0.5 inch wg at 500 fpm.

F. UL 900: Class 2.

G. Basis of design: Camfil (Farr) Opti-Pac.

2.6 FILTER GAUGE

A. Gauge:

1. Range zero to 3 inches wg, with divisions of 0.10 inch.
2. Basis of design: Dwyer “Magnehelic”, Series 2000

B. Accessory package: To adapt the magnehelic gauge for use as a filter gauge. Package includes aluminum surface-mounting bracket with screws, two 5-foot lengths of 0.25-inch aluminum tubing, two static pressure tips, and two molded plastic vent valves, with integral compression fittings on both tips and valves.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Before startup of each item of equipment requiring a filter, install filters for temporary service.

1. Generally, provide throwaway filters for temporary service.
2. On equipment with prefilter and final filter, provide only the specified prefilter for temporary service.

B. Immediately prior to air balancing, remove temporary filters and install filters required for regular service.

3.2 INSTALLING FILTER GAUGE

A. Mount across filter section in accordance with manufacturer's instructions.

END OF SECTION

SECTION 23 8127

DUCTLESS SPLIT-SYSTEM UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ductless split system with interior and exterior units and refrigerant piping.

B. Heat pump units.

1.2 RELATED SECTIONS

A. Motors: Section 23 0513.

B. Piping: Section 23 2300.

C. Refrigeration service and compressor warranty: Section 23 0100.

D. Filters: Section 23 4100.

1.3 REFERENCES

A. ASHRAE 15: Safety Code for Mechanical Refrigeration.

B. ASHRAE 90.1: Energy Efficient Design of New Buildings Except Low-rise Residential Buildings.

1.4 PERFORMANCE REQUIREMENTS

A. Design of the HVAC system, including associated work of other design disciplines and trades, is based on scheduled and specified equipment. If a different item of equipment should be proposed, as permitted under the article “Acceptable Manufacturers” below, ascertain that it will:

1. Perform to the scheduled and specified capacities.
2. Make no additional demands on other systems such as domestic, heating, and chilled water, or electricity.
3. Meet or exceed all specified requirements.
4. Electrical power connections for the basis-of-design unit require the indoor unit to be wired through the outdoor unit. Other manufacturers may require separate power connections, which the contractor shall provide as required.

1.5 SUBMITTALS

A. Shop drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring diagrams: For power, signal, and control systems, differentiating between factory- and field-installed wiring.

B. Product data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model.

1. Submit product data which verifies compliance with ASHRAE 90.1, or provide certified performance ratings by a qualified independent testing agency.
2. Submit precharged tubing description.

C. Samples: Color chips, showing manufacturer's complete line of finishes.

1.6 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 23 0500, Common Work Results for HVAC.

B. Fabricate and label refrigeration components to comply with ASHRAE 15.

C. Energy efficiency ratio and coefficient of performance: Equal to or greater than prescribed by ASHRAE 90.1.

1.7 SPECIAL WARRANTY

A. Besides general project warranty, provide manufacturer's seven-year extended warranty for replacing compressors, for each system, executed to the Government.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the scheduled Mitsubishi Electric Corporation P Series unit, or comparable product by one of the following:

1. Daikin
2. Enviromaster International (EMI)
3. Mitsubishi Electric Corporation
4. Panasonic Air Conditioning Group
5. Trane
6. Or approved equal.

2.2 MATERIALS

A. Refrigerant: HFC 410a.

B. Refrigerant pipe: Precharged Type L soft drawn, preinsulated seamless copper tubing, ASTM B 280. Length: As short as possible.

2.3 UNITS, GENERAL

A. Each unit shall be provided with factory-installed means of disconnect in compliance with NEC (NFPA 70) and local codes. In the event a factory-installed disconnect is not available, provide an approved means of disconnect for field mounting.

B. Heat pump units: Include reversing valves and defrost controls. When heat is called for, the reversing valve reverses the refrigerant flow, the interior coil operates as a condenser, heat is circulated into the room, and the outdoor coil operates as an evaporator.

2.4 INTERIOR UNIT

A. Frames: Steel angles or aluminum extrusions, welded construction.

B. Panels:

1. Insulated with 0.5-inch (13-mm) thick, 2 lbs per cubic foot (32 kg per cubic meter) density glass fiber insulation, with an R value no less than 15.
2. Fasteners: Concealed, captive, easily operated for access without tools.
3. Exterior finish: Manufacturer's standard baked enamel.

C. Grilles: Each one-piece construction, aluminum, brushed finish, with foam gasket providing airtight seal between grille and cabinet. Supply grille adjustable in three directions. Return air grille hinged for access to filter.

D. Drain pan: Insulated steel or plastic, with connections to exterior of cabinet.

1. Slope to drain in two directions, minimum 0.25 inch in 1 foot, to 0.75-inch drain connection.
2. Provide access for cleaning.

E. Cooling coil: Aluminum fins extruded on to copper tubing with quick connections to precharged tubing. Pressure tested at 1.5 times working pressure. Provide expansion device.

F. Fan: Centrifugal type with direct-connected controlled-speed motor mounted on vibration isolators.

G. Filter: Throwaway type.

2.5 EXTERIOR UNIT

A. Unit shall be factory-assembled and -tested, of capacity and current characteristics indicated on the drawings. Unit shall be packaged type. Cabinet: weatherproof construction, steel, with baked enamel finish.

B. Refrigeration circuit: Completely pre-piped, equipped with refrigerant; access valves in suction and liquid lines; filter dryer, sight glass, and pressure fittings for charging and evacuation.

C. Compressors: Welded shell; reciprocating hermetic, rotary screw or scroll type; high efficiency.

D. Condenser coil: Constructed of copper tube and aluminum fins, factory leak-tested at 1.5 times working pressure, dehydrated, and provided with full charge of refrigerant. Provide subcooler and accumulator.

1. Low ambient control: Provide head pressure control and accessories required to operate at temperatures down to 0 degrees F (minus 18 degrees C).

E. Fans: Propeller, direct drive, dynamically balanced, speed-controlled motor.

2.6 CONTROLS

A. Wall-mounted hard-wired controllers shall incorporate the following features:

1. Operation mode setting (Heat, Auto, Cool)
2. Temperature setting: The LCD indicator displays the set temperature in units of 2 degrees F.
3. Room temperature (intake air) display
4. 24-hour on/off timer: Operation can be set to start or stop after a specified time in 1-hour increments from 1 to 24. The remaining time is indicated on the LCD display.
5. Fan speed indicator: Displays the fan speed setting (high or low).

6. Vane control: The angle of the air outlet vanes can be adjusted to one of four positions by pressing the air discharge Up/Down button.
7. Auto air swing vanes: The air outlet vanes swing up and down for uniform air distribution.
8. Self-diagnostic display: When unit stops, the display indicates where the trouble is located.
9. Memory feature for storing instructions

PART 3 - EXECUTION

3.1 INSTALLATION

A. Assemble and set each unit in place in accordance with the manufacturer's instructions, plumb and level, firmly anchored, maintaining manufacturer's recommended clearances, tight to adjoining surfaces.

B. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.

C. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.

D. Connect piping as shown on the drawings and in accordance with manufacturer's instructions.

E. In a finished space, all piping, wiring, and conduit shall be behind finished surfaces.

F. Test each drain pan and ensure that installed slope is as specified and pan drains completely.

G. Filters:

1. Provide throwaway filter before energizing the unit fan.
2. Before air balancing, remove throwaway filter and install disposable filter.

H. Install accessories required for low ambient operation.

3.2 SYSTEM CONTROLS INSTALLATION

A. Provide the entire system with required controls, including wall-mounted controller, designed and installed by the equipment manufacturer to provide a complete working system.

B. Provide wiring in compliance with the requirements of the Division 23 Section "Control System Wiring."

3.3 OPERATING INSTRUCTIONS

A. As specified in Section 23 0500, provide operating instructions.

END OF SECTION

SECTION 23 8143

AIR-SOURCE HEAT PUMP UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Split-system heat pump units.

1.2 RELATED SECTIONS

A. Refrigeration equipment startup and maintenance: Section 23 0100.

B. Refrigeration piping: Section 23 2300.

C. Motors: Section 23 0513.

D. Filters: Section 23 4100.

1.3 PERFORMANCE REQUIREMENTS

A. Design of the HVAC system, including associated work of other design disciplines and trades, is based on scheduled and specified equipment. If a different item of equipment should be proposed, as permitted under "Available Manufacturers," below, ascertain that it will:

1. Perform to the scheduled and specified capacities.
2. Make no additional demands on other systems such as domestic, heating, and chilled water, or electricity.
3. Meet or exceed all specified requirements.

1.4 SUBMITTALS

A. Shop drawings: Heat pump units

B. Product data: Heat pump units and dampers, including leak test data.

C. Unit shown on drawings is based on the dimensions of the design basis unit specified in Part 2 below. If another acceptable manufacturer's unit should be proposed, ascertain that it will fit in the available space.

1. Include, with shop drawings of the unit, scale drawings similar to the contract drawings, including plans, elevations, sections, and diagrams, showing any changes in wiring, arrangement, or access necessary to accommodate the proposed unit.
2. Include shop drawings and product data sufficient to show conformance to the article “Performance Requirements” above.

D. Shop drawings shall show complete dimensions of complete assembled unit with accessories, including dimensions and configuration as required to coordinate with framing and bracing roof structure and deck.

1. Include design of refrigeration piping prepared by manufacturer of the refrigeration compressor.
2. Wiring diagrams: Prepared for this project.

E. Submit product data which verifies compliance with ASHRAE 90.1, or provide certified performance ratings by a qualified independent testing agency.

F. Certifications: Availability of replacement parts and compressors as required in Part 2 below.

1.5 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 23 0500, Common Work Results for HVAC.

B. Regulatory requirements:

1. ICC: HVAC equipment shall meet the energy performance requirements of ASHRAE 90.1.
2. COMAR 14.26.03: Packaged equipment with over 20 tons of cooling capacity shall meet Tier 2 requirements for minimum efficiencies for unitary commercial air conditioners or heat pump units of the Consortium for Energy Efficiency (CEE), in effect on 1 January 2002.
3. EPA: Refrigerant: HFC-410A.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide specified or scheduled Trane products, or comparable product by one of the following:

1. Valent.
2. Aaon
3. Or approved equal.

2.2 HEAT PUMP SPLIT SYSTEM

A. System shall be split-type heat pump system consisting of an outdoor condensing unit and indoor fan with cooling coil and electric reheat coils (air handling unit). All units and sections shall be of one manufacturer.

B. System shall be approved by manufacturer for operation in cooling between 100 and minus 10 degrees F, outdoors.

C. Outdoor sound rating number in ARI Directory shall not exceed 22.

D. Capacity and electric current characteristics of system: Indicated on the drawings.

E. Outdoor equipment shall be listed by Underwriter's Laboratories as suitable for outdoor installation. Each unit shall meet the applicable ARI standards.

F. Replacement parts and compressors shall be available from a warehouse located in the Baltimore-Washington-D.C. metropolitan area.

G. Heat pumps shall have factory-installed switchover valves and check valves. Heat pump thermostat shall have built-in emergency heat switch and heating control shall be outdoor temperature compensated. Heat pump control system shall prevent use of supplementary resistance heat when outdoor temperature rises above 45 degrees F. Heat pump defrost cycle shall operate only when outdoor coil has excessive pressure drop and defrost control shall also energize supplementary resistance heaters.

H. Outdoor condensing unit: Galvanized steel weatherproof unit with weather resistant finish, containing hermetic or semihermetic compressors, condensers, condenser fans, service valves, internal pressure relief valves, liquid line filter-drier, compressor overload, safety and operation controls. Unit shall be completely factory assembled and wired, and have access panels for service and maintenance.

I. Air-handling unit: Steel construction, fully insulated, including fan and fan motor. Blower system may be multispeed directly driven or belt-driven, provided it meets airflow requirements indicated on the drawings. Air handler shall be UL listed and shall meet requirements of ARI 210/240. Unit shall have removable access panels properly located for service and maintenance.

J. Coils shall be constructed of aluminum plate fins mechanically bonded to non-ferrous tubing with all joints brazed.

K. Motors shall comply with the requirements of Section 23 0513.

L. Unit shall be provided with factory installed means of disconnect in compliance with NEC and local codes. In the event a factory installed disconnect is not available as an option, an approved means of disconnect shall be provided for field mounting.

M. Electric resistance heaters shall fit within the air handler cabinet or shall be duct type as indicated on the drawings. Electric heater shall be UL listed for use with air handler.

N. All the necessary outdoor thermostat, time delay relays, air sensing control for defrost cycle, low ambient controls, transformers, and necessary appurtenances shall be provided factory- wired to provide a completely integrated system.

O. Provide factory precharged and preinsulated refrigerant lines of the length required.

P. Provide filter rack with two inch deep disposable MERV 8 filter and 4 inch deep MERV 13 filter, maximum 300 cfm per square foot. Provide filters as specified in Section 23 4100.

2.3 OUTDOOR AIR DAMPER

A. Damper:

1. Construction: Extruded aluminum frames and blades.

2. Blades: Maximum width 6 inches. Seals mechanically fastened extruded-bulb type, neoprene or vinyl. Seals fastened to blade with adhesive are not acceptable.
3. Performance: Maximum total leakage 0.5 percent when subjected to static pressure of 2 inches water gauge.
4. Basis of design: Arrow United Industries "Pin-lock" No. OBDPL-507, Johnson Controls **VD-1250**, or equal by Honeywell, Inc.

B. Operator:

1. Two-position spring-return type, 240 volt, complete with mounting brackets and coupler to damper.
2. Basis of design: Honeywell, Inc. Model M436A.

2.4 CONTROL SEQUENCE

A. The following controls shall be provided by the unit manufacturer.

1. Room thermostat manual changeover, 24 volt heat/cool complete with fan "Auto-On" switch and system "Heat-Off-Cool."
2. All outdoor thermostats for operation of heat pump and supplemental heaters during heating mode.
3. Time delay relays in the control circuit to prevent all supplemental heaters from being energized at once.
4. Air sensing control for defrost cycle.
5. Low ambient operation control.

B. The supplemental electric heaters shall be energized during the heat pump "Defrost" cycle.

C. OA damper for system shall be furnished for duct mounting. Whenever the fan motor is deenergized, the OA damper shall close tight.

D. Provide under this section:

1. Wiring for OA damper operator including a switch beside room thermostat to shut damper during "Unoccupied" operation. Plastic nameplate on switch shall read "OA Damper/Open/Closed."

E. Occupied cycle system manually in "Heat" position:

1. Unit fan shall run continuously as set manually on room thermostat in "On" position.
2. After start of unit fan the OA damper shall open to minimum position when damper switch is set in "Open" position.
3. On a rise in room temperature, the electric heating coils shall be deenergized in steps. These steps are also controlled by outdoor thermostats and time delay relays in accordance with recommendations of the unit manufacturer.
4. On a further rise, the compressor shall be deenergized in the heating mode.
5. On a fall in room temperature, the cycle shall reverse.

F. Occupied cycle system manually in "Cool" position:

1. Unit fan shall run continuously as set manually on room thermostat in "On" position.
2. After start of unit fan the OA damper shall open to minimum position when damper switch is set in "Open" position.
3. On a rise in temperature, the heat pump changeover valve shall be energized and the heat pump shall be energized in a cooling mode.
4. On a fall in room temperature, the cycle shall be reversed.

G. Unoccupied cycle:

1. Unit shall be controlled as manually set on room thermostat normally on the following settings:

   a. System switch "Heat" position.
   b. Fan switch in "Automatic" operation.
   c. OA damper switch in "closed" position.

2. Unit and fan will cycle to maintain the set point of the "Heat" thermostat.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Assemble and set the air-handling units in place as indicated.

B. Connect piping and ductwork as shown on the drawings.

C. Coordinate with air balancing to obtain the airflow and static pressure indicated on the drawings.

3.2 MANUFACTURER'S FIELD SERVICE

A. Provide refrigeration equipment startup, and service during the correction period by a factory authorized agent as specified in Section 23 0100.

3.3 OPERATING INSTRUCTIONS

A. As specified in Section 23 0500, provide operating instructions.

B. Provide at least8 hours of additional instruction time for the equipment specified in this section, consisting of 2 periods of 4 consecutive hours, during a period of not less than 60 days.

END OF SECTION

SECTION 26 0101

ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for electrical work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

B. Commissioning requirements: Divisions 01 and 23.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers.

B. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 26.

B. Visit the site and study all aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of all labor, equipment and materials, and the performance of all operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for, all necessary signatures and paperwork, all permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Government.

E. Electrical work of this project includes, as a brief general description, the following:

1. Demolition of existing electrical equipment, devices and systems of the existing registration building.
2. New electrical equipment, devices and systems for the new registration building, new charging booths and gates.
3. The project includes commissioning under the direction of a Commissioning Agent (CxA).

F. See Division 01 for requirements related to Government's occupancy of the premises, limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 26 specifications.

B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for all coordination and additional costs as specified in article "Substitutions" below for substitutions.

C. Products specified by reference standards or by description only: Any product meeting those standards or description.

D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance, and shall not be construed as limiting competition. Contractor may use products of any manufacturer, which meet the specifications.

E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 26 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to the Government.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse the Government for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project, and of representative manufacturer. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. All equipment, construction and installation must meet requirements of local, state and federal governing codes.

C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

1. Furnish: Supply item
2. Install: Mount and connect item
3. Provide: Furnish and install

E. All materials and equipment shall be installed and completed in a first class and workmanlike manner and in accordance with the best modern methods, practice and manufacturers' instructions. Any work which shall not present an orderly and neat or workmanlike appearance shall be removed and replaced with satisfactory work when so directed in writing by the DGS Project Manager.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall workmanship.

G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the DGS Project Manager will determine sizes to be utilized.

H. In all cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the DGS Project Manager of said uncertainty, doubt, or conflict and obtain a decision as to the intent prior to initiating any work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the DGS Project Manager and await a written decision.

B. Plan and coordinate all work to proceed in an orderly and continuous manner without undue delay, and in conformance with the project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate electrical work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of all conduit, light fixtures, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor's responsibility to bring this to the attention of the DGS Project Manager prior to initiation of work. Correct improperly coordinated installation at no additional cost.

E. The Contractors' assistants shall include a competent electrical foreman, who shall be on the premises at all times to check, layout, coordinate and superintend the installation of work. The foreman shall establish all basic requirements relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers' and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for all equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of Shop Drawings and Product Data for every item of equipment. Shop drawings or product data will not be considered until Manufacturers' Lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor's name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.
3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.
4. All exclusively electrical items furnished as items associated with mechanical items but not specifically described in the mechanical item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the mechanical item by identified specification paragraph.
5. Product data sheets shall be 8.5-inches by 11-inches cut sheets for operating and maintenance manual.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of Government's representative, and project type and size.

E. After the work is completed, submit all required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the Government prior to final acceptance of the work.

1.10 SPECIALIST

A. The term “Specialist” as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer’s direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:

   a. Contract Drawings.
   b. Specifications.
   c. Addenda.
   d. Change Orders and other Modifications to the Contract.
   e. Reviewed shop drawings, product data, and samples.

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:

   a. Manufacturer’s name and product model and number.
   b. Product options, substitutions, or alternates utilized.
   c. Changes made by addenda and modifications.

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:

   a. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   b. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
   c. Field changes of dimension and detail.
   d. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.
2. Binders: Three-ring binders with vinyl-covered hard covers. Provide large enough binders, and sufficient quantity, that the required contents can be easily turned, removed, and reinserted.

3. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," and title of project. Print on spine of binder "O & M INSTRUCTIONS." If more than one binder is required, print covers and spines with volume numbers. Include in the front of every binder an index to all binders.
4. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
5. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.
6. Part 1: Directory, listing names, addresses, and telephone numbers of electrical engineers; contractor; electrical subcontractors; and major electrical equipment suppliers.
7. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

    a. Significant design criteria.
    b. List of equipment.
    c. Parts list for each component, including recommended spare parts list.
    d. Operating instructions.
    e. Maintenance instructions for equipment and systems.
    f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

8. Part 3: Project documents and certificates, including the following:

    a. Shop drawings and product data.
    b. Photocopies of certificates.
    c. Photocopies of warranties, guarantees, and bonds.
    d. Test reports: Copies of the results of all tests required under all sections of specifications.
    e. Photocopies of each panelboard circuit directory or directories for each panelboard provided, including panel name, panel location, panel ratings, spare circuit breakers and spaces for additional circuit breakers.

9. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.
10. Submit final volumes revised, within ten days after final inspection.

1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

    1. The electrical, building, fire, and safety codes of the state and county or city in which the work is being performed.
    2. The National Electric Code, NFPA 70 (NEC).

3. The National Fire Protection Association Code (NFPA).
4. International Building Code (IBC).
5. International Energy Conservation, Fire, and Electrical Codes (ICC).

1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply.

1. Factory Mutual (FM)
2. Federal Specifications (FS)
3. Military Standards (Mil. Std.)
4. American National Standards Institute (ANSI)
5. American Society for Testing and Materials (ASTM)
6. International Code Council (ICC)
7. Institute of Electrical and Electronics Engineers (IEEE)
8. National Electrical Code (NEC) (NFPA 70)
9. National Electrical Manufacturer's Association (NEMA)
10. National Fire Protection Association (NFPA)
11. The Occupational Safety and Health Act (OSHA)
12. Underwriters Laboratory Inc. (UL)
13. American Association of State Highway and Transportation Officials (AASHTO)
14. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
15. Maryland Occupational Safety and Health Act (MOSHA)
16. Illuminating Engineering Society of North America (IESNA)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for all contents within these areas. Provide all security measures necessary for this area.

B. Area shall be maintained and shall be returned to original condition at the completion of the project.

C. Store electrical construction materials such as wire, raceways and boxes, devices, and equipment in buildings, enclosed trailers, or portable enclosed warehouses.

1. Materials and products subject to damage from moisture: Store in dry locations. If necessary, protect with protective wraps or covers.
2. Plastics and other materials and products subject to damage from heat or cold: Store at manufacturer's recommended temperatures.
3. Plastics and other materials and products subject to damage from sunlight: Protect from sunlight.

D. Electrical equipment such as motor controllers, panelboards and circuit breakers stored before installation and installed during construction: Provide clean, dry locations at manufacturer's recommended temperatures, and cover or wrap if required to protect from incidental damage.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.
5. Seal off all return air registers and other mechanical systems to prevent dust from entering.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair all damage or soiling to the complete satisfaction of the DGS Project Manager; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, all at no addition to the Contract sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer's recommended temperatures.

E. Protect electrical materials and products from weather events and accidents of construction.

F. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.16 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.17 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in "Cutting and Patching" below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the DGS Project Manager in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.18 WARRANTY

A. All work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties as specified in individual sections.

B. During the correction period, the Contractor shall begin correcting any work found to be not in accordance with the requirements of the Contract Documents within 4-hours of receiving written notice from the DGS Project Manager. Provide detailed schedule for completion of work within 24-hours of receiving written notice from the DGS Project Manager and revise schedule based on any Government comments generated. Except as otherwise required in General Conditions and Division 01, the correction period is one year after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

1. Service reports for warranty work shall be provided to the Government.

C. When use of the permanent equipment has been permitted for temporary services during construction of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Government.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers' standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.19 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor's and subcontractors' responsibilities are described in Divisions 01 and 23.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of conduits. Close superfluous openings and remove all debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the DGS Project Manager.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and all materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.3 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or DGS Project Manager finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, and the DGS Project Manager shall each be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

3.4 COMMISSIONING

A. Comply with requirements of ‘Commissioning” in Part 1 above.

END OF SECTION

SECTION 26 0500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to work of more than one section of Division 26.

B. Basic material and equipment required for electrical work.

C. Date sensitive equipment.

D. Operating instructions.

E. Testing wiring systems.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 26 0101.

B. Operation and Maintenance Manuals: Division 01 and Section 26 0101.

C. Painting: Division 09.

D. Commissioning requirements: Division 01 and Division 23.

1.3 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

1.4 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed on the basis of using the particular manufacturers' products specified and scheduled on the drawings.

B. Products of other manufacturers that are listed under the article "Available Manufacturers," or permitted as "equal," are permitted provided:

1. Product shall meet the specifications.
2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that make their use impractical or cause functional fit, access, or connection problems.

1.5 SUBMITTALS

A. Test reports: Show that tests specified in Part 3 below demonstrate the specified results.

1.6 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the electrical, building, fire, and safety codes and regulations of the state, county, or city in which the work is performed.

B. Electrical control panels, equipment, materials and devices provided or installed as work of Division 26 shall bear UL label, or, if UL label is not available, the item shall be tested and labeled by a qualified testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70. Provide testing, if required, without addition to the contract sum.

C. VOC content: Field-applied adhesives and sealants, limits per South Coast Air Quality Management District (SCAQMD), Rule No. 1168.

D. Products shall contain no urea-formaldehyde content.

1.7 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractors' and subcontractors' responsibilities are described in Division 01 and Division 23.

PART 2 - PRODUCTS

2.1 GENERAL

A. Techniques, testing, and operating instructions specified in this section apply to products specified in other sections of Division 26.

B. Equipment that uses or processes date and time data in order to perform its function shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

2.2 MATERIALS

A. Electrical equipment backing panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated in accordance with AWPA C27, in thickness indicated, not less than 0.5 inch (13 mm) nominal.

1. One side finished.

B. Wood-preservative-treated lumber: Treated by pressure process, AWPA C2, with chemicals acceptable to authorities having jurisdiction, and marked with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. Application: Treat items indicated on the drawings, and the following:

a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.

b. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
c. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
d. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
e. Wood floor plates that are installed over concrete slabs-on-grade.

C. Aircraft cable: 0.25-inch (6-mm) steel wire rope, galvanized, construction 7 by 19 strands, minimum 7000 lbs (31138 N) breaking strength.

2.3 DATE-SENSITIVE EQUIPMENT

A. Date-sensitive equipment: Systems, equipment, or components which use or process date and time data in order to perform their functions.

B. Each item of date-sensitive equipment used in the project shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

PART 3 - EXECUTION

3.1 GENERAL

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify the DGS Project Manager if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

B. The contract drawings are diagrammatic, and do not indicate all fittings or offsets in conduit or all pull boxes, access panels, or other specialties required. Provide required fittings, offsets, access panels, and specialties to coordinate the work.

C. No conduit shall be run below the head of a window or door.

D. Equipment and conduits installed in areas without a suspended ceiling shall be as tight to structure as possible, but at least above a height of 6'-8", unless otherwise noted.

E. Items which require access for operation or maintenance shall be easily accessible. Do not cut or form hand holes for operation or maintenance of appliances through walls or ceilings.

3.2 INSTALLATION OF PRODUCTS AND EQUIPMENT

A. Install conduit exposed to view parallel with the lines of the building and as close to walls, columns, and ceilings as may be practical, maintaining adequate clearance for access at parts requiring servicing.

B. Install conduit a sufficient distance from other work to permit a clearance of not less than 0.5 inch (13 mm) between its finished covering and adjacent work.

C. Pull boxes and other appurtenances which require operation or maintenance shall be easily accessible. Do not cut or form handholes for operation or maintenance of appliances through walls or ceilings.

D. Install plywood backing panels with finished face exposed.

3.3 OPERATING INSTRUCTIONS (DEMONSTRATION)

A. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Government's designated personnel in operation, maintenance, lubrication, and adjustment of systems and equipment.

1. Instructions by manufacturer's technical representative for each type of equipment shall include the performance of the recommended preventive maintenance procedures for that equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions for use by instructors and Government personnel.

E. Schedule the general and specialized instruction periods for a time agreed upon by the DGS Project Manager.

3.4 TESTS

A. During the progress of the work and after completion, test the branch circuits and distribution system, and the low-voltage alarm and signal systems.

B. Results of the tests shall show that the wiring meets the requirements of this specification. Should any test indicate defect in materials or workmanship, immediately repair, or replace with new, the faulty installation, and retest the affected portions of the work.

C. Furnish equipment and instruments necessary for testing.

D. Tests shall demonstrate the following:

1. Lighting, power, and control circuits are continuous and free from short circuits.
2. Circuits are free from unspecified grounds.
3. The resistance to ground of each non-grounded circuit is not less than one megohm.
4. Circuits are properly connected in accordance with the applicable wiring diagrams.
5. Circuits are operable. Demonstration shall include functioning of each control not less than ten times, and continuous operation of each lighting and power circuit for not less than 0.5 hour.

E. Test circuit breakers larger than 100 amps at full voltage.

F. Make voltage built-up tests with a voltage sufficient to determine that no short circuits exist.

G. Immediately repair defects and retest until systems are operating correctly.

H. Submit test reports.

END OF SECTION

SECTION 26 0501

EXCAVATION AND FILL FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Trenching, backfilling, and compacting for electrical work underground inside the building, and outside the building as shown on drawings.

B. Restoring and reseeding grassed areas.

1.2 RELATED SECTIONS

A. Cutting and patching: Division 01 and Section 26 0101.

B. Repairing pavements: Division 32.

C. Underground electrical ductbanks: Section 26 0544.

D. Conduit: Section 26 0533.

E. Service entrance: Section 26 0541.

F. Identification for electrical systems: Section 26 0553.

1.3 REFERENCES

A. ASTM D 1557: Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/cu ft (2700 kN-m/cu m).

1.4 SUBMITTALS

A. Shop drawings: At the same scale as the contract drawings, showing field verified locations of utilities, and proposed detailed trenching plan.

B. Product data: Seed and mulch.

C. Certifications: Test reports showing that compaction meets specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill: Earth materials, free from perceptible amounts of wood, debris, or topsoil, free of frost at the time of placement, and not containing marl or other elements which tend to stay in a plastic state.

2.2 EQUIPMENT

A. Mechanical tampers for compacting backfill: Capable of exerting a blow equal to 250 pounds per square foot (12 kPa) of area of the tamping face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Contact local utility company underground information service, Potomac Edison (First Energy) Miss Utility, before beginning excavation outside buildings.

B. The general locations of underground utilities are indicated on the drawings and are not to be assumed to be accurate or complete. Before beginning work, field check the area with the most accurate instruments available, such as Fisher Labs' Pipe and Cable Locators.

3.2 INSTALLATION

A. Perform all excavating, cutting of paved areas, trenching, sheeting, shoring, backfilling, and compacting required for the proper installation of the work. Repair of pavement is specified in Division 32.

B. Where obstructions are encountered, obtain written approval and make necessary changes in line, grade or location.

C. Protect existing utilities from damage during excavation and backfilling. Repair damaged new or existing work at no addition to the contract sum. Bracing, shoring and other protection of existing utilities is part of this work.

D. Do not damage or remove existing shrubs or trees including their root systems, without prior notification to the DGS Project Manager.

E. Provide temporary roadways over trenches with railings and other safeguards, including amber blinker lamps or other warnings for night use.

F. Note the depths of footings. In cases where conduit is in close proximity to or below footings and where the natural earth under footings is disturbed, after the line is installed the voids shall be filled up to bottoms of such footings with solid concrete.

3.3 CUTTING

A. Cut concrete and asphalt concrete with masonry saw prior to breaking it into smaller pieces for removal.

B. Cut sidewalks perpendicular to the length at the closest existing joint that is a minimum of 24 inches back from either side of the top of the new trench.

3.4 TRENCHING

A. Excavations inside the building shall be carefully planned. Stockpile excavated earth so as not to interfere with other construction. Dig trenches to the proper depths, providing extra depressions where required for hubs of pipes.

B. Excavations outside the building shall generally follow the routes indicated on the drawings. Stockpile topsoil separately for later replacement. Excavations shall be of sufficient depths to provide, unless indicated otherwise on the drawings, a minimum cover as follows:

1. Electrical conduit: Depth required by NFPA 70 (NEC).

C. Trenches shall be of necessary depth and width for the proper laying of conduit with a minimum of 8 inches (205 mm) on each side of the joint.

1. The sides shall be as nearly vertical as practicable. Unless local regulations are more strict, trenches 4 ft. (1220 mm) and deeper shall have shored sides as required by OSHA trenching regulations.
2. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for each section of conduit on undisturbed soil at every point along its entire length, except for bell holes.
3. No greater length of trench shall be left open, in advance of the completed structure placed in it, than can be completed in that day's operation.
4. Except where rock is encountered, do not excavate below the depths required. Where rock excavation is required, excavate to a depth of at least 6 inches (150 mm) below the trench depth and fill the overdepth with compacted crusher run or bank run stone or sand. Unauthorized overdepths in excavation shall be backfilled with crushed stone, slag or gravel, thoroughly compacted.
5. Whenever wet or otherwise unstable soil is encountered, it shall be removed to the depth and extent directed, and the trench backfilled to the proper grade with crushed stone, slag or gravel.

D. Should springs be encountered within the work area, or soft soil conditions at the elevations required for load bearing, immediately notify the DGS Project Manager and do not place any portion of the work on such surfaces until instructions are received.

E. Furnish and maintain pumps, flumes, gutters, and appurtenances if required to keep the excavations free from water. Water shall be directed to a point remote from building operations, shown on the approved shop drawing.

3.5 BACKFILL

A. Place no backfill until the adjacent construction or the utility to be covered has been inspected, tested, and approved.

B. Installing underground warning tape: Install in backfill above exterior buried lines not encased in concrete. Select legend and color appropriate for type of line. Install metallic lined tape for non-metallic lines. Install approximately 12 inches (305 mm) below grade.

C. Electrical systems backfill:

1. Backfill and compact in 8-inch (200-mm) layers, to level finished grade with the excavated materials approved for backfilling.
2. Surplus earth shall be mounded up on excavation and left to settle. When directed by the DGS Project Manager, surplus earth shall be removed and excavations leveled off to proper grade. Where direct burial cables are placed in trenches, first cover the cables with clean earth.

D. Structure backfill:

1. Do not backfill against structures with cement mortar joints until the mortar is at least twelve hours old.

3.6 COMPACTION

A. Test in accordance with the requirements of ASTM D 1557.

B. Compact under slabs, roads, and sidewalks to a 95 percent density.

C. Compact unpaved areas to a 90 percent density.

D. Backfill and compact trench in unpaved areas to within 4 inches (102 mm) of existing grade. Furnish and install compacted select topsoil for the final layer to finish even with existing grade. Remove surplus earth and rake unpaved areas for final planting.

E. Take particular care in compaction of earth under joints of mechanical piping.

3.7 RESURFACING

A. Resurface sidewalks, roads, streets, and other paved areas as work of this section, matching the construction and finish of adjacent paving. Paving shall meet the requirements of Division 32.

END OF SECTION

SECTION 26 0504

ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Extent and location of demolition are shown on the drawings.

B. Removal of items for reuse.

C. Removal and disposal of PCB-containing fluorescent light ballasts.

D. Removal of fluorescent lamps without breaking them, and disposal to a recycler.

1.2 RELATED SECTIONS

A. Demolition: Division 02.

1.3 SUBMITTALS

A. Shop drawings: Demolition and removal procedures and schedules.

1. PCB disposal plan.

B. Certifications showing compliance with EPA and State regulations for removal and disposal of PCB-containing lamp ballasts, including but not limited to:

1. Contractor's generator identification number.
2. Hazardous waste manifests.
3. Certification of licensed hazardous waste hauler.
4. Certification of disposal facility.

C. Qualifications of fluorescent lamp recycler as required in the article "Quality Assurance" below.

D. Project record documents:

1. Record drawings.
2. For PCB removal, copies of completed required forms showing compliance with EPA requirements. Forms include, but are not limited to, records showing that the correctly identified hazardous material from this project has been properly transported, delivered, and accepted at the certified disposal facility.
3. For fluorescent lamp disposal, records demonstrating that all the fluorescent lamps removed from the site have been received and accepted at the recycling facility. Receipt or bill of sale shall include the typewritten name and signature of the person responsible for receiving and logging in, and shall be dated.

1.4 QUALITY ASSURANCE

A. Demolition shall be carried out as expeditiously as possible, in accordance with accepted practice and applicable building code provisions.

B. For PCB removal:

1. Regulatory requirements: Comply with EPA requirements for removal, handling, and disposal of PCB-containing lamp ballasts.
2. Instruct employees on the dangers of PCB exposure; protective clothing; methods for identification, removal, and storage on site; and applicable EPA regulations.
3. Dispose of PCB-containing ballasts and PCB-contaminated materials by incineration at an EPA-approved rotary kiln incinerator.

C. Fluorescent lamp recycler shall be in compliance with federal and state regulations applicable at its location, including licenses if required, to commercially recycle lamps and mercury-containing materials.

1.5 HANDLING AND STORAGE

A. PCB-containing ballasts:

1. Store removed ballasts in lined steel drums or other approved leak-proof containers, labeled in accordance with EPA requirements, in a secured area.
2. Containers shall be removed from the site within 30 days.

B. Fluorescent lamps:

1. Handle lamps so as not to break them. Store and ship in containers which prevent breakage during storage and shipping.
2. Store lamps in secure location approved by the Government, until they are shipped to the recycler.
3. The lamps are not defined as hazardous. If a few lamps should be broken accidentally, treat the debris as general construction debris.

1.6 PROJECT CONDITIONS

A. If, in the course of the work, workers unexpectedly encounter a material not identified for special removal but which they suspect to be asbestos, to contain lead or PCBs, or to present some other hazard:

1. Promptly notify the DGS Project Manager in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

B. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.

C. Locate, identify, and protect mechanical and electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate removal and storage of fluorescent lamps and ballasts. Protect lamps to prevent breaking them during removal.

B. Protect existing building and equipment that is to remain, particularly to prevent entry of either dust or water. Ensure weathertightness at all times. Keep materials on hand to patch and maintain protection.

3.2 DEMOLITION

A. Comply with demolition and disposal requirements of Division 02.

B. Perform removal work neatly with the least possible disturbance to the building.

C. Provide temporary barriers, danger signals, and appurtenances for protection of personnel and equipment during removal operations.

D. Demolish, remove, demount, and disconnect inactive and obsolete conduit, fittings and specialties, equipment, and fixtures.

1. Conduit and ducts embedded in floors, walls, and ceilings may be abandoned in place if they do not interfere with new installations. Cut back to at least one inch below finished surface.
2. Remove materials above accessible ceilings.
3. Patch and repair surface materials as required in Division 01 and Section 26 0101 article, “Cutting and Patching.”

E. Remove the anchors, bolts, and fasteners associated with conduit and equipment to be removed.

3.3 ITEMS FOR REUSE

A. The following items shall be removed and reused as indicated or specified:

1. Telephone equipment.
2. Security cameras.

B. Remove items to be reused in a manner to prevent damage. Pack or crate if required to protect the items from damage in storage.

3.4 REMOVAL OF FLUORESCENT LAMP BALLASTS

A. Where fluorescent light fixtures are shown on the drawings to be removed, remove ballasts.

B. If a ballast is stenciled “No PCBs”, dispose of it as general demolition debris. If ballast has no such identification, assume that it contains PCBs.

C. Workers removing ballasts shall be: informed as to the danger of skin contact with PCBs; informed that PCB-containing ballasts contain paper or cardboard impregnated with PCBs inside the casings; instructed to handle ballasts so as not to damage the casings; and shall wear protective gloves.

D. Examine ballasts for evidence of leaking PCBs. Black, tarry material may contain PCBs. Where leakage has contaminated materials outside the ballast itself, dispose of the contaminated materials by the same methods used to dispose of the ballasts, except that nonporous surfaces such as smooth metal or plastics may be properly decontaminated and then treated as clean material.

3.5 REMOVAL OF FLUORESCENT LAMPS

A. Remove lamps without breaking them and pack in protective containers for shipment to recycler.

B. Prepare a record of lamps removed and prepared for shipment. This record shall be used to account for disposal of lamps to qualified recycler.

3.6 DISPOSAL

A. Dispose of equipment and materials removed, and rubbish and waste material, as work progresses. Do not allow demolition debris to accumulate on site. Remove products of demolition from the building daily.

B. Transport and dispose of PCB-containing ballasts, discarded protective clothing, and other contaminated material in accordance with applicable EPA regulations. Maintain and submit records showing compliance with regulations, as specified in Part 1 above.

C. Transport fluorescent lamps without breaking them and deliver to the recycler. Submit records of disposal as required in Part 1 above.

END OF SECTION

SECTION 26 0507

FIRESTOPPING FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Through-penetration firestopping in fire-rated construction.

B. Through-penetration smoke-stopping in smoke partitions.

1.2 RELATED SECTIONS

A. Conduit: Section 26 0533.

1.3 REFERENCES

A. Underwriters Laboratories

1. UL Fire Resistance Directory
2. UL 1479: Through Penetration Firestops.

B. American Society for Testing and Materials Standards:

1. ASTM E 814: Standard Test Method for Fire Tests of Through-Penetration Firestops.

1.4 DEFINITIONS

A. Assembly: Particular arrangement of materials specific to given type of construction described in referenced documents.

B. Barriers: Time-rated fire walls, smoke barrier walls, time-rated ceiling/floor assemblies and structural floors.

C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gasses and smoke.

D. Penetration: Opening or foreign materials passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.

E. Sleeve: Metal fabrication or pipe section extending through thickness of barrier and used to permanently guard penetration. Sleeves are described as part of penetrating system in other sections and may or may not be required.

F. System: Specific products and applications, classified and numbered by the rating agency to close specific barrier penetrations.

1.5 SYSTEM DESCRIPTION

A. Design requirements:

1. Fire-rated construction: Maintain barrier and structural floor fire resistant ratings including resistance to cold smoke at all penetrations.

2. Smoke barrier construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations.

1.6 SUBMITTALS

A. Product data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.

B. Shop drawings: Submit firestop assemblies and devices for all openings and through penetrations in fire-rated construction. Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.

1. Details of each proposed assembly identifying intended products and applicable rating agency classification.
2. Manufacturer or manufacturer's representative shall provide qualified engineering judgments and drawings relating to conditions where rated assemblies do not exist.

C. Quality control submittals:

1. Statement of qualifications.

D. Applicators' qualifications statement:

1. List past projects indicating required experience.

E. Certifications: Letters or forms showing acceptance by local authorities for systems without acceptance by a rating agency.

1.7 QUALITY ASSURANCE

A. Products and assemblies shall be tested and labeled by an independent, nationally recognized testing and labeling authority.

B. Installer's qualification: Firm experienced in installation or application of systems similar in complexity to those required for this project, plus the following:

1. Acceptable to or licensed by manufacturer, state, or local authority where applicable.
2. At least 2 years' experience with systems.
3. Successfully completed at least 5 projects of comparable scale, using these systems.

C. Local and state regulatory requirements: Obtain acceptance for proposed assemblies not conforming to specific rating agency classifications or rated assemblies.

D. Materials shall have been tested to provide fire rating at least equal to that of the construction in which they are to be installed.

E. VOC content: Field-applied adhesives and sealants, limits per South Coast Air Quality Management District (SCAQMD), Rule No. 1168.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:

1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Coordinate delivery with scheduled installation date, allow minimum storage at site.

B. Storage and protection: Store materials in a clean, dry, ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instructions.

1.9 PROJECT CONDITIONS

A. Existing conditions:

1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

B. Environmental requirements:

1. Furnish adequate ventilation if using solvent.
2. Furnish forced-air ventilation during installation if required by manufacturer.
3. Keep flammable materials away from sparks or flame.
4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
5. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

1.10 WARRANTY

A. General project warranty and correction period, as required in general conditions and Division 01, requires repair or replacement of materials or systems which fail in joint adhesion, co-adhesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Manufacturers and products: Those listed in the UL Fire Resistance Directory for the UL System involved, or rated for the application by Warnock Hersey or by another acceptable rating agency.

2.2 THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

A. Provide systems or devices listed and labeled by a rating agency, and conforming to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance. The system shall be symmetrical for wall applications. Systems or devices shall be asbestos-free.

1. Additional requirements: Firestopping shall withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the rated system or device, and designed to perform this function.
2. Additional requirements: Firestopping sealants shall be red in color to facilitate field verification of firestopping application.

2.3 SMOKE-STOPPING AT SMOKE PARTITIONS

A. Through-penetration smoke-stopping: Any system complying with the requirements for through-penetration firestopping in fire-rated construction is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.

2.4 ACCESSORIES

A. Fill, void or cavity materials and forming materials: Classified for firestopping use, or included in a rated firestopping assembly, by a rating agency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

1. Verify barrier penetrations are properly sized and in suitable condition for application of materials.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces to be in contact with penetration seal materials, of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

3.3 INSTALLATION

A. Provide firestop devices or assemblies for every opening and penetration in floors or fire-rated construction.

B. Install penetration seal materials in accordance with printed instructions of the rating agency and in accordance with manufacturer's instruction.

C. Ensure an effective smoke barrier in each sealed penetration. Install smoke stopping as specified for firestopping.

D. Protect materials from damage on surfaces subject to traffic.

E. Where large openings are created in walls or floors to permit installation of conduits, cables, or other items, close unused portions of opening with firestopping material tested for the application.

3.4 FIELD QUALITY CONTROL

A. Examine penetration seals to ensure proper installation before concealing or enclosing them.

B. Keep areas of work accessible until inspection and acceptance by applicable authorities.

C. Before substantial completion, patch and repair firestopping cut or penetrated by other construction work.

3.5 ADJUSTING AND CLEANING

A. Clean up spills of liquid components.

B. Neatly cut and trim materials as required.

C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

END OF SECTION

SECTION 26 0519

WIRES AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wire and cable rated 600-volts and less.

B. Type MC and Type MC luminary cables as permitted in Part 3.

C. Type NM cable is not permitted.

1.2 RELATED SECTIONS

A. Underground ducts and utility structures: Section 26 0544.

B. Conduits: Section 26 0533.

C. Lighting controls: Sections 26 0923 and 26 0936.

D. Lighting: Section 26 5100.

1.3 REFERENCES

A. ANSI/NEMA WC 70 – Power Cables rated 2000 Volts or Less for Distribution of Electrical Energy.

B. ASTM B3 – Standard Specification for Soft or Annealed Copper Wire.

C. ASTM B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors.

D. UL 44 – Standard for Thermoset-Insulated Wires and Cables.

E. UL 83 – Standard for Thermoplastic-Insulated Wires and Cables.

F. Additional UL Standards as indicated.

1.4 SUBMITTALS

A. Product data:

1. Each type of wire and cable, including accessories.
2. Include copies of UL certifications showing compliance with requirements in “Quality Assurance” below.

B. Cable limiters: Submit time/current curves and peak let-through values.

1.5 QUALITY ASSURANCE

A. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Products and installation shall comply with NFPA 70 and other applicable national, state, and local electrical codes.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General requirements: Deliver, store, and handle wire and cable in accordance with the manufacturer's instructions.

1. Wire and cable shall be packaged in a manner that protects them during ordinary handling and shipping. Ship from manufacturer with ends temporarily sealed against moisture.
2. Protect wire and cable during storage (both onsite and offsite).

a. Store in a clean and dry location. Elevate from surfaces where water can accumulate, and cover cable rolls to protect against weather.

3. Handle wire and cable as recommended by the manufacturer. Do not pull from the center or periphery of the cable reel.
4. Damaged wire and cable shall be removed from the project site.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE (600-Volts Max.)

A. Conductors: UL listed and NEMA WC 70 compliant; Copper, 98 percent conductivity, suitable for 600-volt duty; rated 90-degree Celsius temperature for wet/dry applications; solid bare annealed copper for No. 10 and smaller complying with ASTM B 3, and stranded for No. 8 and larger complying with ASTM B 8.

B. Conductor insulation:

1. Type THHN/THWN-2: Comply with UL 83; PVC insulation, nylon jacket.

C. Conductor identification: Markings along outer braid denoting conductor size, voltage classification, type of insulation, and manufacturer's trade name, and color code. Identification shall extend to branch circuits and outlets. Use the color coding system tabulated below throughout the building's network of feeders and circuits, unless otherwise required by the authority having jurisdiction.

1. Colors on conductors No. 10 and smaller, or No. 6 and smaller for grounded and grounding conductors: Solid colored insulation.
2. Colors on conductors No. 8 and larger, or No. 4 and larger grounded and grounding conductors: Colored tape wrapped a minimum of 6 inches (150 mm) on either end of conductor.

COLOR CODE				
VOLTAGE	NEUTRAL	PHASE		
		A	B	C
120-V, 2-wire	White	Black or Red, depending on phase		
240/120-V, single phase, 3-wire	White	Black	Red	

D. Wires used solely for grounding purposes shall be green, where insulated.

E. Control wiring shall be coded with colors different from those used to designate phase wires.

2.2 WIRING ACCESSORIES

A. Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service where installed.

B. Twist-on wire connectors (dry locations):

1. Color-keyed.
2. Basis of design: Ideal Industries, Inc., Wingnut®, 3M Company "Scotchlok", or King Innovation.

C. Twist-on wire connectors (damp and wet locations):

1. Connectors shall be listed under UL 486D.
2. Basis of design: Ideal Industries, Inc., UnderGround®, models 60, 64, or 66 as appropriate; King Innovation DryConn®; or 3M Company.

D. Compression connectors:

1. Color-keyed.
2. Basis of design: 3M Company "Scotchlok"™ compressor connectors, "10000" series for copper conductors or Thomas & Betts (Blackburn) or Ilsco.

E. Compression connectors (damp and wet locations):

1. Protect the connectors with a waterproof system, UL-listed for direct burial and 600 volts.
2. Basis of design: 3M Company 8420 series, Thomas & Betts Model DBSK82, or Ilsco.

F. Compression taps:

1. Series CT-2 tap with CT-2C cover, or Series 54710 color-keyed compression taps,
2. Basis of design: Burndy Corporation "Versitap" or OZ/Gedney.

G. Power distribution blocks:

1. Basis of design: Hubbell Burndy “U-Blok.”

2.3 PLENUM CABLES

A. Plenum cable:

1. Insulated with material that is UL classified for low flame and smoke-spread characteristics, for use in plenum areas without conduit in accordance with the requirements of NFPA 70.
2. Communications cable: Type MPP or CMP in accordance with NFPA 70.
3. Insulator basis of design: Dupont “Teflon FEP”.

2.4 METAL-CLAD CABLE, TYPE MC

A. Cable: UL 83 and UL 1569 listed; 600-volt, single- or multi-circuit Type MC Cable, multi-conductor with ground conductor; aluminum or steel interlocked armor.

B. Conductors: Solid copper No. 10 and smaller, and stranded copper No. 8 and larger; conforming to ASTM B 3 or B 8.

C. Conductor Insulation: Type THHN/THWN insulated single conductors including ground conductor.

D. Fittings:

1. UL 514B listed, steel or malleable iron fittings. Zinc die-cast fittings shall not be acceptable.
2. Basis of design: KonKore/Atkore International.

2.5 METAL-CLAD CABLE, TYPE MC LUMINARY CABLE

A. Cable: UL 66, UL 83, UL 1569, and UL 2556 listed; 600-volt, single- or multi-circuit Type MC luminary cable; multi-conductor with power conductors, control conductors, and ground conductor; aluminum or steel interlocked armor.

1. Power conductors: Solid copper, Type THHN insulation, No. 10 and No. 12 AWG.
2. Control conductors: Solid copper, Type TFN insulation, twisted pair No. 16 AWG.

B. Fittings:

1. UL 514B listed, steel or malleable iron fittings. Zinc die-cast fittings shall not be acceptable.
2. Basis of design: KonKore/Atkore International.

2.6 SERVICE ENTRANCE CABLE, TYPE SE

A. Service Entrance Cable, Type SE.

1. Cable: UL 83 and UL 854 listed; copper, 600-volt, multi-conductor with ground. Solid copper No. 10 and smaller, stranded copper No. 8 and larger; Type THHN/THWN insulated conductors and reinforced PVC outer jacket.

2.7 CABLE LIMITERS

A. Current-limiting devices for short-circuit protection of individual cable runs.

B. Current-carrying capacity: Measured by cable size as indicated.

C. Interrupting rating: 200,000 rms symmetrical amperes.

D. Time/current curves and peak let-through values: As indicated on approved submittals.

E. Mounting terminals: Copper.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide wire and cable indicated in accordance with national, state, and local electrical codes.

B. Conceal wire and cable in new construction and in locations with finished walls, ceilings, and floors unless otherwise noted on drawings.

C. Wire and cable serving systems over 100-volts shall be installed in raceways, except where otherwise noted on drawings.

D. Wire and cable serving systems rated below 100-volts shall be installed in raceways, except where otherwise noted in individual specification sections. Refer to paragraph "INSTALLING CABLE RATED BELOW 100-VOLTS" below for additional information.

3.2 INSTALLING INTERIOR WIRING

A. Sizes: Minimum sizes shall be as follows, unless a larger size is indicated on the drawings.

1. 120-volt branch circuits:

a. Homerun from first outlet to panel: No. 12 when run is 50 feet (15,000 mm) or less; No. 10 when run is between 50 feet (15,000 mm) and 100 feet (30,000 mm); No. 8 when run is more than 100 feet (30,000 mm).
b. First outlet to other outlets: No. 12.

2. Other systems (over 100-volts): Minimum No. 12 unless specified or shown on drawings to be smaller.

B. Wiring methods and locations: Wires and cables shall be installed based on the following requirements, unless otherwise noted.

1. Feeders: Type THHN/THWN-2, single conductors in raceway.
2. Branch circuits:

a. Unless otherwise indicated, utilize Type THHN/THWN-2, single conductors in raceway.
b. Metal-clad cable, Type MC cable and MC luminary cable - Refer to section "INSTALLING MC CABLE" below for acceptable locations.

3. All other applications: Provide Type THHN/THWN-2, single conductors in raceway or wire and cable type as indicated.

C. Splicing shall be done in outlet boxes and junction boxes and not in conduit.

1. Conductors No. 8 and larger: Terminated, spliced and taped, wherever practical, with compression connectors or solderless connectors. Use tools recommended by the manufacturer.
2. Splices in conductors No. 10 and smaller, including lighting fixtures: Made with wire connectors.
3. Taps in conductors No. 6 and larger: Made with compression taps or power distribution blocks.

D. Wiring in high ambient temperature areas shall be of types required by NFPA 70 including in fixture channels.

E. Wires shall be neatly shaped in panels, wireways, boxes, and appurtenances.

3.3 COORDINATION WITH DEVICES AND EQUIPMENT

A. Where conductor size or parallel conductors shown on drawings connect to terminals on devices or equipment which is not sized for the connection:

1. Provide a junction box as near the equipment as possible, but no more than 10 feet (3 m) away. Obtain approval of location before installing.
2. Provide conductor(s) sized to the ampacity of the equipment, from equipment to junction box.

3. In the junction box, splice the conductors from the equipment to the conductors of sizes, or parallel conductors, shown on the drawings.

3.4 INSTALLING EXTERIOR WIRING

A. Sizes: Minimum sizes shall be as follows, unless a larger size is indicated on the drawings.

1. 600-volt branch circuits: Copper, No. 10 minimum.
2. Exterior lighting circuits: Copper, No. 10 minimum.

B. Wiring methods and locations: Wires and cables shall be installed based on the following requirements, unless otherwise noted.

1. Feeders and branch circuits: Type THHN/THWN-2, single conductors in raceway.
2. Service entrance: Type THHN/THWN, single conductors in raceway.

C. Splicing shall be done in outlet boxes and junction boxes and not in conduit. Treat these boxes as wet locations.

1. Conductors No. 8 and larger: Terminated, spliced and taped, wherever practical, with compression connectors. Use tools recommended by the manufacturer.
2. Splices in conductors No. 10 and smaller, including lighting fixtures: Made with wire connectors.
3. Taps in conductors No. 6 and larger: Made with compression taps or power distribution blocks.

3.5 INSTALLING CABLE RATED BELOW 100-VOLTS

A. Install in raceway, unless otherwise indicated in individual specification sections.

B. Where individual specification sections allow cable to be installed either in raceway or on J-hooks, install as follows:

1. Wiring method:

a. Wiring in walls, in concrete floors, above inaccessible ceilings, where exposed in finished spaces, exposed on walls, and wherever it may not be accessible or may be subject to physical damage: Install cables in raceway.
b. Wiring exposed in ceilings of unfinished spaces: Install cables in raceway.
c. Wiring concealed above accessible suspended ceilings: Install cables on J-hooks.
d. Wiring within enclosures, consoles, cabinets, desks, and counters: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and/or distribution spools.

2. Conceal raceway and cables, except in unfinished spaces and in open ceiling spaces.
3. Cable not in raceways:

a. Do not install in hangers used for pipes, electric conduits, or ceiling hangers, nor support it in any way by attachments to pipes, conduits, or ceiling hangers.
b. Install without damaging conductors, shield, or jacket. Cables shall not run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
c. Install away from potential EMI sources, including electrical power lines and equipment.
d. Install parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.

4. Cable support with J-hooks:

    a. Install J-hooks at intervals not exceeding 60 inches.
    b. Secure cables on J-hooks with cable ties. Avoid cinching cables.

5. Each cable run shall contain an 'S' loop or other means to accommodate expansion or contraction.
6. Where ceiling plenums are used for passage of air by heating and air conditioning system, install cable in conduit or use UL listed plenum cable.

C. For cable installed in conduit, comply with requirements for raceways and boxes specified in Section 26 0533, Conduits, and Section 26 0534, Boxes.

1. Provide separate conduit systems for each low-voltage system.
2. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

    a. Pull cables simultaneously if more than one is being installed in same raceway.
    b. Use pulling compound or lubricant, if necessary. Use compounds that will not damage conductor or insulation.
    c. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage cables or raceway.

D. Avoid installing near hot utilities, which might adversely affect system performance or result in damage to the cable. If cable must be placed close to such utilities, keep it separate and protect with insulation.

E. Cable bends shall have a radius not less than the value recommended by the cable manufacturer.

F. Tag cables connected to electronic equipment, to show function and the location of other end. Securely fasten labels to the cable.

3.6 INSTALLING MC CABLE

A. Install in compliance with NFPA 70.

B. Sizes: Cables larger than No. 8 shall not be permitted.

C. Locations: Type MC cable may be used for branch circuits concealed in accessible ceiling spaces, in drywall partitions, or within casework.

1. Light fixture whips from junction box in ceiling to recess mounted lighting fixtures.
2. MC cable may be used in metal stud walls between wiring devices and from wiring device up to ceiling and nearest junction box.
3. Provide junction box in accessible ceiling space of each room and terminate MC cables in room at box.
4. MC cabling shall not be used for homeruns back to panelboard. Homeruns shall be wire in raceway.
5. MC cabling may be used from first ceiling junction box located outside electrical closet to branch circuit loads served. MC cabling shall not be used between first junction box and homerun back to panelboard.
6. Do not install in masonry partitions or masonry walls.

D. Connect cable with wiring accessories specified above.

E. MC cable run to switches shall have a neutral conductor. This conductor is not indicated on the drawings.

3.7 INSTALLING MC LUMINARY CABLE

A. Install in compliance with NFPA 70.

B. Locations: Type MC luminary cable may be used only above ceilings for LED lighting fixtures with dimmable drivers controlled by a Class 2, low-voltage 0-10VDC controller; connections between the controller and lighting fixtures within a space.

C. Connect cable with wiring accessories specified above.

D. Cable larger than No. 10 shall not be permitted.

E. Maximum length: 20 feet.

END OF SECTION

SECTION 26 0521

WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Power and control wiring for equipment.

1.2 RELATED SECTIONS

A. Equipment: Installed items requiring electricity, specified in other sections or shown on drawings.

B. Motors requirements for HVAC equipment: Section 23 0513.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conduits, wires and cables, devices, and accessories as specified in other sections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide power wiring from motor starters to each motor and its manual controlling device.

1. Make flexible or liquid tight connections as specified in Section 26 0533, Conduits.

B. Certain equipment, as indicated, will be furnished with control panels and auxiliary control components. Mount the panels, furnish and install source wiring and disconnects, and completely connect controls and motors.

C. Provide source wiring, connections, and disconnects for mechanical heating, ventilating, and air-conditioning (HVAC) equipment specified in Division 23. Refer to sections of Division 23 for equipment and controls.

1. Provide weathertight enclosures for disconnects for outdoor equipment.
2. Mount starters where required, and provide proper size overload protection.
3. Where capacitors are required for power factor correction as specified in 23 0513, Common Motor Requirements for HVAC Equipment, connect the capacitors.

D. Roof exhaust fans will be equipped with factory-wired disconnects located adjacent to the motor under the ventilator hoods as specified in Section 23 3400, HVAC Fans. Exhaust fans shall be controlled by various means as indicated on drawings.

1. For fans shown to be manually controlled, furnish and install a manual motor starting switch with pilot light, located where indicated.
2. Where necessary for larger and three-phase motors, provide magnetic starters.
3. Where fans are provided with electrically operated dampers, provide wiring and relays for single-phase damper operators on three-phase motors.

E. Where a Division 23 section requires installation of equipment under supervision of equipment manufacturer's representative, coordinate electrical installation to cooperate with representative's requirements.

F. Provide power sources for Government-furnished equipment.

G. Provide wiring where required to time clocks provided as specified in automatic temperature controls sections.

END OF SECTION

SECTION 26 0526

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding electrical systems and equipment.

B. Ground system test.

1.2 REFERENCES

A. ANSI/TIA/EIA J-STD-607

B. IEEE STD 142

C. NFPA 70

D. ASTM F467 and F468

E. UL 467

1.3 DEFINITIONS

A. Area served by a separately-derived system: The area within the building that contains any part of a circuit of the system.

B. IBGB: Intersystem Bonding Termination Grounding Busbar.

C. TMGB: Telecommunications Main Grounding Busbar.

D. TGB: Telecommunications Grounding Busbar.

1.4 SUBMITTALS

A. Product data: Ground rods and connections.

B. Certifications: System test.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Ground conductor, unless specifically noted otherwise, shall be copper, 98 percent conductivity, solid for No. 10 AWG and smaller and stranded for No. 8 AWG and larger.

B. Grounding busbar: Predrilled rectangular bars of electro-tin plated copper, 0.25 inches (6.3 mm) thick, 12 inch (300 mm) long, unless otherwise indicated on drawings, with 0.3125 inch or 0.4375 inch (7.9 mm or 11.1 mm) diameter holes horizontally spaced 1 to 1.125 inches (25.4 to 28.6 mm) apart.

1. Intersystem bonding termination grounding busbar (IBGB) and telecommunications main grounding busbar (TMGB) shall be 4 inches (101.6 mm) wide, with four rows of holes. Telecommunications main grounding busbar shall comply with ANSI/TIA/EIE J-STD-607.
2. Other grounding busbars shall be 2 inches (50.8 mm) wide with two rows of holes. Each telecommunications ground busbar (TGB) shall comply with ANSI/TIA/EIA J-STD-607.
3. Stand-off insulators for busbar shall be flame-resistant fiberglass-reinforced thermoset polyester, UL recognized per UL Standard 891.

C. Ground rods:

1. Copper bonded steel, 0.75 inch diameter by 10 feet long, one end pointed and the other end tinned,
2. Basis of design: Erico International Corporation.

D. Mechanical type ground connectors:

1. Connectors:

a. IEEE 837 and UL 467 compliant, listed for use for specific types, sizes, and combinations of conductors and connected items.
b. Basis of design: FCI Burndy G Series.

2. Nuts, bolts, and washers: Silicon bronze alloy type B per ASTM F467 and F468.

E. Exothermic type ground connections:

1. Exothermic welding systems.
2. Basis of design: “Cadweld,” manufactured by Erico International Corporation.

F. Lugs:

1. Lugs shall be two- or four-hole.
2. Basis of design: Burndy Hylug series.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide the complete grounding of conduit systems, electrical equipment, conductor and equipment enclosures, motors, transformers, and neutral conductors in accordance with applicable codes. Grounded phase and neutral conductors shall be continuously identified. Continuity of metal raceways shall be insured by double locknuts.

B. Furnish and install main grounds for secondary electrical service to cold water main in accordance with NEC requirement. In addition to the cold water ground, provide ground rods as indicated or as required by NEC and applicable codes.

C. Grounding busbar: Busbars shall stand off the wall a minimum of 2 inches (50.8 mm). Mount 6 inches (152.4 mm) above finished floor unless otherwise indicated. Insulate the busbar from its supports.

1. Conductors connecting busbar to other busbars, and to the grounding electrode system shall be attached to busbar with exothermic welds.
2. Connect other conductors to busbar using lugs.

D. Install copper grounding jumpers of 3/0 copper cable around each main water valve in the building. Install copper grounding jumpers around conduit expansion fittings. Jumpers shall be of adequate current carrying capacity corresponding to size of conduit.

E. Ground system connections which are beneath the floor and in a concealed or inaccessible location shall be brazed or welded. Brazing and welding shall be "CADWELD."

F. Bonding separately-derived systems:

1. Each metal water piping system, not used as the electrical system's grounding electrode, in the area served by the electrical system shall be bonded to the electrical system's neutral by a system bonding jumper.
2. If exposed structural metal is not used as the grounding electrode for the system, bond exposed structural metal in the area served by the electrical system to the system's neutral by a system bonding jumper.
3. If a metal water piping system in the area served by the electrical system is bonded to exposed structural metal by a NEC-compliant bonding jumper, then only one of the two (piping or structure metal) need to be bonded to the electrical system's neutral.

G. Test wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 26 0544, Underground Ducts and Utility Structures, and shall be at least 12 inches (300 mm) deep, with cover.

1. Test wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

H. Bonding straps and jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to equipment mounted on vibration isolation hangers and supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connections for outdoor locations; if a disconnect-type connection is required, use a bolted clamp secured with a minimum of two bolts and lock washers.

I. Bonding interior metal ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

3.2 EQUIPMENT GROUNDING AND BONDING

A. Provide insulated equipment grounding conductors to all feeders and branch circuits.

B. Air-duct equipment circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water heater, heat tracing, and antifrost heating cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Signal and communication equipment: In addition to grounding and bonding required by NFPA 70, provide grounding systems complying with requirements in ANSI/TIA/EIA J-STD-607-A.

1. Telephone and data equipment may share a common grounding system.

a. Provide a No. 4 AWG minimum conductor from the IBGB to a TMGB, located in the telecommunications entrance facility.
b. Provide a TGB in each telephone and data wiring closet. Where a telephone and data terminal cabinet is not in a wiring closest, provide a TGB next to it.
c. Provide No. 4 AWG minimum conductors to bond the TMGB to TGB's.
d. Where a TMGB or TGB is in a room with a panelboard providing circuits to the telephone or data equipment in the room, locate the busbar as close as is practical to the panelboard, and bond the panelboard's equipment ground or enclosure to the busbar.

2. For other communication equipment, such as fire alarm, intercom, CATV, and security panels, when located in a room other than where the IBGB, TMGB, or TGB is, provide a grounding busbar in the same room as the equipment. Bond the grounding busbar to the IBGB, TMGB, or TGB with a No. 4 AWG minimum conductor.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Grounding manholes and handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout. Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.4 APPLICATIONS

A. Underground grounding conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.
2. Duct bank grounding conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct bank installation.

3.5 IDENTIFICATION

A. Comply with requirements in Section 26 0553, Identification for Electrical Systems, for instruction signs. The label or its text shall be green.

B. Install labels at the ends of telecommunications bonding conductors and the grounding electrode conductor where exposed.

1. Label text: "If this connector or cable is loose or must be removed for any reason, please call the building telecommunications manager."

3.6 GROUNDING SYSTEM TEST

A. Ensure that grounding system is continuous and that resistance to earth is not more than 10 ohms.

B. Test each ground rod for resistance to earth before making connections to rod; tie grounding system together and test for resistance to earth.

C. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall.

D. Submit written results of each test including location of rods as well as resistance and soil conditions at time measurements were made.

END OF SECTION

SECTION 26 0533

CONDUITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Conduit, raceways, and accessories, aboveground and below ground where not in duct banks.

1.2 RELATED SECTIONS

A. Trenching: Section 26 0501.

B. Firestopping: Section 26 0507.

C. Boxes: Section 26 0534.

D. Exterior duct banks and utility structures: Section 26 0544.

E. Painting: Division 09.

1.3 DEFINITIONS

A. FMC: Flexible metal conduit.

B. IMC: Intermediate metal conduit.

C. LFMC: Liquid-tight flexible metal conduit.

D. RGS: Rigid galvanized steel.

1.4 SUBMITTALS

A. Product data:

1. Each type of conduit and raceway included in the work, and related fittings.
2. Sleeves and sleeve seals.
3. Accessory materials.
4. Hangers and fasteners.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

B. Steel conduit and tubing:

1. AFC Cable Systems, Inc. (FMC and LFMC)
2. Allied Tube & Conduit; a Tyco International Ltd-Co.
3. O-Z/Gedney, Unit of General Signal.
4. Wheatland Tube Co.
5. Or approved equal.

C. Steel conduit fittings:

1. Appleton Electric Co.
2. Cooper Crouse-Hinds.
3. Hubbell, Inc.; Killark Electric Manufacturing Co.
4. O-Z/Gedney; Unit of General Signal.
5. Spring City Electrical Manufacturing Co.
6. Thomas & Betts Corporation.
7. Wheatland Tube Co.
8. Or approved equal.

D. Nonmetallic conduit, tubing and fittings:

1. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. Arnco Corp.
3. Beck Manufacturing.
4. CANTEX Inc.
5. Certainteed Corp.; Pipe and Plastics Group.
6. Lamson & Sessions; Carlon Electrical Products.
7. Or approved equal.

E. Wireways and fittings:

1. Hoffman Engineering Co.
2. Lamson & Sessions, Carlon Electrical Products.
3. Schneider Electric; Square D products.
4. Or approved equal.

F. Conduit hangers and supports:

1. Thomas & Betts “Kindorf”.
2. Tyco Power-Strut.
3. Unistrut Diversified Products.
4. Or approved equal.

G. Fasteners:

1. Caddy Fasteners by Erico Products Inc.
2. ITW Ramset “Red Head”.
3. Wej-It Fastening Systems.
4. Or approved equal.

2.2 CONDUIT AND FITTINGS

A. Galvanized steel conduit: Hot-dip galvanized with threads galvanized after cutting, one of the following:

1. Rigid full weight, heavy-wall steel conduit (RGS) conforming to UL 6 and ANSI C80.1.
2. Intermediate steel conduit (IMC) conforming to UL 1242 and ANSI C80.6.

B. Steel conduit fittings: Cast malleable iron fittings with smooth finish and full threaded hubs. Include steel or malleable iron locknuts, bushings, and other fittings.

1. Insulating bushings:

a. Basis of design: Thomas & Betts Series 22.

2. Hub fittings with recessed sealing ring and nylon insulated throat:

a. Basis of design: Thomas & Betts Series 370.

3. Fittings for exposed locations: Conduit outlet bodies, cast iron or cast aluminum, zinc or cadmium plated.

C. Electrical metallic tubing (EMT): Hot-dip galvanized or sherardized thin-wall steel conduit conforming to UL 797 and ANSI C80.3.

D. Connectors and couplings for EMT: Concrete- or rain-tight, compression type, made of zinc- or chromium-plated steel. Connectors shall have nylon insulating throats.

1. Compression connector:

a. Basis of design: Thomas & Betts No. 5223.

2. Compression coupling:

a. Basis of design: Thomas & Betts No. 5220.

E. Flexible metal conduit (Type FMC): Made of sheet metal strip, interlocked construction, conforming to UL 1.

F. Liquidtight flexible metal conduit (Type LFMC) shall conform to UL 360.

G. Connectors for flexible metal conduit:

1. Angle wedge with nylon insulated throat.
2. Basis of design: Thomas & Betts “Tite-Bite” connector Series 3110 and 3130.

H. Liquidtight type connectors:

1. UL 14814A. Fittings: With nylon insulated throat.
2. Basis of design: Thomas & Betts Series 5331.

I. Plastic conduit: Polyvinyl chloride (PVC) Schedule 40, rated for use with 90-degree conductors, for exposed, underground, and encased applications, complying with NEMA Specification TC-2 and UL 651.

J. Electrical nonmetallic tubing (ENT): Polyvinyl chloride (PVC) flexible tubing, complying with NEMA TC-13.

K. Plastic conduit and ENT fittings, solvents and adhesives:

1. Fittings: Complying with NEMA TC 3 and UL 514.
2. Solvents and adhesives: As recommended by conduit manufacturer.

L. Wireways: Steel wireway with hinged cover, UL listed as wireways and auxiliary gutters.

1. Cover: Opening complete width and length of wireway.
2. Finish: Baked enamel.
3. Basis of design: Square D “Square-Duct.”

M. Fittings for wireways: Made with removable covers to permit installation of a complete system with access to wires throughout the system, UL listed with wireways. Connections: Threaded screws at every connector.

N. Weatherproof expansion fittings:

1. With bonding jumpers.
2. Basis of design: O-Z/Gedney Types AX and TX.

2.3 SLEEVES FOR RACEWAYS

A. Steel pipe sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

1. Sleeves for exterior walls: Anchor flange welded to perimeter.

B. Sleeves for rectangular openings: Galvanized sheet steel of length to suit application. Minimum thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm): 0.052 inch (1.3 mm).
2. For sleeve cross-section rectangle perimeter equal to or more than 50 inches (1270 mm) and 1 or more sides equal to or more than 16 inches (400 mm): 0.138 inch (3.5 mm).

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 0507.

2.4 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annual space between sleeve and conduit.

1. Sealing elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure plates: Reinforced nylon polymer. Include two for each sealing element.
3. Connecting bolts and nuts: Stainless-steel of length required to secure plates to sealing elements. Include one for each sealing element.

2.5 ACCESSORY MATERIALS

A. Pull rope:

1. Polypropylene, minimum 0.1875 inch (5 mm) thick, tensile strength 800 pounds (3559 N), work load 130 pounds (578 N).
2. Basis of design: Graybar Electric Co., Inc., “Pro-Pull.”

B. Caps and plugs:

1. Basis of design: Thomas & Betts Series 1470.

C. Lubricant:

1. UL approved.
2. Basis of design: Ideal Industries, Inc. “Yellow 77”.

D. Bituminous protective coating: Coal tar based, self-priming on steel, applied in a wet film thickness at least 22.0 mils (559 microns) per coat.

E. Rust inhibitive paint:

1. Alkyd based, white, black, or bronzetone; applied in a wet film thickness of at least 2.9 mils.
2. Basis of design: Benjamin Moore Super Spec HP D.T.M. Alkyd Low Lustre P23.

2.6 CONDUIT HANGERS

A. Adjustable hangers:

1. Basis of design: Kindorf C-711 lay-in hanger or C-710 Clevis hanger.

B. Trapeze hangers:

1. Constructed of channels with notched steel straps.
2. Steel strap basis of design: Kindorf C-105.

C. Channels:

1. Steel, 1.5 inches (38 mm) wide with 7/8-inch (22-mm) continuous slot, gauges and weights.
2. Basis of design: Kindorf B-900 series.

D. Beam clamps:

1. Adjustable type for connecting hanger rod to steel beam.
2. Basis of design: Kindorf E-160 or U-569

E. Hangers for conduit 1.0 inch (27 mm) and smaller, through or below bar joists: “Hang-on” hangers attached to joists with Minerallac scissor clips or two-piece stud clips.

F. Finish: For hangers, assemblies, plate washers, rods, locknuts, channels, bolts, and appurtenances:

1. Zinc plated.
2. Hot-dip galvanized, where required for weather-exposed or damp locations.

2.7 FASTENERS

A. General: Select fasteners such that load applied does not exceed one-fourth of manufacturer’s load capacity in 3500 psi (24000 kPa) concrete.

B. Fasteners to concrete: Self-drilling type expansion anchors, or machine bolt drop in anchors for drilled holes. Fasteners to concrete ceilings shall be vibration- and shock-resistant.

C. Fasteners to drywall or cavity wall: Toggle bolts, hollow-wall drive anchors, or nylon anchors as required.

D. Powder-actuated or drive pin type fasteners are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide complete, separate and independent raceway system for each of the various wiring systems including, but not limited to, the following:

1. Lighting
2. Power
3. Voice and Data Systems
4. Security Systems

B. Wire raceway systems completely, except where otherwise indicated, as shown on drawings and as required for satisfactory operation of each system.

C. Where wireways are required or used to facilitate the installation, size them to accommodate conductors, in accordance with NFPA 70.

D. Types and locations of conduits are scheduled at the end of the section.

E. Do not install conductors or pull rope during installation of conduit.

F. Where conduit is connected to a cabinet, junction box, pull box, or auxiliary gutter, protect the conductors with an insulating bushing. Provide locknuts both inside and outside the enclosure. Where conduit is stubbed up to above ceilings for future wiring, close ends with bushings.

G. Bituminous protective coating:

1. Coat exposed threads on steel conduits in concrete slabs at couplings and fittings, after joints are made up.
2. Coat metallic conduits below grade not in concrete, and where emerging from below grade or slabs, four inches above and below grade or slab.

H. Rust-inhibitive paint:

1. Exposed threads of exterior conduit.
2. Unfinished metal components.

I. Make turns in conduit runs with manufactured elbows or using machines or tools designed to bend conduit. Turns shall be not less than the various radii permitted by NFPA 70.

J. Sizes:

1. Do not use conduit smaller 0.75 inch (21 mm).
2. Feeder conduits shall be as large as indicated, or as required by NFPA 70 (whichever is larger). Do not install more than one feeder in a single conduit.
3. Conduit sizes shown on drawings are based on Type THHN/THWN-2 wire.

K. Make vertical runs plumb and horizontal runs level and parallel with building walls and partitions.

L. Ground conduits as required by NFPA 70.

M. Where conduits pass through building expansion joints, and wherever relative movement could occur between adjacent slabs, equip with weatherproof expansion fittings and bonding jumpers.

N. Run conduits concealed in new construction except where connecting to surface-mounted cabinets and equipment, and in electrical and mechanical equipment spaces. Install conduit above suspended ceilings and within walls and partitions.

O. From each flush-mounted lighting or power panelboard, provide at least four 0.75-inch empty conduits, to terminate in furred ceiling space above. Cap these conduits.

P. Immediately after each run of conduit is completed, test it for clearance, smooth the joints, and close at each end with caps or plugs to prevent entrance of moisture or debris.

Q. Conduit installed outdoors or at indoor locations exposed to continuous or intermittent moisture shall provide a liquidtight seal. Use steel or malleable iron hub fittings. Coat exposed threads with bituminous protective coating.

R. Install no conduit in these locations:

1. Setting beds for terrazzo or tile.
2. Concrete toppings.

S. Where conduit is stubbed up through concrete slab, exterior walls, or bearing walls, provide galvanized steel conduit elbows.

T. Install insulated bushings on ends of conduit stubs and sleeves.

3.2 INSTALLING PULL BOXES, JUNCTION BOXES, OUTLET BOXES

A. Install as specified in Section 26 0534, Boxes.

B. Install pull or junction boxes in long runs of conduits or where necessary to reduce the number of bends in a run.

1. Select inconspicuous locations. Do not install until locations have been approved by the DGS Project Manager.
2. Install boxes flush with wall or ceiling surfaces, with flat covers. Where removable ceiling units are used, locate boxes above ceilings.

C. Verify door swings with door frame installed before locating switch outlets.

3.3 INSTALLING FLEXIBLE CONDUIT

A. Installation shall comply with NFPA 70.

1. Minimum length: Two feet (610 mm).
2. Maximum length: Six feet (1830 mm).

B. Make immediate connections to transformers, recessed lighting fixtures, speakers, and other equipment in suspended ceilings with flexible metal conduit. Include sufficient slack to permit removal of fixture or equipment.

C. Make immediate connections to motors with liquidtight flexible metal conduit. Include sufficient slack to reduce the effects of vibration.

D. In wet locations, install liquidtight type, in such a manner that liquid tends to run off the surface and not drain toward the fittings.

E. Where fittings are brought into an enclosure with a knockout, install a gasket assembly consisting of an O ring and retainer on the outside.

3.4 INSTALLING PULL ROPE AND CONDUCTORS

A. After conduit is installed, fish pull rope. After completion of the work of this project, pull rope shall remain in conduits identified as to be left empty.

B. Do not use a pull rope that has a tensile strength of more than one of the conductors of a two-wire circuit, more than two of the conductors of a three-wire circuit, or more than three of the conductors of a four-wire circuit.

C. Do not pull conductors into the conduits until the system is entirely completed and wet building materials are dry.

D. Use only a lubricant approved for use with conductor materials and pull rope materials.

3.5 INSTALLING SLEEVES

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 0507.

B. Concrete slabs and walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Fire-rated assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

D. Cut sleeves to length for mounting flush with both surfaces of walls.

E. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

F. Size pipe sleeves to provide 0.25-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed.

G. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

H. Interior penetrations of non-fire-rated walls and floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.

I. Fire-rated-assembly penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Section 26 0507.

J. Exterior-wall penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 INSTALLING CONDUIT HANGERS

A. Single runs of overhead conduits 1.25-inch (35-mm) size and larger shall be supported by adjustable hangers, using 0.375-inch (10-mm) rods for conduits up to 2.0 inch (53-mm) size and 0.5-inch (13-mm) rods for conduits larger than 2.0 inches (53 mm).

B. Support groups of conduits run in parallel on trapeze hangers suspended from 0.5-inch (13-mm) hanger rods.

C. Space hangers not over 5 feet (1.5 m) apart for non-metallic conduits, and not over 10 feet (3 m) apart for metal conduits. Support conduits within 3 feet of each outlet, junction or pull box.

D. Below bar joist construction, support hangers from a length of structural channel, welded to the top chords of at least two joists.

E. Where large numbers of conduits are grouped together, stagger individual hangers so as not to concentrate the load on a few joists.

F. Where hanger rods are attached to structural beams, use adjustable beam clamps.

G. Below precast plank construction, hanger rods shall pass through the precast planks and be secured on top side with nut, locknut and plate washer. Plate washers shall be at least 4 inches (102 mm) square and 0.125 inch (3.2 mm) thick. Top of hanger assembly shall be concealed in the concrete fill which will be placed over the planks.

H. Attach hanger rods to concrete with expansion bolts and anchors.

3.8 INSTALLING UNDERGROUND CONDUIT, GENERAL

A. Depth:

1. Buried under building slabs: Top of conduit no less than 12 inches below the vapor barrier. Seal around conduits where they penetrate the vapor barrier.
2. Outside building: Top of conduit no less than 24 inches below finish grade.

B. Slope: At least 3 inches in 100 feet away from buildings and toward manholes or other drainage points.

C. Cleaning: At the completion of each run, in each conduit, first run a testing mandrel not less than 12 inches (305 mm) long with diameter 0.25 inch (6.35 mm) less than the inside diameter of the conduit; then draw through a stiff-bristled brush until particles are removed. Immediately install conduit plugs.

D. Except at conduit risers, make changes in direction of runs, either vertical or horizontal, by long sweep bends. Bend may be made up of one or more curved or straight sections or combinations. Use manufactured bends with a minimum radius of 36 inches.

E. Where underground nonmetallic conduit runs penetrate floor slabs, exterior walls, or bearing walls, use galvanized steel conduit elbows. Coat metallic elbows with bituminous protective coating.

3.9 INSTALLING UNDERGROUND CONDUIT WITHOUT CONCRETE ENCASEMENT

A. Run conduit in straight lines except as necessary.

B. Trenches: At least three inches (80 mm) clearance on each side of the conduit.

C. Warning tape: Install in backfill approximately 12 inches (300 mm) below grade.

D. Under existing roads and paved areas not to be disturbed, jack rigid steel conduit into place.

3.10 SCHEDULE OF LOCATIONS

A. RGS with screw joint couplings:

1. Conduits in concrete slabs except where noted to be plastic.
2. First five feet of conduit extending outside building.
3. Under roads and paved areas where existing pavement is not to be disturbed, extending at least five feet beyond edges of pavement.
4. Elbows penetrating floor slabs, exterior walls, or bearing walls.
5. Wiring to exterior equipment.

B. IMC with screw joint couplings:

1. Wiring to exterior equipment.

C. EMT:

1. Sizes 4 inches (102 mm) and smaller except as noted above.

D. Plastic with solvent cement joints:

1. For exterior circuits, directly buried, except first five feet from building.
2. Where noted under concrete slab, concrete encased, except elbows penetrating floor slabs, exterior walls, or bearing walls shall be galvanized steel conduit.
3. Where noted under concrete slab, direct buried.
4. Where noted in concrete slabs.
5. For concrete encased duct banks.

END OF SECTION

SECTION 26 0534

BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Boxes with covers.

1.2 RELATED SECTIONS

A. Conduits: Section 26 0533.

B. Access doors: Division 08.

C. Wiring devices: Section 26 2726.

D. Outlet boxes where required for special systems: Provided by the equipment manufacturers of the various systems.

1.3 SUBMITTALS

A. Product data: Each type of box included in the project.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

B. Boxes:

1. Appleton/EGS Electrical Group
2. RACO/Hubbell Electrical Products
3. Steel City/Thomas & Betts
4. Or approved equal.

2.2 MATERIALS

A. Outlet, switch, and junction boxes:

1. Sheet metal: NEMA OS 1, sherardized or galvanized stamped.
2. Cast-metal, where required for weather-exposed, or exposed locations: NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.

2.3 BOXES FOR WALLS AND PARTITIONS

A. Outlet boxes in concrete construction: Octagonal, two-piece type, of sufficient depth to keep conduits not closer than 1 inch (25 mm) to surface.

B. Switch and receptacle boxes in masonry partitions and walls: Square cornered tile wall boxes 3.5 inches (90 mm) deep, or four-inch (100-mm) square boxes with raised tile wall device covers. The device covers shall be of extra depths required to suit the block or brick construction in which they are placed.

C. Switch and receptacle boxes in metal stud partitions: 4 inches (100 mm) square by 1.5 inches (38 mm) deep boxes with 0.75-inch (19-mm) raised tile wall device covers finishing flush with finished wall surface.

D. Wall- and partition-mounted outlets for low-voltage systems: Same as specified above for switches and receptacles.

2.4 JUNCTION AND PULL BOXES

A. Junction and pull boxes in feeder conduit runs: Galvanized, of size required for conduit arrangement and not less than the size required by NFPA 70, and furnished with screwed covers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide box at each outlet, switch, and appurtenance. Each box shall be of a type suitable for the duty intended and shall be installed in accordance with the manufacturer's instructions.

1. Where conduit is weather-exposed or exposed, provide cast-steel or cast-aluminum boxes.

B. Coordinate locations of boxes with installation of conduit as specified in Section 26 0533.

C. Do not install boxes back-to-back (through the wall) in partitions.

D. Firmly secure the boxes in place, plumb, level, and with front of device cover even with finished wall surface.

E. Boxes in metal stud walls or partitions shall be securely supported by metal channels spanning between two studs and attached to same.

F. Outlet boxes used for supporting lighting fixtures: Furnish with malleable iron fixture studs of "No-Bolt" type, secured by locknut. Provide structural channel supports for boxes occurring in ceilings. Outlets in ceilings directly on bottom of joists shall be supported independent of ceiling construction. Outlets in suspended ceilings shall not be supported from ceiling construction. Special supports for boxes shall be as directed and approved by the DGS Project Manager.

G. Where service fittings will not permit ganging of boxes for floor outlets, outlets shall be as close as practical.

H. Provide a single cover plate where two or more devices are grouped together in one box.

I. Verify door swings with door frame installed before locating switch outlets.

J. Outlet boxes in fire-rated assembly:

1. Clearance between boxes and wallboard shall not exceed 0.125 inch (3.2 mm).
2. Surface area of individual outlet box does not exceed 16 square inches (103 sq cm).
3. Entire surface area of boxes shall not exceed 100 square inches (645 sq cm) per 100 square feet (9.3 sq m) of wall surface.

3.2 IDENTIFICATION

A. Identification on outside covers of pull and junction boxes in ceiling space or exposed on walls: Paint with colored enamel or mark with permanent waterproof black marker, or both, as specified.

1. Other special systems: Mark with system type, such as Data.
2. Power and lighting: Panelboard designation and circuit number(s).

B. Identification inside boxes for recess-mounted or concealed in walls and partitions: Plasticized card stock tags marked with permanent waterproof black markers.

1. Other special systems: Mark with system type, such as Data.
2. Power and lighting: Panelboard designation and circuit number(s).

END OF SECTION

SECTION 26 0541

LOW-VOLTAGE SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Start/stop service and scheduled outage for electric service, 120/240 V, 1 phase, 3 wires.

1.2 RELATED SECTIONS

A. Temporary power for construction: Division 01.

B. Trenching: Section 26 0501.

C. Electrical handholes and underground ductbank: Section 26 0544.

1.3 PAYMENT PROCEDURES

A. New start/stop service and scheduled outage will be installed by Potomac Edison (First Energy) (the Power Company).

B. Submit the bill on completion of this part of the work. Government will directly pay the Power Company.

1.4 SUBMITTALS

A. Product data: Each type of device or equipment required for the installation.

B. Shop drawings: Submit shop drawings and other information as required to the Power Company.

C. Certifications: Copy of certification for installation required by Power Company.

1.5 COORDINATION

A. Start/stop service and scheduled outage will be provided by Potomac Edison (First Energy) (the Power Company). Contact the designated power company service representative and verify the status of the project service application. If the current service application has expired, resubmit the service application using load data from the original application.

B. Arrange a project site meeting to verify that the proposed service entrance configuration is acceptable to the service company. Participants of the meeting shall include the service company representative, the DGS Project Manager and the Contractor.

C. Contact “Miss Utility” (1-800-257-7777) prior to any excavation or underground work. The location and depth for all utilities shall be verified. Provide test pits to verify location and depth of all existing utilities crossing new incoming services.

PART 2 - PRODUCTS

2.1 CONDUITS, FITTINGS, AND CONDUCTORS

A. Power Company will provide primary cables, transformers, and meters, as described in the article “Installation by Power Company,” below.

B. Conduits: As specified and scheduled in Section 26 0533, Conduits.

C. Fittings: As required by installation and by Power Company requirements, and as specified in Section 26 0533, Conduits.

1. Service entrance heads: UL 514B, threaded for rigid conduit (RGS), weather-resistant, galvanized malleable iron body and phenolic insulator.
2. Basis of design: O-Z/Gedney Type 17.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate installation with Power Company.

3.2 INSTALLATION BY POWER COMPANY

A. Primary power from Power Company lines to a point underground at the property line.

B. Primary cables, transformer, and terminations to disconnect switch downstream of meter, including meters.

3.3 INSTALLATION INCLUDED IN WORK OF THIS PROJECT

A. Direct buried conduit from utility pole to meter and disconnect as indicated on the drawings, minimum 3-inches (102 mm), as specified in Section 26 0544, Underground Ducts and Utility Structures, including markers or underground warning tape, and in accordance with Power Company requirements.

B. Where conduit enters a transformer or meter cabinet, provide bellmouth fittings on conduit ends 2 inches (51 mm) above the concrete slab.

END OF SECTION

SECTION 26 0544

UNDERGROUND DUCTS AND UTILITY STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Ducts in directly buried duct banks.
2. Ducts in concrete-encased duct banks.
3. Handholes and handhole accessories.

B. Related sections include the following:

1. Section 26 0526 for grounding electrodes, counterpoise conductors, clamps and connectors for grounding metallic handhole accessories, and testing of grounds.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO-HB 17: Standard Specifications for Highway Bridges. Includes the AASHTO categories for structural loads:

a. Heavy traffic: HS20.
b. Medium traffic: HS15.
c. Light traffic: H10.

B. ASTM International (ASTM)

1. ASTM C 478: Precast Reinforced Concrete Manhole Sections.
2. ASTM C 857: Minimum Structural Design Loading for Underground Precast Concrete Utility Structures. Includes classes which correspond to AASHTO categories:

a. Heavy traffic: Class A-16.
b. Medium traffic: Class A-12.
c. Light traffic: Class A-8.
d. Walkway: Class A-0.3, 300 lb/sq ft (1465 kg/sq m).

3. ASTM C 858: Specification for Underground Precast Concrete Utility Structures.

C. Society of Cable Telecommunications Engineers (SCTE):

1. SCTE 77: Specification for Underground Enclosure Integrity. Light duty and pedestrian traffic only. Includes Tiers for specific applications, and static vertical wheel load ratings:

a. Tier 5: Sidewalk applications with a safety factor for occasional nondeliberate vehicular traffic.
b. Tier 8: Sidewalk applications with a safety factor for nondeliberate vehicular traffic.
c. Tier 15: Driveway, parking lot, and off-roadway applications subject to occasional nondeliberate heavy vehicular traffic.

1.3 SUBMITTALS

A. Product data: For the following:

1. Handhole hardware, cable racks, and stanchions.
2. Conduit and ducts, including elbows, bell ends, bends, fittings, and solvent cement.
3. Duct bank materials, including spacers and miscellaneous components.
4. Warning tape.

B. Shop drawings: Show fabrication and installation details for underground ducts and utility structures and include the following:

1. For precast handholes, shop drawings shall be signed and sealed by a qualified professional engineer, and shall show the following:

a. Construction of individual segments.
b. Joint details.
c. Design calculations.

C. Coordination drawings: Show duct profiles and coordination with other utilities and underground structures. Include plans and sections drawn to scale, and show all bends and location of expansion fittings.

D. Product certificates: For concrete and steel used in underground precast handholes, according to ASTM C 858.

E. Product test reports: Indicate compliance of handholes with ASTM C 857 and ASTM C 858, based on factory inspection.

1.4 QUALITY ASSURANCE

A. Electrical components, devices, and accessories [(including ducts for communications and telephone service)]: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete units at project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.6 PROJECT CONDITIONS

A. Existing utilities: Do not interrupt utilities serving facilities occupied by the Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify the Government at least two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without DGS Project Manager's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of ducts and handholes with final arrangement of other utilities and site grading, as determined in the field.

B. Coordinate elevations of ducts and duct bank entrances handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure duct runs drain to handholes, and as approved by the DGS Project Manager.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Available manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

1. Nonmetallic ducts and accessories:

   a. ARNCO Corp.
   b. Beck Manufacturing Inc.
   c. Cantex, Inc.
   d. CertainTeed Corp.; Pipe & Plastics Group.
   e. ElecSys, Inc.
   f. Electri-Flex Co.
   g. IPEX, Inc.
   h. Lamson & Sessions; Carlon Electrical Products.
   i. Manhattan/CDT
   j. Spiraduct/AFC Cable Systems, Inc.

2. Underground precast concrete utility structures:

   a. A.C. Miller Concrete Products, Inc.
   b. Elmhurst-Chicago Stone Co.
   c. Oldcastle Precast Group
   d. Wausau Tile, Inc.

3. Precast polymer concrete enclosures for underground construction:

   a. Quazite/Strongwell (Hubbell Power Systems, Inc.).
   b. Synertech (Division of Oldcastle Precast).

4. Frames and covers:

a. Campbell Foundry Co.
b. East Jordan Iron Works, Inc.
c. McKinley Iron Works, Inc.
d. Neenah Foundry Co.

2.2 CONDUIT

A. Conduit and fittings are specified in Section 26 0533.

2.3 DUCTS

A. Rigid nonmetallic conduit: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

B. Rigid nonmetallic conduit: NEMA TC 2, Type EPC-80-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

C. Plastic utilities duct: NEMA TC 6, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 9.

D. Reinforced fiberglass epoxy duct: Type FRE, NEMA TC-14A (IPS) medium wall, UL listed and meeting applicable ASTM standards for medium-voltage service.

2.4 HANDHOLES

A. Cast-metal boxes: Cast aluminum, with outside flanges and recessed, gasketed cover for flush mounting and with nonskid finish and legend on cover. Unit, when buried, shall be designed to support AASHTO H10 loading.

B. Precast handholes: Reinforced concrete, monolithically poured walls and bottom, with steel or cast-aluminum frame and access door assembly forming the top of handhole. Duct entrances and windows shall be located near corners to facilitate racking. Pulling-in irons and other built-in items shall be installed before pouring concrete. Cover shall have nonskid finish and legend. Unit, when buried, shall be designed to support AASHTO H10 loading.

C. Polymer concrete handholes: Molded of sand and aggregate bound with polymer resin, and reinforced with steel, with 6-inch (150-mm) square cable entrance at each side and weatherproof cover with nonskid finish and legend. Unit, when buried, shall be designed to support SCTE 77 Tier 15 loading.

D. Cover legend: “ELECTRIC” or “COMMUNICATIONS”.

2.5 ACCESSORIES

A. Duct spacers: Rigid, nonmetallic, horizontally and vertically interlocking spacers, selected to provide minimum duct spacings and cover depths indicated while supporting ducts during concreting and backfilling.

B. Duct-sealing compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and of adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

C. Warning tape: Underground-line warning tape specified in Section 26 0553, Identification for Electrical Systems.

2.6 CONSTRUCTION MATERIALS

A. Waterproofing: Comply with Division 07 section specifying waterproofing.

B. Dampproofing: Comply with Division 07 section specifying dampproofing.

C. Mortar: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. (60 L) where packaged mix complying with ASTM C 387, Type M, may be used.

D. Brick for manhole chimney: Sewer and manhole brick, ASTM C 32, Grade MS.

E. Concrete: Use 3000-psi- (20.7-MPa-) minimum, 28-day compressive strength and 0.375-inch (10-mm) maximum aggregate size. Concrete and reinforcement are specified in Division 03 Section “Cast-in-Place Concrete.”

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Underground ducts for electrical cables higher than 600 V: Type FRE, Type EPC-40-PVC concrete-encased duct bank.

B. Underground ducts for electrical feeders 600 V and below: Type EB-20-PVC or EPC-40-PVC, concrete-encased duct bank.

C. Underground ducts for electrical branch circuits 600 V and below: Type EPC-40-PVC, directly buried duct bank, except use Type EPC-80-PVC when crossing roads.

D. Underground ducts for telephone utility service: Type EPC-40-PVC, directly buried duct bank, except use Type EPC-80-PVC when crossing roads.

E. Underground ducts for communication circuits: Type EPC-40-PVC, directly buried duct bank.

F. Handholes: Underground precast concrete utility structures or precast polymer concrete enclosures.

3.2 EARTHWORK

A. Excavation and backfill: Comply with Section 26 0501, Excavation and Fill for Electrical Work, Division 31 Section specifying Earthwork but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Section specifying Landscaping Lawns and Grasses.

D. Restore disturbed pavement. Refer to “Cutting and Patching” in Section 26 0101.

3.3 CONDUIT AND DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward handholes and away from buildings and equipment.

B. Curves and bends: Use manufactured rigid steel elbows for stub-ups at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of 25 feet (7.5 m), both horizontally and vertically, at other locations.

C. Use solvent-cement joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

D. Duct entrances to handholes: Space end bells approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts and vary proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line. Grout end bells into handhole walls from both sides to provide watertight entrances.

E. Building entrances: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below:

1. Concrete-encased ducts: Install reinforcement in duct banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building wall.
2. Waterproofed wall and floor penetrations: Install a watertight entrance-sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight.

F. Concrete-encased, nonmetallic ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator installation: Space separators close enough to prevent sagging and deforming of ducts and secure separators to earth and to ducts to prevent floating during concreting. Stagger spacers approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct bank application. Pour each run of envelope between handholes or other terminations in one continuous operation. If more than one pour is necessary, terminate each pour in a vertical plane and install 0.75-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
3. Reinforcement: Reinforce duct banks where they cross disturbed earth and where indicated.
4. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
5. Minimum clearances between ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.

6. Depth: Install top of duct bank at least 24 inches (600 mm below finished grade in nontraffic areas and at least 30 inches (750 mm) below finished grade in vehicular traffic areas, unless otherwise indicated.

G. Directly buried ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator installation: Space separators close enough to prevent sagging and deforming of ducts.
2. Install expansion fittings as shown on shop drawings.
3. Trench bottom: Continuous, firm, and uniform support for duct bank. Prepare trench bottoms as specified in Section 26 0501, Excavation and Fill for Electrical Work and Division 31 Section specifying earthwork.
4. Backfill: Install backfill as specified in Section 26 0501, Excavation and Fill for Electrical Work and Division 31 Section specifying earthwork. After installing first tier of ducts, backfill and compact. Repeat backfilling after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, complete backfilling normally.
5. Minimum clearances between ducts: 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
6. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade, unless otherwise indicated.

H. Warning tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank.

I. Stub-ups: Use rigid steel conduit for stub-ups to equipment. For equipment mounted on outdoor concrete bases, extend steel conduit a minimum of 5 feet (1.5 m) from edge of base. Install insulated grounding bushings on terminations. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches (75 mm) of concrete.

J. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

K. Pull rope: Equal to Graybar Electric Co., Inc., “Pro-Pull”: Polypropylene, minimum 0.1875 inch (5 mm) thick, tensile strength 800 lbs (3559 N), work load 130 lbs (578 N).

3.4 HANDHOLE INSTALLATION

A. Elevation: Install handholes with rooftop at least 15 inches (375 mm) below finished grade. Install handholes with depth as indicated. Where indicated, cast handhole cover frame directly into roof of handhole and set roof surface 1 inch (25 mm) above grade.

B. Drainage: Install drains in bottom of units where indicated. Coordinate with drainage provisions indicated.

C. Access: Install cast-iron frame and cover.

1. Install brick chimney to support frame and cover and to connect cover with roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.
2. Install precast collars and rings to support frame and cover and to connect cover with roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

3. Set frames in paved areas and trafficways flush with finished grade. Set other frames 1 inch (25 mm) above finished grade. Inside building, set frames flush with floor.

D. Waterproofing: Apply waterproofing to exterior surfaces of units after concrete has cured at least three days. Apply according to Division 07 Section specifying waterproofing. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of handhole chimneys after brick mortar has cured at least three days.

E. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

F. Field-installed bolting anchors: Do not drill deeper than 3.875 inches (98 mm) for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

G. Grounding: Install ground rod through floor in each structure with top protruding 4 inches (100 mm) above floor. Seal floor opening against water penetration with waterproof nonshrink grout. Ground exposed metal components and hardware with bare-copper ground conductors. Train conductors neatly around corners. Use cable clamps secured with expansion anchors to attach ground conductors.

H. Cast-in-place installation: Comply with applicable requirements in Division 03 Section "Cast-in-Place Concrete."

1. Finish interior surfaces with a smooth-troweled finish.
2. Windows for future duct connections: Form and pour concrete knockout panels 1.5 to 2 inches (38 to 50 mm) thick, arranged as indicated.

I. Precast concrete handhole installation: Unless otherwise indicated, comply with ASTM C 891.

1. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
2. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

3.5 FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

B. Duct integrity: Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of the duct. If obstructions are indicated, remove obstructions and retest.

C. Correct installations if possible and retest to demonstrate compliance. Remove and replace defective products and retest.

3.6 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

END OF SECTION

SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes electrical identification materials and devices required to comply with ANSI, NFPA, and OSHA standards.

B. This section addresses identification of electrical equipment, raceways, boxes, conductors, and other related electrical system components.

1.2 SECTION INCLUDES

A. Identification of power conductors and control cables.

B. Identification of equipment and instructions.

C. Miscellaneous identification products.

1.3 RELATED SECTIONS

A. Sections in Division 26.

1.4 REFERENCES

A. ANSI A13.1: Scheme for the Identification of Piping Systems.

B. ANSI Z535.4: Standard for Product Safety Signs and Labels.

C. ANSI/IEEE C2: National Electrical Safety Code.

D. NFPA 70: National Electrical Code.

E. NFPA 70E: Standard for Electrical Safety in the Workplace.

F. OSHA 29 CFR 1910.144: Safety Color Code for Marking Physical Hazards.

G. OSHA 29 CFR 1910.145: Specifications for Accident Prevention Signs and Tags.

H. UL 969: Standard for Marking and Labeling Systems.

1.5 SUBMITTALS

A. Product data: For each type of electrical identification product.

1.6 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with OSHA standards.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.7 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other sections requiring identification applications, drawings, shop drawings, manufacturer's wiring diagrams, and the operation and maintenance manual; and with those required by codes, standards, and safety regulations. Use consistent designations throughout Project.

B. Coordinate installation of identification materials and devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identification materials and devices with location of access panels and doors.

D. Install identifying materials and devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following manufacturers, or approved equal:

1. Brady USA, Inc.
2. Carlton Industries
3. Graphic Products, Inc.
4. Ideal Industries, Inc.
5. Panduit Corporation
6. Presco
7. Seton Identification Products
8. Thomas & Betts Company
9. Utility Safeguard

2.2 GENERAL PRODUCT REQUIREMENTS

A. Except where otherwise indicated, provide manufacturer's standard identification products of category and type suitable for each application. Where more than one identification method is specified for an application, the Installer shall select and utilize each material in a consistent manner.

2.3 EQUIPMENT IDENTIFICATION

A. Engraved plastic nameplates: Laminated plastic, engraved, white letters on black background, except where other color schemes are noted or specified.

1. Size: Minimum 0.75-inch (19 mm) by 2.5-inches (64 mm).
2. Letter size: Minimum height of 0.375-inch (10 mm).
3. Mechanically fastened, except adhesive mounted where necessary due to substrate.

a. Mechanical fastener: Punched or drilled, with vandalproof stainless steel or brass screws or rivets.

B. Exterior, metal-backed, signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate (CAB) signs with galvanized steel backing; punched or drilled for fasteners with corner grommets; with colors, legend, and size required for application.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Underground warning tape: Permanent, bright-colored, continuous-printed, vinyl tape for use with underground cables, conduits, and ductbanks. Comply with ANSI Z535.

1. Not less than 6-inches wide by 4 mils thick (152 mm wide by 0.102 mm thick).
2. Tape Material:

a. Made of metal detectable polyester or vinyl.
b. Compounded for permanent direct-burial service. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to destructive substances commonly found in soils.

3. Printed legend with black lettering, indicating type of underground line.

a. Provide inscriptions for power cabling with red-colored tape: Example – “CAUTION – BURIED ELECTRIC LINE BELOW”.

B. Wiring device tape labels:

1. Adhesive film label: Machine-printed, black letters on clear background, through thermal transfer or equivalent process. Minimum letter size height of 0.25-inch (6 mm).

a. Labeling for electrical devices and components such as receptacles, switches, control device stations, manual motor starters, network and phone jacks, junction and pull boxes, etc.

C. Warning labels and signs:

1. Self-adhesive warning labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configures for display on front cover, door, or other access to equipment unless otherwise noted.
2. Baked-enamel warning signs: Preprinted, aluminum signs, punched or drilled for fasteners with corner grommets; with colors, legend, and size required for application.
3. Fasteners: Self-tapping, stainless-steel screws or, stainless-steel machine screws with nuts, flat and lock washers.

D. Cable ties: Fungus-inert, self-extinguishing, one-piece, self-locking, color-coded, nylon cable ties suitable for the application (general purpose, UV-stabilized outdoor, or plenum rated).

E. Paint: Formulated for the type of surface, location, and intended use.

F. Stenciling: Nonfading, waterproof, ink or paint. Black or color-coded.

G. Adhesive: Heavy-duty, thermo-resistant, industrial grade adhesive, for adhesion to any surface without identification curling, peeling, or falling off.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification products at locations for most convenient viewing without interference with operation and maintenance of equipment.

1. For finished public spaces, coordinate identification product mounting locations with the DGS Project Manager

C. Apply identification products to surfaces after equipment finish work has been completed.

D. Clean surfaces before applying identification products, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System identification labeling for raceways and cables: Each label shall be installed on sidewall of conduit and easily placed for proper identification. Locate labels at changes in direction, at penetrations of walls and floors, at 50-foot (15 m) maximum intervals in straight runs, and at 25-foot (7.6 m) maximum intervals in congested areas.

G. System identification color-coding bands for raceways and cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15 m) maximum intervals in straight runs, and at 25-foot (7.6 m) maximum intervals in congested areas.

H. Aluminum wraparound marker labels and metal tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Cable ties: For attaching tags, use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In spaces handling environmental air: Plenum rated.

J. Underground-line warning tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16-inches (400 mm) overall.

K. Painted identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 APPLICATION

A. Miscellaneous:

1. Access doors and panels: Apply engraved nameplate labels at access doors identifying concealed electrical item. Do not locate labels in finished, public spaces.

B. Junction and pull boxes:

1. Label each junction and pull box, identifying circuit designation or type of system.

    a. Exposed boxes: Place label on coverplate, externally visible.
    b. Concealed boxes: Place label or tag on inside cover of box.
    c. Junction boxes concealed above suspended ceilings or exposed in non-occupied spaces may be marked with permanent ink marker in lieu of printed labels.

2. Boxes with conductors greater than 600V: Apply labels identifying nominal system voltage on cover and minimum of one fixed side. One label shall be visible from the floor where boxes are installed exposed.

C. Wiring and cabling identification:

1. Power circuit conductor identification, 600 V or less: Apply color-coded identification for cables, feeders, and power circuit conductors exposed in accessible vaults, junction and pull boxes, utility structures, and equipment enclosures. Apply color-coding scheme as indicated below throughout the building's network of feeders and circuits, unless otherwise required by the authority having jurisdiction.

    a. Colors on conductors No. 10 and smaller, or No. 6 and smaller for grounded and grounding conductors: Solid colored insulation.
    b. Colors on conductors No. 8 and larger, or No. 4 and larger for grounded and grounding conductors: Apply colored tape wrapped a minimum of 6 inches (150 mm) on either end of conductor and in boxes where splices or taps are made.
    c. Conductors used solely for grounding purposes shall be green, if insulated.
    d. Where multi-conductor cables are used, use same color coding system for identification of wiring.

COLOR CODE (600 V Max.)				
VOLTAGE	NEUTRAL	PHASE		
		A	B	C
120-V, 2-wire	White	Black or Red depending on phase		
240/120-V, single phase, 3-wire	White	Black	Red	

2. Power circuit conductor identification, greater than 600 V: Apply nonmetallic tags or aluminum, wraparound marker bands where cables, feeders, and power circuits are exposed in vaults, junction and pull boxes, and utility structures. Apply securely fastened legend identifying circuit or feeder designation.
3. Conductors for future use: Attach tags with circuit designation for conductors to be extended for future use.
4. Control and low-voltage system wiring shall be coded with colors and markings different from those used to designate phase wires.

D. Wiring device labels: For wiring devices such as receptacles, devices installed in surface raceway assemblies, and other wiring devices operating at or greater than 120V.

1. Apply adhesive film labels on inside of wiring device coverplates identifying circuit designation serving device.

E. Equipment Identification: Install unique designation label consistent with contract documents and shop drawings.

1. Labeling instructions:

a. Engraved plastic laminate nameplates, unless otherwise indicated.
b. Unless otherwise required, provide a single line of text with 0.5-inch (13 mm) high lettering on 1.5-inch (38 mm) high label. Where two or more lines are required, use single label with increased height.
c. For multi-section or multi-compartment equipment, apply labels identifying each compartment or section.
d. For fusible equipment, identify fuse type and size on the front cover.

2. Apply nameplates and labels to equipment according to the below identification schemes:

a. Identify equipment designation; voltage rating; phase and number of wires; and designation and location of load served. Apply products to the following equipment:

(1) Panelboards

b. Identify equipment designation; primary and secondary voltage ratings; phase and number of wires; circuit designation and location of primary source; and designation and location of load served. Apply products to the following equipment:

(1) Disconnect switches

c. Identify equipment designation; and circuit designation and location of primary source. Apply products to the following equipment:

(1) Monitoring and control equipment
(2) Control stations
(3) Fire alarm control panels and auxiliary equipment
(4) Security panels and auxiliary equipment

3. Nameplates shall incorporate white lettering on colored backgrounds based on the following color-coding scheme:

a. Normal power system: Black background.

F. Warning and caution labels and signs:

1. Apply warning and caution labels on equipment in accordance with NFPA 70 and 70E, ANSI, and OSHA requirements including arc flash hazard warning labels and special clearance requirements.
2. Apply warning and caution labels and signs at locations where safe operation and maintenance of electrical system equipment is of concern.
3. Apply warning signs on electrical room doors in accordance with NFPA 70 and 70E, ANSI, and OSHA requirements. Where doors are located in finished, public areas, located sign on the inside of the door. Coordinate mounting requirements with door type.

G. Service-entrance equipment: Provide field marking of service entrance equipment maximum available fault current values in accordance with NFPA 70 requirements.

H. Underground warning tape: Apply underground warning tape above underground ductbanks, conduit, or direct-buried cable.

3.3 FIELD QUALITY CONTROL

A. Coordinate names, abbreviations, colors, and other designations with construction documents, submittals, and applicable code and standards requirements. Utilize consistent designations and identification techniques throughout project.

B. Install identification products at locations that are clearly visible at normal viewing angles and without interference with operation and maintenance of the equipment.

C. Install identification products in a neat and clean, workmanship-like manner where products are securely attached and oriented parallel to equipment edges.

END OF SECTION

SECTION 26 0573

OVERCURRENT PROTECTIVE DEVICE STUDIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical system fault-current and protective device study:

1. Fault-current analysis.

B. Description: Provide fault current analysis to confirm available fault current at panelboards.

1.2 RELATED SECTIONS

A. Sections in Division 26.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
2. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
3. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
4. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
4. ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. National Fire Protection Association (NFPA):

1. NFPA 70 – National Electrical Code, latest edition.
2. NFPA 70E – Standard for Electrical Safety in the Workplace.

D. Occupational Safety and Health Administration (OSHA):

1. OSHA 29 Code of Federal Regulations (CFR) Part 1910, Subpart S.

1.4 SUBMITTALS

A. Product data: For computer software to be used to perform studies.

B. Product certificates: For coordination-study and fault-current analysis computer software programs, certifying compliance with IEEE 399.

C. Qualifications:

1. Submit evidence indicating individual and organization compliance with requirements indicated in “Quality Assurance” below.

D. Preliminary electrical system study: Submit for review before distribution equipment shop drawings have been submitted, and before equipment order has been released to the manufacturer.

1. If formal completion of the study may delay the project schedule, DGS Project Manager may approve use of the preliminary draft for ordering equipment.
2. If approved for use in ordering equipment, preliminary draft shall include sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.

E. Final electrical system study:

1. Submit final report for review and record.
2. Incorporate changes resulting from deficiencies and corrections of preliminary draft report.

F. Reports:

1. Electrical system study report: Submit reports required above including the following items:

a. General report information: Scope, definitions, descriptions, assumptions, and other information necessary to properly interpret results of the report.
b. Tabulated summary comparing protective device ratings and calculated available fault-current levels.
c. Tabulated summary of protective device settings including circuit breaker, fuse, and relays.
d. Tabulated summary of values associated with load flow study.
e. Tabulated summary of values associated with voltage drop analysis.
f. Recommendations for system improvements.
g. System one-line diagram.
h. Input and output data used for each component and for study calculations.

2. Submit final reports as electronic files in portable document format (.pdf) to the Government. Submit program base files in file format compatible with software utilized by the Government.

1.5 QUALITY ASSURANCE

A. Electrical system study shall be performed by one or more independent qualified organizations, and under the supervision and approval of a Registered Professional Engineer skilled in performing and interpreting the power system studies.

B. Qualifications of organization performing electrical system study: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices:

1. Registered Professional Engineer shall be a full-time employee of the equipment manufacturer or of an approved engineering firm.
2. Registered Professional Engineer shall have a minimum of five (5) years of experience in performing power system studies and registered in the state where the project is located.

C. Qualifications of computer based software: Widely available, complying with standards, guides, and codes as referenced above.

D. Comply with IEEE 399 for general study procedures.

E. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Computer software: Subject to compliance with requirements, utilize product by one of the following:

1. EDSA Micro Corporation
2. Operation Technology, Inc.
3. SKM Systems Analysis, Inc. (Basis of Design)
4. Or approved equal.

2.2 COMPUTER SOFTWARE REQUIREMENTS

A. Comply with IEEE 399.

B. Computer software program shall be capable of performing fault-current analysis of project electrical distribution system.

C. Computer software program shall be capable of plotting and diagramming time-current characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

D. Software shall include a comprehensive equipment library of manufacturer-based and IEEE / ANSI based equipment to accurately model the electrical distribution system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine project submittals for compliance with electrical distribution system requirements outlined on the drawings and in electrical specification sections.

3.2 SYSTEM DATA COLLECTION

A. The Contractor shall furnish all data required to perform the power system studies. The Engineer performing the fault analysis, protective device coordination, and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to ensure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. If applicable, include fault contribution of existing motors and equipment in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

C. The Engineer performing the studies shall gather and tabulate input data necessary to support each study including the following:

1. Product data for each component of the electrical distribution system.
2. Utility available fault contribution and impedance values.
3. Drawings, one-line, and riser diagrams showing system configuration, equipment designations, feeder lengths, and other applicable system characteristics.

3.3 SYSTEM FAULT CURRENT ANALYSIS

A. Calculate the maximum available short-circuit momentary current and interrupting duties in amperes rms symmetrical for electrical power distribution system components. The calculation shall be performed for current immediately after initiation and for a three-phase bolted fault at each of the following locations:

1. Electric utility's supply termination.
2. Branch circuit panelboards.

B. Study the project's electrical distribution system from normal power source.

C. For grounded systems, provide line-to-ground fault current values for areas as defined above for the three-phase, bolted fault, short-circuit study.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141, IEEE 241 and IEEE 242.

E. Study Report:

1. Input data: Gather and provide the following input data, in tabular or graphic form, used to perform fault calculations and other studies in this section.

a. Utility three-phase and line-to-ground available contribution with associated X/R ratios.
b. Short-circuit reactance of rotating machines with associated X/R ratios.
c. Cable type, construction, size, quantity per phase, length, impedance and conduit type.
d. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio.
e. Circuit breaker types and sizes.

2. Methods and assumptions: Indicate calculation methods and assumptions that may have been used to perform analysis.
3. Results: Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram. Provide the following in a table format:

a. Source fault impedance and generator contributions
b. X/R ratios
c. Asymmetry factors
d. Motor contributions
e. Short circuit KVA
f. Symmetrical and asymmetrical fault currents

4. Equipment evaluation and conclusions:

a. Verify interrupting ratings and withstand ratings are equal to or higher than calculated fault current levels.
b. Verify adequacy of phase conductors at maximum three-phase, bolted fault currents.

c. Verify adequacy of equipment grounding conductors and grounding electrode conductors for grounded systems at maximum ground-fault currents.

5. Recommendations: List recommendations for equipment with inadequate ratings. Notify the DGS Project Manager, in writing of existing equipment improperly rated for the calculated available fault current of the system.

3.4 FIELD QUALITY CONTROL

A. Field Adjustment: Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Notify the DGS Project Manager in writing of any required equipment modifications.

END OF SECTION

SECTION 26 0923

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Switches

B. Dimmer switches.

C. Lighting contactors.

D. Centralized lighting control system with 0-10V room-based control.

E. Standalone power pack lighting control system.

F. Occupancy sensors.

G. Daylight sensors.

1.2 RELATED SECTIONS

A. Identification: Section 26 0553.

1.3 SUBMITTALS

A. Product data: Each type of device used in the project.

B. Field quality control test reports.

C. Qualifications of testing agency.

1.4 QUALITY ASSURANCE

A. Comply with requirements for LEED certification specified in Division 01.

B. All devices shall be UL listed for their intended application.

C. Provide services from a third party testing agency to perform functional testing.

D. Testing agency qualifications: An independent agency, not directly involved in either the design or construction of the project, with the experience and capability to conduct the testing indicated.

PART 2 – PRODUCTS

2.1 SWITCHES

A. Manufacturers:

1. Pass and Seymour, Inc. (Basis of Design).
2. Leviton Manufacturing Co.
3. Hubbell/Bryant Electric.
4. Cooper Industries/Cooper Wiring Devices.

5. Or approved equal.

B. Switches: Industrial extra heavy-duty specification grade switches conforming to UL 20:

1. Toggle switch types: Single pole, 3-way, and 4-way.

a. Basis of design: Pass & Seymour PS20AC1, PS20AC3 (3-way), PS20AC4 (4-way).

2. Switches, weatherproof cover:

a. Basis of design: Pass & Seymour CA1-GL cover for PS20AC1, PS20AC3 (3-way), PS20AC4 (4-way), with CA1-GL switches.

C. Device color: White.

D. Device plates: Smooth plastic to match device color.

1. Basis of design: Pass & Seymour, SS Series.

2.2 DIMMER SWITCHES

A. Incandescent dimmers:

1. Each dimmer shall have an air gap switch.
2. Color: White with matching wallplate.
3. Gangable by breaking off fins and faceplate.
4. RFI filter.
5. Voltage-compensated.
6. UL listed.
7. Basis of design: Lutron Electronics Co. Models listed with wattage rating as scheduled below:

Watt Load	
Up to 500	NT 600
501 - 900	NT 1000
901- 1400	NT 1500
1401 - 1900	NT 2000

2.3 LIGHTING CONTACTORS

A. Lighting contactors: UL 508 listed, in NEMA 250 Type 1 enclosure, mechanically held, electrically operated, enclosed silver-alloy double-break contacts, coil-clearing contacts; withstand rating as indicated on the drawings; Hand/Off/Auto selector switch on cover.

B. Basis of design: Square D 8903.

2.4 LIGHTING CONTROL SYSTEM – 0-10V DIMMING CONTROLLERS

A. Basis-of-design product: Subject to compliance with requirements, provide products manufactured by Lutron, Energi-Savr Node, or comparable product by one of the following:

1. Acuity; nLight
2. Cooper Controls; Greengate
3. Crestron
4. Leviton
5. Lutron Electronics, Inc. (Project basis-of-design)
6. Or approved equal.

B. Devices for use with 0-10V room-based lighting control system:

1. Lighting room controller:

a. Description: The lighting controller shall provide room-based, space-based, area-based, or zone-based lighting control for loads indicated. Device assembly shall incorporate 0-10V dimming and relay-based switching of lighting loads.
b. Delivered and installed as a UL listed factory assembly.
c. Panels passively cooled via free-convection, unaided by fans or other means.
d. Module to integrate up to 4 groups of wired sensors and control stations.
e. Wired devices to include the following:

(1) Occupancy sensors
(2) Daylight sensors
(3) Wall control stations

f. LED status indicators confirm communication with occupancy sensors.
g. System Programming via head-end control system.
h. Basis of design: Lutron QSN-4T16-S.

2. Occupancy sensor: See low-voltage, ceiling mounted occupancy sensors below.
3. Daylight sensor: See low-voltage, ceiling mounted daylight sensors below.
4. Low-voltage wall control stations:

a. Provide low voltage wall control station with ‘on/off’ and scene selection functionality, with number of buttons as identified on the drawings.
b. Functionality:

(1) LEDs to reflect the true system status. LEDs to remain illuminated if the button press was properly processed or the LEDs turn off if the button press was not processed.
(2) Allow for easy reprogramming without replacing unit.

c. Provide faceplates with concealed mounting hardware and custom engraving.
d. Buttons or faceplates shall be provided with custom engraving identifying mode selection.
e. RS485 communications interface with building automation system.
f. Basis of design: Lutron Seetouch QS.

5. Emergency control interface.
6. Communications with head-end centralized control panel and central processor.

2.5 LIGHTING CONTROL SYSTEM – INDIVIDUAL POWER PACKS

A. Available manufacturers: Provide products manufactured by one of the following manufacturers. Sensors shall be compatible with the associated lighting controls system when functioning as a component of that lighting control system.

1. Acuity; Sensor Switch

2. Hubbell Inc.
3. Leviton
4. Watt Stopper/Legrand
5. Or approved equal.

B. Power pack: Universal 120/277V switched input, controlled through a high-current 20A relay. Low voltage output, less than or equal to 24VDC, for powering low voltage occupancy sensors and wall control station. Enclosure shall be plenum rated.

C. Occupancy sensor: See low-voltage occupancy sensors below.

D. Wall control station: Low-voltage control device shall operate on voltage less than or equal to 24VDC and shall have a momentary contact actuator to send a signal to the associated power pack to change the current lighting state.

1. Two- or three- button control, as indicated on drawings.
2. Finish: Color shall be white with matching coverplate.

2.6 OCCUPANCY SENSORS

A. Available manufacturers: Provide products manufactured by one of the following manufacturers. Sensors shall be compatible with the associated lighting controls system when functioning as a component of that lighting control system.

1. Acuity
2. Crestron
3. Hubbell Inc.
4. Leviton
5. Lutron
6. Cooper Controls
7. Watt Stopper/Legrand
8. Or approved equal.

B. Sensor types:

1. Wall switch sensor: Dual technology, combination ultrasonic/passive infrared detector with override switch, capable of installation in a standard wall switch backbox.

a. Line voltage: Rated at 120/277 dual-input voltage, 60 Hz.
b. Vacancy mode operation: Manual On / Automatic Off

2. Ceiling sensor: Dual technology, combination ultrasonic/passive infrared detector capable of installation in acoustic ceiling tile or gypsum ceiling. Detector shall provide 360 degree coverage.

a. Low-voltage: Rated at 24V input voltage, 60 Hz, with power pack and low-voltage wiring per manufacturer's requirements.
b. Provide one set of Form C auxiliary contacts for interface with other systems.

C. Ultrasonic detector type: Volumetric sound wave at 40 kHz frequency. Detector shall automatically adjust detection threshold to compensate for learned environmental behavior.

D. Infrared detector type: Passive, with field-adjustable ambient light adjustment.

E. Indicator: LED positive detection.

F. Adjustable delayed off-time range: Between 30 seconds and 15 minutes, factory set to 15 minutes.

G. Fail on: Lights will stay on if sensor fails.

2.7 DAYLIGHT SENSORS

A. Wired, low-voltage, daylight sensors; ceiling or fixture mounted open loop interior photocell. Rated at 24V input voltage, 60 Hz, with low-voltage wiring per manufacturer's requirements.

1. Sensor Scheme:

a. Spaces with exterior glazing (windows and/or clerestories): Open-loop design for daylight sensor control scheme. Continual monitoring of daylight entering building windows to enable daylight harvesting control of room lighting.
b. Spaces without exterior glazing (solar tubes): Closed-loop design for daylight sensor control scheme. Continual monitoring of total ambient light level from all available light sources to maintain a consistent level of light.

2. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
3. Provide linear response from 0 to at least 500 footcandles.

2.8 INTERFACE DEVICES

A. Power Interface: Provide power interfaces as required to dim associated loads, or as defined on project drawings, to translate the dimmed line voltage signal into the protocol appropriate for each load type, including non-dimmed loads, such as mechanical equipment.

B. Output (or Input) Control Interface: Contact closure interface providing integration with third-party equipment requiring contact closure input/output.

1. Lighting Contactors.
2. Security System Equipment.
3. Mechanical HVAC System Controls.

C. Emergency Lighting Interface:

1. Provides total system listing to UL 924 when used with lighting control system.
2. Senses all three phases of building power.
3. Provides an output to power panels or digital ballast interfaces if power on any phase fails and sends all lights controlled by these devices to full-light output.
4. Accepts a contact closure input from a fire alarm control panel.

2.9 DEVICE PROGRAMMING REQUIREMENTS

A. The control requirements described herein shall be considered integral to the startup and testing of the system and shall be performed by factory trained technicians as defined in the project specifications. Refer to the end of this section for the "Lighting Controls Narrative", which further describes general lighting control requirements for typical spaces.

2.10 CONDUCTORS AND CABLES

A. Wiring to supply side of remote-control power sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 0519, Wires and Cables.

B. Low-voltage control cable: Manufacturer's standard multi-conductor cable with stranded-copper conductors not smaller than No. 22 AWG, plenum rated.

1. Class 2 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 18 AWG.
2. Class 1 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 14 AWG.

C. Digital UTP Cabling: Unshielded, twisted-pair cable with copper conductors, complying with TIA/EIA-568-B.2, Category 5E for horizontal copper cable.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install devices in complete compliance with the manufacturer's recommendations.

B. Provide a single cover plate where two or more devices are grouped together in one box.

C. Verify door swings with door frame installed prior to rough-in for switches.

D. Fully document all control device calibration settings after system programming with manufacturer's representative and submit this information as a part of the O&M manual.

E. Devices shall be installed and programmed to meet the control intent as outlined in the lighting controls narrative provided at the end of this specification section.

3.2 INSTALLING PHOTOCELLS

A. Location of exterior photocell shall be positioned, whenever possible, to view true north, in an inconspicuous location. Contractor shall verify location with DGS Project Manager prior to installation.

B. Location of interior photocells, both open and closed loop shall be determined by a trained factory representative or commissioning agent, based on optimization calculations for greatest energy savings.

3.3 INSTALLING ROOM CONTROLLERS

A. Lighting control module shall be surface mounted in ceiling space in an accessible location.

1. For classrooms, offices, and other instructional spaces: Mount above entry door in public/corridor side.

B. Tag ceiling grid below lighting control module to locate device.

3.4 INSTALLING OCCUPANCY AND DAYLIGHT SENSORS

A. Install in accordance with manufacturer's written instructions.

B. Provide line voltage type detectors when a single device, wall or ceiling, controls lighting within a single space.

C. Provide low voltage type detectors when multiple detectors, wall or ceiling, are wired together for control over a single space.

D. Coverage pattern: Verify coverage pattern of single detector or system of detectors to be capable of complete coverage of the space in which the lighting is intended to be controlled. Provide additional detectors as necessary to satisfy complete coverage.

3.5 FIELD QUALITY CONTROL

A. Functional testing. Perform tests and prepare test reports for the following:

1. Control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the contract documents and manufacturer's installation instructions.
2. For occupancy sensors, confirm that the placement, sensitivity, and time-out settings are optimized to ensure lights turn off only after each space is vacated and do not turn on unless the space is occupied.
3. For time switches and programmable schedule controls, confirm settings are programmed to turn the lights off. Document the settings of these devices.
4. For photocells and daylight harvesting systems, confirm photocell location is optimized to achieve maximum energy savings while maintaining the desired setpoint and that the electric light is reduced relative to the amount of usable daylight in the space.

END OF SECTION

SECTION 26 0936

MODULAR DIMMING CONTROLS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. This section shall include the following components:

1. Master control station with integral processor and dimmer modules
2. Power interface devices
3. Wall station devices

1.2 RELATED SECTIONS

A. Interior Lighting: Section 26 5100.

B. Lighting Control Devices: Section 26 0923.

C. Identification of Electrical Systems: Section 26 0553.

1.3 REFERENCES

A. ASHRAE/IESNA 90.1: Energy Standard for Buildings except Low-Rise Residential Buildings.

B. NECA 1: Standard Practices for Good Workmanship in Electrical Construction.

C. NFPA 70: National Electrical Code.

D. UL 1472: Solid-State Dimming Controls

1.4 DEFINITIONS

A. Fade override: The ability to temporarily set fade times to zero for all lighting scenes.

B. Fade rate: The time it takes each zone to arrive at the next scene, dependent on the degree of change in lighting level.

C. Fade time: The time it takes all zones to fade from one lighting scene to another, with all zones arriving at the next scene at the same time.

D. Scene: The lighting effect created by adjusting several zones of lighting to the desired intensity.

E. Zone: A fixture or group of fixtures controlled simultaneously as a single entity. Also known as a “channel.”

1.5 SUBMITTALS

A. Product data: Include assembly ratings and dimensioned plans, sections, and elevations showing minimum clearances, cable termination sizes, conductor entry, gutter space, installed features and devices, and material lists for each component. Include the following system components:

1. Master control station

2. Power interface devices
3. Wall station devices

B. Bill of Materials: Provide detailed list of components and quantities.

C. Shop drawings: Detail assemblies of standard and project specific components. Indicate dimensions and arrangement of components.

1. Include representative views of components, including button layouts, engraving, colors, and other physical characteristics pertinent to each device.
2. Wiring diagrams: Power, signal, and control wiring, differentiating between manufacturer-installed and field-installed wiring, provided on a schematic diagram.
3. Load schedules indicating actual connected load, load type, and voltage per circuit, circuits and their respective control zones, circuits that are on emergency, and capacity, phase, and corresponding circuit numbers.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For lighting control system and associated components, provide product data, shop drawings, and test reports in operation and maintenance manual. In addition to items specified in Division 01 Section, Operation and Maintenance Data, include the following:

1. List of replacement parts and assemblies.

1.6 QUALITY ASSURANCE

A. Lighting control system installation shall comply with NFPA 70.

B. System components UL listed and labeled.

C. Obtain central dimming components from a single source with total responsibility for compatibility of lighting control system components.

D. Manufacturer shall have their quality system registered to the ISO 9001 Quality Standard, including in-house engineering for all product design activities.

E. Lighting control system shall meet IEC801-2, tested to withstand a 15kV electrostatic discharge without damage or loss of memory.

F. System shall be compatible with dimming ballasts connected to system.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store switches indoors in clean dry space with uniform temperature to prevent condensation. Protect switches from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.8 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install equipment until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, work above equipment is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. The lighting system controls must operate in an ambient temperature range of 0 degrees C (32 degrees F) to 40 degrees C (104 degrees F) and 90 percent non-condensing relative humidity without the requirement of a regularly scheduled maintenance program for air filtration components.

1.9 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting control system and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty period: Two years from date of substantial completion.
2. Warranty shall include all parts and labor.
3. Warranty shall begin at the date the equipment is accepted by the Government.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide products manufactured by Acuity Brands (nLight Series), or comparable product by one of the following:

1. Leviton Manufacturing Company
2. Lighting Control & Design, an Acuity Brand Company
3. Lutron Electronics, Inc
4. Philips Lighting Controls
5. Or approved equal.

2.2 GENERAL SYSTEM REQUIREMENTS

A. Compatibility: Dimming control components shall be compatible with other elements of lighting fixtures, ballasts, transformers, and lighting controls, for control of incandescent/halogen, magnetic low voltage, electronic low voltage, neon/cold cathode, fluorescent dimming ballasts, LED drivers, and non-dim loads.

B. Dimmers and dimming modules: Comply with UL 508.

1. Line-voltage surge suppression: Factory installed as an integral part of control devices.
2. Audible noise and radio-frequency interference suppression. Solid-state dimmers shall operate smoothly over their operating ranges without audible lamp or dimmer noise or radio-frequency interference. Modules shall include integral or external filters to suppress audible noise and radio-frequency interference.

2.3 POWER INTERFACE DEVICES

A. Provide power interfaces as required to dim associated loads, or as defined on project drawings, to translate the dimmed line voltage signal into the protocol appropriate for each load type, including non-dimmed loads, such as mechanical equipment.

2.4 WALL STATIONS

A. Low-voltage, programmable wall station device with button configurations and functions as shown in details on the drawings.

B. Device functionality: Wall station(s) shall provide an immediate local LED illumination response upon button activation to indicate that a system command has been requested. LED will remain lit contingent upon receiving system confirmation of the successful completion of the command.

1. Each button shall be capable of performing an 'On' or 'Off' operation of the programmed zone.
2. Buttons shall be capable of modifying the state of multiple zones to create a scene.
3. Override of programmable timeclock function.

C. Wall stations shall have control over programmed scenes, stored in the master control panel memory.

D. Wall stations shall be engraved with appropriate zone and scene descriptions, furnished to the manufacturer prior to fabrication. Size and style of engraving type shall be determined by the DGS Project Manager during submittal stage. Any silk-screened borders, logos, graduations, etc. shall use a graphic process that chemically bonds the graphics to the metal faceplate, resisting removal by scratching, cleaning, etc. Use zone designations indicated on drawings.

E. Wall station(s) functions shall be configured through software.

F. Finish: White.

1. Faceplate shall match wiring device finish.

2.5 CONDUCTORS AND CABLES

A. Wiring to supply side of remote-control power sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 0519, Wires and Cables.

B. Low voltage control cable: Manufacturer's standard multi-conductor cable with stranded-copper conductors not smaller than No. 22 AWG, plenum rated as required.

2.6 SOURCE QUALITY CONTROL

A. Perform full-function testing on 100 percent of all system components and panel assemblies at the factory.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Wiring method:

1. Comply with requirements in Section 26 0519, Wires and Cables.
2. Install wiring and cabling for control and signal transmission conductors in conduit between devices and system components.
3. Minimum conduit size shall be 0.75 inch (21mm).

C. Wiring within enclosures; Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise noted.

E. Splices, taps, and terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

F. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

G. Install in accordance with national, state, and local codes, and manufacturer's instructions.

H. Include items not specifically mentioned but necessary for proper operation.

I. Connect wiring as indicated on the drawings and in accordance with manufacturer's recommendations.

J. Identify components.

3.2 SYSTEM INTEGRATION AND PROGRAMMING

A. Coordinate at least one meeting between the Facility Representative, Lighting Control System Manufacturer, and other related equipment manufacturers to discuss equipment integration procedures and programming requirements. The results of the meeting(s) shall be documented and included in the O&M manual.

3.3 CONNECTIONS

A. Ground equipment according to Section 26 0526, Grounding and Bonding.

3.4 IDENTIFICATION

A. Materials: Refer to Division 26 Section, "Identification of Electrical Systems". Identify devices and wiring. Labeling shall be concealed.

B. Wall stations: Label each wall station with field-selected device address as programmed into the addressable system.

C. Custom engraving: Provide custom engraving on each button of each wall station, defining button's function. Coordinate with the DGS Project Manager for final approval of engraving.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's field service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Tests and inspections:

1. Perform a continuity test of circuits.
2. Operational test: Set and operate controls to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operation functions.

a. Include testing of dimming control equipment under conditions that simulate actual operational conditions. Record control device settings, preset dimming levels, and scene selections.

C. Remove and replace malfunctioning dimming control components and retest as specified above.

D. Reports: Written reports of tests and observations. Record defective materials and workmanship and report unsatisfactory test results. Record repairs and adjustments made to the system.

3.6 CLEANING

A. Inspect and clean surfaces and repair damaged finishes to match original finish.

3.7 OPERATING INSTRUCTIONS

A. As specified in Section 26 0101, provide operating instructions.

B. Engage a factory-authorized service representative to provide instruction to Government's maintenance personnel and User representative of system, including overview, adjustment, operation, and maintenance of system. Provide at least one session(s) of four consecutive hours of instruction time.

END OF SECTION

SECTION 26 2416

PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Circuit breaker panelboards, distribution and lighting and appliance branch-circuit types.

1.2 RELATED SECTIONS

A. Identification for electrical systems: Section 26 0553.

B. Overcurrent protective device studies: Section 26 0573.

C. Fuses: Section 26 2813.

1.3 REFERENCES

A. ANSI/NECA 407: Recommended Practice for Installing and Maintaining Panelboards.

B. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA PB 1: Panelboards.

D. NEMA PB 1.1: Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

E. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

F. UL 50: Enclosures for Electrical Equipment.

G. UL 67: Panelboards.

1.4 DEFINITIONS

A. Circuit-breaker panelboards in this section: Lighting and appliance panelboard: Maximum branch breaker amperage 100 A.

1.5 SUBMITTALS

A. Product data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated.

B. Bill of materials: Provide detailed list of components.

C. Shop drawings: For each type of panelboard, include the following details:

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings in panel schedule format.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.

5. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

D. Operation and Maintenance Data: For panelboards and components to include in operation and maintenance manuals. In addition to items specified in Division 01 and Section 26 0101, include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Copy of each printed panelboard schedule representing final version following installation.

1.6 QUALITY ASSURANCE

A. Do not submit equipment submittals prior to completing Short-Circuit and Coordination Study as indicated in Section 26 0573.

B. Source limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

C. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency accepted by the authority having jurisdiction, and marked for intended location and application; listed as a complete assembly.

1. UL label and local testing (where required): As specified in Section 26 0500, Common Work Results for Electrical.

D. Comply with referenced standards and listings previously identified including NEMA PB 1, NFPA 70, and UL 67.

1.7 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.9 PROJECT CONDITIONS

A. Interruption of existing electrical service: Do not interrupt electrical service to facilities occupied by the Government or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify the Government no fewer than seven days in advance of proposed interruption of electrical service. Provide applicable details of proposed outage including sequence of work and methods of providing temporary electrical service.
2. Do not proceed with interruption of electrical service without written permission.

B. Environmental limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
    b. Altitude: Not exceeding 6600 feet (2000 m).

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

    1. Keys: Two spares for each type of panelboard cabinet lock.
    2. Furnish spare breakers for panelboards as indicated in schedule on drawings.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Circuit breaker panelboards: Subject to compliance with requirements, provide circuit breaker panelboards manufactured by Schneider Electric; Square D products or comparable product by one of the following:

    1. Eaton Corporation.
    2. General Electric Company.
    3. Schneider Electric; Square D products.
    4. Siemens Industry, Inc.
    5. Or approved equal.

2.2 PANELBOARDS, GENERAL

A. UL listing: UL 67, listed and labeled.

B. Panelboards for service entrance shall be listed and labeled for service entrance.

C. Integrated equipment short-circuit rating: Each panelboard, as a complete unit, shall have a short-circuit rating equal to or greater than the integrated equipment rating shown or scheduled on the drawings.

    1. Rating shall be established by testing in accordance with UL 67, with the overcurrent devices mounted in the panelboard. Make short-circuit tests on the overcurrent devices and on the panelboard structure simultaneously, by connecting the fault to each overcurrent device with the panelboard connected to its rated voltage source. The source shall be capable of supplying specified panelboard short-circuit current or greater.
    2. Testing of overcurrent devices only while individually mounted is not acceptable. Testing the bus structure by applying a fixed fault to the bus structure alone is not acceptable.
    3. Mark each panelboard with its maximum short-circuit current rating at the supply voltage.
    4. Series rating of panelboards with devices outside of the panelboard enclosure are not permitted.

D. Enclosures: Flush- or surface-mounted as indicated, NEMA PB 1, Type 1, UL 50, galvanized steel.

1. Size: Where multiple-width or multiple-section panelboards are indicated or required, each cabinet shall be the same width and height.
2. Provide enclosure type as indicated below:

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

E. Directory card: Inside panelboard door, mounted in transparent card holder or metal frame with transparent protective cover with information as indicated in Part 3, Identification.

F. Provisions for future devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Furnish each unit with a master nameplate, listing standard manufacturer information including voltage, ampacity, frequency, and short-circuit ratings; manufacturer's model and project designations.

2.3 CIRCUIT-BREAKER PANELBOARDS

A. Factory-assembled complete with breakers.

B. Cabinets and fronts: Minimum 20 inches wide, wiring gutter space in accordance with UL 67, with minimum four-inch width on every side.

1. Cabinet front: Door-in-door construction, one or more latches as required for size, with outer door covering the gutter.
2. Door: Required for sizes up to and including 600 amps.

a. Lock: Flush, cylinder tumbler type, with catch and spring-loaded stainless-steel door pull. All panelboards shall be keyed alike. Provide two keys per lock. Provide extra keys as required in "Extra Materials" in Part 1 above.
b. Hinges: Steel, completely concealed.

C. Circuit breakers: UL 489; voltage, continuous-current rating, and interrupting rating as indicated on the drawings or determined by the results of the Short-Circuit Analysis performed under Section 26 0573, whichever is greater.

1. Breakers shall be 1-, 2- or 3-pole, with an integral crossbar to ensure simultaneous opening of all poles in multipole circuit breakers.
2. Operating mechanism: Over center, trip-free, toggle-type with quick-make, quick-break action. Handles shall have on, off, and tripped positions.
3. Circuit breakers shall be able to be installed in the panelboard without requiring additional mounting hardware or disturbing adjacent units, bars, or branch circuit connections.
4. Where indicated on the drawings, provide shunt-trip main breakers, standard main breakers, or lugs.
5. Main and branch circuit breakers shall have device ampacity rating engraved on the front or side of each breaker handle. The breaker rating shall be clearly visible without removing panelboard cover.
6. Circuit breakers shall be rated for use with 75 deg C wire (conductor temperature rating).
7. Thermal-magnetic circuit breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 amps and larger.

8. Adjustable instantaneous-trip circuit breakers: Magnetic trip element with front mounted, field-adjustable trip setting
9. Ground-fault circuit interrupter (GFCI) type circuit breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
10. Tandem breakers are not permitted.

D. Bussing assembly and temperature rise: Panelboard bus structure and main lugs or main circuit breaker shall have current ratings as shown on the panelboard schedule, established by heat rise tests conducted in accordance with UL 67.

1. Conductor dimensions shall not be accepted in lieu of actual heat tests.
2. Current-carrying parts of the bus structure shall be hard-drawn copper, 98 percent conductivity.
3. Provide a separate copper ground bus with screw terminals for branch wiring and feed-through lugs.

E. Branch circuit panelboards: Panelboard shall be capable of accepting up to 100-amp branch breakers.

1. Single-pole, 15 and 20 A circuit breakers intended to switch lighting loads on a regular basis shall carry the SWD marking.

2.4 SOURCE QUALITY CONTROL

A. With branch circuit breakers installed, short-circuit test panelboards as complete units, in accordance with requirements of UL 67.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely attach panelboards to the wall where indicated on the drawings. Install in accordance with NEMA PB 1.1 and manufacturer's written installation instructions.

1. Mounting height:

a. 72 inches (1829 mm) to top of panelboard.
b. Panelboards taller than 72 inches (1829 mm): Bottom edge no more than 4-inches (102 mm) above floor.
c. Top breaker maximum height: No more than 6-feet, 7-inches (2.0 m) above the floor or working platform.

B. Comply with applicable portions of NECA 407.

C. Frame and mount printed circuit directory indicating type and location of equipment on each circuit.

D. Wiring in gutters: Arrange conductors into groups, and bundle and wrap with wire ties.

E. Install filler plates in unused spaces.

F. Spare conduits: Where panelboards are recessed in wall construction, stub four 1-inch (27 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

3.2 CONNECTIONS

A. Connect panelboards and components to wiring and to ground as indicated.

B. Shared neutral conductors shall not be permitted, except where indicated.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

A. Materials: Refer to Division 26 Section "Identification for Electrical Systems." Identify units, auxiliary devices, controls, and wiring. Identify equipment ratings.

B. Nameplates: Refer to Division 26 Section "Identification for Electrical Systems" for additional requirements. Provide identification nameplate for each panelboard and associated components located on front of assembly.

C. Identify field-installed wiring and components. Refer to Division 26 Section "Identification for Electrical Systems" for additional requirements.

D. Provide printed directory for each panelboard. Handwritten directories are not acceptable. Copying of panel schedules and descriptions on drawings is not acceptable. Circuit directory shall reflect final circuit installation. Include the following information:

1. Panelboard designation and room location.
2. Circuit breakers, size and number of poles.
3. Circuit or feeder description including destination room name(s) and number(s).
4. Clear description of type of load circuit serves.
5. Panelboard ratings: Main bus ampacity, main circuit breaker or main lug ampacity, AIC rating.
6. Incoming primary feeder size and source panelboard circuit designation.

E. Room names and numbers on the panelboard circuit directories shall match names and numbers used by the Government. Note that room names and numbers on the drawings may not match the Government's final room name and numbering scheme.

3.4 FIELD QUALITY CONTROL

A. Make insulation-resistance tests of each panelboard bus, component, and connecting supply, feeder, and control circuit.

B. Make continuity tests of each circuit.

C. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 CLEANING

A. Clean interior and exterior of panelboards.

B. Refinish painted surfaces damaged during construction to match the rest of the panelboard.

END OF SECTION

SECTION 26 2726

WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Switches and receptacles.

B. Time-based control devices.

C. Relays

D. Terminal blocks.

1.2 RELATED SECTIONS

A. Nameplates: Section 26 0553.

1.3 SUBMITTALS

A. Product data: Each type of device used in the project.

PART 2 - PRODUCTS

2.1 SWITCHES AND RECEPTACLES

A. Available manufacturers:

1. Pass & Seymour, Inc.
2. Leviton Manufacturing Co.
3. Hubbell/Bryant Electric
4. Cooper Industries/Cooper Wiring Devices.
5. Or approved equal.

B. Switches: Industrial extra heavy-duty specification grade switches conforming to UL 20:

1. Toggle type switches: Single pole.

a. Basis of design: Pass & Seymour PS20AC1.

C. Receptacles: Heavy-duty specification grade receptacle conforming to UL 498:

1. Convenience receptacles: Duplex, brass mounting strap, NEMA 5-20R.

a. Basis of design: Pass & Seymour PS5362.

2. Single-gang weatherproof receptacle cover:

a. Basis of design: Pass & Seymour WIUC10FRED.

D. GFCI receptacles: Specification grade receptacle conforming to UL 498:

1. Convenience receptacles: Duplex GFCI, NEMA 5-20R.

a. Basis of design: Pass & Seymour 2097.

2. Single-gang weather-proof Cover:

a. Basis of design: Pass & Seymour WIUC10FRED.

3. Exterior and wet location receptacles: Tamper-resistant, weather-resistant duplex GFCI, 20 amps.

a. Basis of design: Pass & Seymour 2097TRWR.

E. Dual controlled/switched duplex receptacle: Conforming to UL 498, 20 amps.

1. Basis of design: Pass & Seymour 5362CD.

F. Half-controlled/switch duplex receptacle: Conforming to UL 498, 20 amps.

1. Basis of design: Pass & Seymour 5362CH.

G. Device color:

1. Switches and general-purpose receptacles: White.

H. Device plates: Smooth plastic, color shall match device color.

1. Basis of design: Pass & Seymour: Smooth plastic, SP Series, color shall match device color.
2. Device plates for receptacles controlled by an automatic control device shall be custom engraved for metal, or pad printed for plastic, and shall identify the device with the words “Switched Receptacle”.

2.2 TIME-BASED CONTROL DEVICES

A. Spring-wound timers: Spring wound for mounting in flush box complete with properly marked cover plate. Time cycle as indicated.

B. Basis of design: Mark Time 93 series.

2.3 RELAYS

A. Provide in NEMA 250 type 1 enclosure.

B. Contacts: Double-break, fine silver, convertible from normally open to normally closed contacts. Provide contact status indication.

C. Coils: Molded construction, terminals provided with pressure wire connectors.

D. Coil voltage and number of contacts shall be as indicated on the drawings.

E. Basis of design: Square D Company, Class 8501 Type C.

2.4 TERMINAL BLOCKS

A. Terminal blocks: Screw-terminal type, size as required by NFPA 70, NEMA 250 Type 1 enclosure with hinged cover.

B. Basis of design: Square D.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices in complete compliance with the manufacturer's recommendations.

B. Receptacle orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

C. Device plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

D. Arrangement of devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent devices under single multi-gang wall plates.

3.2 IDENTIFICATION

A. Comply with Section 26 0553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on back of plate, and durable wire markers or tags inside outlet boxes.

C. Attach nameplates securely to receptacle cover plates. Provide nameplates for all devices except 120-volt receptacles, identifying equipment and use.

END OF SECTION

SECTION 26 2800

ENCLOSED CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Enclosed switches (disconnects/safety switches).

1.2 RELATED SECTIONS

A. Motor requirements for HVAC equipment: Section 23 0513.

B. Fuses: Section 26 2813.

C. Overcurrent protective device study: Section 26 0573.

1.3 REFERENCES

A. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. UL 98: Enclosed and Dead-Front Switches.

1.4 SUBMITTALS

A. Product data: Each type of enclosed switch.

1.5 QUALITY ASSURANCE

A. Comply with the following standards:

1. NEMA KS 1 for enclosed switches.
2. UL 98.
3. UL 198E.

B. UL label and local testing (if required): As specified in Section 26 0500, Common Work Results for Electrical.

PART 2 - PRODUCTS

2.1 ENCLOSED SWITCHES (DISCONNECTS/SAFETY SWITCHES)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corporation.
2. General Electric Company.
3. Schneider Electric; Square D products.
4. Siemens Industry, Inc.
5. Or approved equal.

B. Properly size switches for number of poles and provide fused or non-fused as required for project conditions and to meet NFPA 70 requirements.

1. Neutral kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
2. Auxiliary contact kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

C. Fuse contacts and quick-make/quick-break jaws shall ensure positive contacts with reinforcing spring clips or other approved means.

D. Switches shall be front-operated.

E. Current-carrying parts: Plated copper.

F. Hinges: Noncurrent-carrying.

G. Switches shall be lockable in either open or closed position.

H. Type:

1. Nonfused switches: General-duty type on 120/208 V or 120/240 V systems.
2. Fused switches: Heavy-duty type on all voltages.

I. Enclosures: Indoors NEMA 250 Type 1; outdoors Type 3R with raintight hubs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed switches where indicated and as required for motor outlets, transformers, and other equipment.

B. Securely attach and properly connect enclosed switches.

C. Provide an enclosed switch for each motor, as required by NFPA 70, except where it is provided in a panelboard within sight and easy reach of the motor, and provide wiring and connections from source. Enclosed switches shall be fused where protection is required or indicated on drawings and unfused elsewhere.

D. Enclosed switches:

1. Provide neutral kit where required for four-wire application.
2. Provide auxiliary contact kit where indicated on drawings.

END OF SECTION

SECTION 26 2813

FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fuses.

1.2 RELATED SECTIONS

A. Motor requirements for HVAC equipment: 23 0513.

B. Enclosed switches: Section 26 2800.

1.3 REFERENCES

A. UL 198E: Class R fuses.

B. UL 198C: High-Interrupting-Capacity Fuses, Current Limiting Types.

1.4 SUBMITTALS

A. Product data: Each type of fuse.

B. Published data on fuses shall include time/current curves, peak-let-through curves and I^2t melting and clearing curves.

1.5 QUALITY ASSURANCE

A. Comply with UL 198C, Class L fuses, also Classes G and J.

B. UL label and local testing (if required): As specified in Section 26 0500, Common Work Results for Electrical.

1.6 EXTRA MATERIALS

A. Provide three spare fuses for each type and size of fuse in the work.

PART 2 - PRODUCTS

2.1 FUSES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corporation; Bussmann
2. Littelfuse, Inc.
3. Mersen
4. Or approved equal.

B. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

C. Fuses 0-600 amps for 600 V or 250 V, UL labeled Class RK1 with time delay, with a minimum short-circuit interrupting capacity of 200,000 rms symmetrical amperes, and shall carry 500 percent of rating for a minimum of 10 seconds.

1. Fuses for disconnecting switches for packaged HVAC equipment: Size and type recommended by the equipment manufacturer and as required for equipment to meet UL rating.

D. Fuses 601 amps and larger shall be UL labeled Class L with time delay, 600 V, with minimum short circuit interrupting capacity of 200,000 rms symmetrical amperes and dimensions to properly mount in switchboard or disconnecting switches.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses where indicated and as required for motor outlets or other equipment.

END OF SECTION

SECTION 26 2914

ENCLOSED MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Alternating-current motor starters (enclosed controllers) rated 600 V and less that are supplied as enclosed units.

1. Manual motor starters.

1.2 RELATED SECTIONS

A. Motor requirements for HVAC equipment: 23 0513.

B. Fuses: Section 26 2813.

1.3 SUBMITTALS

A. Product data: Each type of motor starter included in the project, including dimensions, ratings, and data on features and components.

B. Operation and maintenance data: For operating and maintenance manuals, as specified in Section 26 0101.

1.4 QUALITY ASSURANCE

A. Source limitations: Obtain motor starters of a single type through one source from a single manufacturer.

B. Electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

A. Coordinate layout and installation of motor starters with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for work space and for access.

B. Coordinate features, accessories, and functions of each motor starter with ratings and characteristics of supply circuit, motor, control sequence, and duty cycle of motor and load.

1. Refer to wiring diagrams required in the sections specifying the equipment.

PART 2 - PRODUCTS

2.1 MOTOR STARTERS, GENERAL

A. Basis-of-design product: Subject to compliance with requirements, provide the specified Schneider Electric; Square D products, or comparable products by one of the following:

1. Eaton Corporation

2. General Electric Company
3. Schneider Electric; Square D products
4. Siemens Industry, Inc.
5. Or approved equal.

2.2 MANUAL MOTOR STARTERS

A. Enclosures: NEMA 250 Type 1 for interior use and NEMA 250 Type 3R for exterior or damp or wet locations.

1. Mounting: Flush-mounted in finished areas and where possible; surface-mounted elsewhere, with cover plates to suit the mounting.
2. Indicating lights mounted in enclosure.
3. Engraved plastic identification plates.

B. Manual motor-starting switch: Single- or two-pole as required, with built-in thermal overload protection.

1. Basis of design: Square D Class 2510.

C. Switch: Toggle, quick-make and quick-break, with self-indicating, trip-free handle, and means for locking in Off position.

D. Overload protection unit: Melting-alloy type, interchangeable; starter shall be inoperative if unit is removed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. For equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For equipment not at walls, mount on lightweight structural-steel channels bolted to floor or to structure above ceiling.

B. Provide wiring as indicated on the drawings.

C. Install starters, auxiliary contacts, and automatic control devices furnished with equipment, except those that are already mounted on the equipment, fully wired and connected. See coordination requirements specified in Part 1 above.

D. Check the size of the overload protection, and change or adjust it as required, after the HVAC systems have been adjusted and balanced as specified in Section 23 0593, Testing, Adjusting, and Balancing.

E. Install fuses in each fusible switch. Comply with requirements of Section 26 2813.

END OF SECTION

SECTION 26 5100

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Lighting fixtures, including lamps, drivers, and accessories.

1.2 RELATED SECTIONS

A. Commissioning requirements: Divisions 01 and 23.

B. Dimming control:

1. Lighting control devices: Section 26 0923.
2. Modular dimming controls: Section 26 0936.

C. Occupancy sensors: Sections 26 0923 and 26 0936.

1.3 SUBMITTALS

A. Product data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:

1. Dimensions of fixtures, photometrics and efficiency, wattage, reflectors, glassware, voltage, suspension, and appurtenances.
2. Certified results of laboratory tests for fixtures and lamps for photometric performance.
3. Emergency lighting unit battery and charger.
4. LED drivers.
5. Lumen output, rated color temperature, and manufacturer's LED binning procedures.
6. Types of lamps.

B. Shop drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.

1. Wiring diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.

C. Field test reports: Provide test results for compliance with performance requirements.

D. Maintenance data: For lighting fixtures to include in maintenance manuals specified in Division 01.

E. Warranties: Special warranties specified in this section.

1.4 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 26 0500, Common Work Results for Electrical.

B. Fixtures, emergency lighting units, and accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

C. Comply with NFPA 70.

D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

A. Fixtures, mounting hardware, and trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver glassware and lamps in their original cartons, clearly labeled.

1.7 WARRANTY

A. Special warranty for batteries: Written warranty, executed by manufacturer agreeing to replace rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Special warranty period for batteries: Manufacturer's standard, but not less than 5 years from date of substantial completion. Full warranty shall apply for first year, and prorated warranty for last four years.

1.8 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor's and subcontractors' responsibilities are described in Divisions 01 and 23 for Commissioning Requirements.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-design products: Fixtures indicated in the Fixture Schedule on the drawings are the basis of design of the project.

1. Subject to compliance with requirements, provide the scheduled products. Unnamed products will only be considered and approved according to Bidding and Contracting requirements and Division 01 requirements for substitutions.

B. Subject to compliance with requirements, provide products by one of the following:

1. Drivers:

a. Philips/Advance
b. Osram Sylvania
c. Universal Lighting Technologies
d. Lutron
e. EldoLED
f. Or approved equal.

C. Subject to compliance with requirements, provide products by one of the following:

1. Lamps:

    a. General Electric
    b. Osram Sylvania
    c. Philips
    d. Venture
    e. Or approved equal.

2.2 FIXTURES, GENERAL

A. Fixtures shall comply with UL 1598 and be complete with sockets, casings, fittings, holders, shades, glassware, lamps, and appurtenances, wired and completely assembled.

B. Metal parts: Free from burrs, sharp corners, and edges.

C. Sheet metal components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, frames, and other internal access: Smoothly operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

E. Metal finishes: Painted after fixture fabrication.

F. Reflecting surfaces: Minimum reflectance as follows, unless otherwise indicated:

1. White surfaces: 85 percent.
2. Specular surfaces: 83 percent.
3. Diffusing specular surfaces: 75 percent.
4. Laminated silver metalized film: 90 percent.

G. Lenses, diffusers, covers, and globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated, exactly as scheduled or specified in optical details and lighting characteristics.

1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
2. Lens thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.

2.3 LED DRIVERS

A. Driver shall operate from a 120-volt or 277-volt, 60-Hz input power source and be suitable for outputting power to 12-volt or 24-volt LED lamp sources, as required.

B. Drivers, where specified, shall be capable of being dimmed. Dimmable drivers shall be controlled by a Class 2 low-voltage 0-10VDC controller.

C. Performance Criteria:

1. Driver shall have a Class A sound rating.
2. Driver shall have a power factor (PF) greater than 0.90.
3. Driver shall have Total Harmonic Distortion (THD) of input current equal to or less than 20 percent.

D. Driver shall meet FCC and Title 47 CFR regulations for EMI/RFI.

E. Driver shall comply with ANSI C62.41 Class A requirements for transient protection.

2.4 EXIT SIGNS

A. General requirements: Exit signs shall meet the Energy Star Program requirements to operate on 5 W or less input power per face. Comply with UL 924 and the following:

1. Sign colors and lettering size: Comply with authorities having jurisdiction.

B. Internally lighted signs: As follows:

1. Lamps for ac operation: Fluorescent, two for each fixture, 20,000 hours rated lamp life.
2. Lamps for ac operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.
3. Additional lamps for dc operation: Two minimum, bayonet-base type, for connection to external dc source.

C. Self-powered exit signs (battery type): Integral automatic charger in a self-contained power pack.

1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from unit when circuit voltage drops to 80 percent of nominal or below. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

2.5 LAMPS

A. Provide lamps with wattages and coatings as scheduled, verifying each lamp is compatible with the fixture in which it is installed.

B. Lamps, LED:

1. The LED manufacturer shall provide the quantity and wattage of LEDs required to achieve the defined lighting output set forth by the lighting fixture manufacturer.
2. LED lamps shall be integrated into an engineered package for the specific lighting fixture application, including heat dissipation components.
3. Color temperature: As specified in lighting fixture schedule, with a tolerance of plus or minus 100K and within a range of three macadam ellipses. Noticeable color temperature variation between adjacent lighting fixtures shall be considered a failure to meet these specifications and shall be replaced at no cost to the Government.
4. Minimum performance characteristics:

a. Life: Minimum lumen maintenance of L70 at 50,000 hours, as defined by IES LM-80.
b. Lumen Output: Based on absolute photometry, lumens (total luminous flux exiting the physical luminaire), as specified on contract drawings and schedules.
c. Color Rendering Index: Rated at 85 or higher.

2.6 FIXTURE SUPPORT COMPONENTS

A. Comply with Section 26 0500, Common Work Results for Electrical, for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-stem hangers: 1/2-inch (12-mm) steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.

C. Twin-stem hangers: Two, 1/2-inch (12-mm) steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.

D. Rod hangers: 3/16-inch- (5-mm-) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

F. Aircraft cable support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.7 FINISHES

A. Fixtures: Manufacturer's standard, unless otherwise indicated.

1. Paint finish: Applied after fabrication over corrosion-resistant treatment or primer, free of defects.
2. Metallic finish: Corrosion-resistant.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before ordering the light fixtures, consult with the installer of the ceilings to ensure that the correct fixture trim is supplied and installed. Provide the supports and accessories required for installation in each ceiling system.

B. Before ordering the light fixtures, verify the specified voltage with the voltage shown on the drawings to ensure the correct voltage is supplied.

3.2 INSTALLATION

A. Furnish and install a complete lighting fixture for every outlet indicated on the drawings so that every outlet shall be properly provided with a suitable fixture of type specified, of wattage indicated.

B. Fixture wire shall bear UL label. Fixture wiring for fixtures and branch circuit wiring in fixture channels shall be type THHN.

C. Each fixture shall be completely equipped with lamps of the size, type, wattage and shape indicated and specified. Lamps shall be of the proper voltage for the building.

D. Furnish fixtures in the quantities, sizes, and types indicated on drawings.

E. Where a letter designating fixture type is adjacent to a row of fixtures, it shall be understood that all fixtures in the row shall be of this type, consisting of either four-foot or eight-foot units, the rows consisting of the total lengths indicated. Where the catalog numbers of the fixtures refer to 4-foot units, 8-foot units may be used where applicable.

F. Provide recessed fixtures with flexible conduit connector and wire (fixture whip), or a removable wiring access plate, so that they may be wired without removing ballast cover. Plate shall be screwed to fixture housing and conduit shall be securely attached and grounded to fixture to meet NEC requirements.

3.3 FIXTURE SUPPORT

A. Support from building structure: Provide fasteners appropriate to the supporting substrate, and wire, jack chain, or rods as specified for particular fixture types below.

1. Provide channels bolted or welded between joists where required to obtain proper spacing for lighting supports.
2. Connections to joists or beams: Beam clamps. For wire supports, wrap wire securely around structural member.
3. Connections to concrete: Embedded, as specified in Section 26 0533, Conduits.

B. In suspended plaster and drywall ceilings, fixtures may be supported from the suspended ceiling construction. Fasten box and fixture supports securely to suspension system. Where fixtures are surface-mounted, cut neat holes in the plaster as required for supports.

C. Recessed fixtures in suspended acoustical ceilings: Coordinate fixture installation with ceiling installer. Ensure that ceiling supports are located to clear fixtures.

1. Support from building structure: Use fasteners specified in Section 26 0533, Conduits, and 0.25-inch (6-mm) rods, jack chains, or No. 10 wire.

a. Provide 2 supports for each individual fixture, one at each end of fixture. In continuous rows, install additional supports at each joint.

2. Provide double nuts on rods.

D. Surface-mounted and stem-suspended fixtures on or below suspended acoustical ceilings: Supported from the building structure above with No. 10 wire or 0.25-inch (6-mm) rods.

1. Install double nuts on rods.
2. Provide 2 supports for each individual fixture, 1 at each end of fixture. In continuous rows, install an additional support at each joint.
3. Surface-mounted fixtures mounted on low-density ceilings shall be provided with spacers where required.

E. Where it is necessary for a fixture to be installed directly below an air duct, install two hanger rods, one on each side of the duct, bolted to a channel or angle suspended from the hangers under the duct, and support the fixtures from the suspended channel or angle.

3.4 ADJUSTMENT PERIOD

A. Occupancy adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting fixtures to suit occupied conditions. Provide up to 2 visits to project outside of normal occupancy hours for this purpose. Some work may be required after dark.

3.5 CLEANING

A. Light fixtures, used for temporary lighting during construction, shall be cleaned free of construction dirt to like-new condition, and re-lamped with the specified lamps.

END OF SECTION

SECTION 26 5600

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fixtures

1.2 RELATED SECTIONS

A. Commissioning requirements: Divisions 01 and 23.

B. Conduits: Section 26 0533.

C. Wires and cables: Section 26 0519.

D. Excavation and fill for electrical work: Section 26 0501.

1.3 DEFINITIONS

A. Bracket: An attachment to a standard, on which a luminaire is carried.

B. Luminaire: A lighting device consisting of a light source together with its direct appurtenances, including globe, reflector, refractor, housing, and such support as is integral with the housing. The standard and the bracket are not part of the luminaire.

1.4 SUBMITTALS

A. Product data: Submit for each type of fixture.

1. Type
2. Wattage
3. Voltage
4. Efficiency
5. Suspension
6. Glassware
7. Finished diameters
8. Mounting heights
9. Lamps
10. LED drivers
11. Length and diameter of poles and standards
12. Appurtenances

B. Shop drawings shall show complete dimensions of complete assembled unit with accessories. Include wiring diagrams, showing clearly manufacturer-installed and field-installed wiring.

1.5 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 26 0500, Common Work Results for Electrical.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver glassware and lamps in their original cartons, clearly labeled.

1.7 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor's and subcontractors' responsibilities are described in Divisions 01 and 23 for Commissioning Requirements.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-design products: Fixtures indicated in the Fixture Schedule on the drawings are the basis of design of the project.

1. Subject to compliance with requirements, provide the scheduled products. Unnamed products will only be considered and approved according to bidding and Contracting requirements and Division 01 requirements for substitutions.

B. Subject to compliance with requirements, provide products by one of the following:

1. LED drivers:

a. EldoLED
b. Lutron
c. Osram Sylvania
d. Philips/Advance
e. Universal Lighting Technologies
f. Or approved equal.

2. Lamps:

a. General Electric
b. Osram Sylvania
c. Philips
d. Venture
e. Or approved equal.

2.2 CONCRETE

A. Concrete shall be 3,000 psi strength.

2.3 EXTERIOR LIGHTING FIXTURES

A. Provide lighting fixtures of sizes, types, and ratings scheduled, complete with, but not limited to, housings, energy-efficient ballasts, starters, and wiring.

2.4 LED DRIVERS

A. Driver shall operate from a 120-volt or 277-volt, 60-Hz input power source and be suitable for outputting power to 12-volt or 24-volt LED lamp sources, as required.

B. Drivers, where specified, shall be capable of being dimmed. Dimmable drivers shall be controlled by a Class 2 low-voltage 0-10VDC controller.

C. Performance criteria:

1. Driver shall have a Class A sound rating.
2. Driver shall have a power factor (PF) greater than 0.90.
3. Driver shall have Total Harmonic Distortion (THD) of input current equal to or less than 20 percent.

D. Driver shall meet FCC and Title 47 CFR regulations for EMI/RFI.

E. Driver shall comply with ANSI C62.41 Class A requirements for transient protection.

2.5 LAMPS

A. Lamps, LED:

1. The LED manufacturer shall provide the quantity and wattage of LEDs required to achieve the defined lighting output set forth by the lighting fixture manufacturer.
2. LED lamps shall be integrated into an engineered package for the specific lighting fixture application, including heat dissipation components.
3. Color temperature: As specified in lighting fixture schedule, with a tolerance of plus or minus 100K and within a range of three macadam ellipses. Noticeable color temperature variations between adjacent lighting fixtures shall be considered a failure to meet these specifications and shall be replaced at no cost to the Government.
4. Minimum performance characteristics:

a. Life: Minimum lumen maintenance of L70 at 50,000 hours, as defined by IES LM-80.
b. Lumen output: Based on absolute photometry, lumens (total luminous flux exiting the physical luminaire), as specified on contract drawings and schedules.
c. Color rendering index: Rated at 85 or higher.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install accessories, and fixtures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NFPA 70, NESC and NEMA standards, and with recognized industry practices.

3.2 GROUNDING

A. Provide equipment grounding connections for poles and standards as indicated, and in accordance with Section 26 0526, Grounding and Bonding. Tighten connections to comply with tightening torques specified in UL 486A.

3.3 FIELD QUALITY CONTROL

A. At the date of substantial completion, replace lamps in exterior lighting fixtures which are observed to be noticeably dimmed after Contractor's use and testing, as judged by the DGS Project Manager.

3.4 ADJUSTING AND CLEANING

A. Aim adjustable lighting fixtures and lamps in night test of system. Verify that measured illuminance values comply with approved photometric diagram.

B. Clean lighting fixtures of dirt and debris upon completion of installation.

C. Protect installed fixtures from damage during construction period.

3.5 DEMONSTRATION

A. Upon completion of installation of exterior lighting fixtures, and associated electrical supply circuitry, apply electrical energy to circuitry to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities .
7. Temporary erosion and sedimentation control.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings**.**

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Topsoil stripping and stockpiling program.

C. Rock stockpiling program.

D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Utility Locator Service: Notify Miss Utility for area where Project is located before site clearing. Obtain services of a utility locator to locate onsite utilities.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

E. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."

F. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #23 (surface-tolerant, anticorrosive metal primer) or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than fourteen days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

E. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
3. Use only hand methods or air spade for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 3 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Do not stockpile topsoil within protection zones.
2. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
3. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Burning tree, shrub, and other vegetation waste is permitted according to burning requirements and permitting of authorities having jurisdiction. Control such burning to produce the least smoke or air pollutants and minimum annoyance to surrounding properties. Burning of other waste and debris is prohibited.

C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000

EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses and plants.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete walks and pavements.
6. Subbase course for asphalt paving.
7. Subsurface drainage backfill for walls and trenches.
8. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:
1. Section 311000 "Site Clearing" for site stripping, grubbing, stripping topsoil, and removal of above- and below-grade improvements and utilities.
2. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
3. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D1586.

I. Disintegrated Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 60 blows per foot and auger refusal (50 blow over 1 inch) when tested by a geotechnical testing agency, according to ASTM D1586.

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

M. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct preexcavation conference at Project site.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:

a. Personnel and equipment needed to make progress and avoid delays.
b. Coordination of Work with utility locator service.
c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
d. Extent of trenching by hand or with air spade.
e. Field quality control.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Warning tapes.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to ASTM D1557.

C. Seismic survey report from seismic survey agency.

D. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.7 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

1.8 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Utility Locator Service: Notify "Miss Utility" for area where Project is located before beginning earth-moving operations. Obtain services of a utility locator to locate onsite utilities.

D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 311000 "Site Clearing" are in place.

E. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

F. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, CG, SW, SP, SM according to ASTM D2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

G. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

H. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.

I. Sand: ASTM C33/C33M; fine aggregate.

J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Separation Geotextile: As indicated on the Drawings.

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

a. 24 inches outside of concrete forms other than at footings.
b. 12 inches outside of concrete forms at footings.
c. 6 inches outside of minimum required dimensions of concrete cast against grade.
d. 6 inches beneath bottom of concrete slabs-on-grade.
e. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: As indicated.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

E. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.8 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

G. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use satisfactory fill.
4. Under building slabs, use satisfactory fill.
5. Under footings and foundations, use satisfactory fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 97 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase course to required crown elevations and cross-slope grades.
4. Place subbase course 6 inches or less in compacted thickness in a single layer.
5. Place subbase course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
6. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 97 percent of maximum dry unit weight according to AASHTO T-180, Modified Proctor.

C. Pavement Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase layer to not less than 97 percent of maximum dry unit weight according to AASHTO T-180, Modified Proctor.

3.18 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches or less in compacted thickness in a single layer.
3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
4. Compact each layer of drainage course to required cross sections and thicknesses with at least two passes of a suitable vibratory compaction equipment.

3.19 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material classification and maximum lift thickness comply with requirements.
3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 321216

ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold milling of existing asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt overlay.

B. Related Requirements:

1. Section 312000 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
2. Section 321313 "Concrete Paving" for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.
3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.
4. Section 321400 "Unit Paving" for bituminous setting bed for pavers and for stone and precast concrete curbs.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.

2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
3. Job-Mix Designs: For each job mix proposed for the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.

B. Material Certificates: For each paving material. Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.

C. Material Test Reports: For each paving material, by a qualified testing agency.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.

B. Testing Agency Qualifications: Qualified according to ASTM D3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Standard Specifications for Construction and Materials of the Maryland State Highway Administration for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F.
2. Tack Coat: Minimum surface temperature of 60 deg F.
3. Slurry Coat: Comply with weather limitations in ASTM D3910.
4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: In accordance with Maryland State Highway Standards and Specifications, Category 900 – Materials.

C. Fine Aggregate: In accordance with Maryland State Highway Standards and Specifications, Category 900 – Materials.

D. Mineral Filler: In accordance with Maryland State Highway Standards and Specifications, Category 900 – Materials.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: In accordance with Maryland State Highway Standards and Specifications, Category 900 – Materials.

B. Asphalt Cement: In accordance with Maryland State Highway Standards and Specifications, Category 900 – Materials.

C. Emulsified Asphalt Prime Coat: In accordance with Maryland State Highway Standards and Specifications, Category 900 – Materials.

D. Tack Coat: In accordance with Maryland State Highway Standards and Specifications, Category 900 – Materials.

E. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

B. Sand: In accordance with Maryland State Highway Standards and Specifications, Category 900 – Materials.

2.4 MIXES

A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: 12.5mm Superpave.
3. Surface Course: 19mm Superpave.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

3.3 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 2 inches
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, driveway aprons, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
7. Keep milled pavement surface free of loose material and dust.
8. Do not allow milled materials to accumulate on-site.

3.4 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Undersealing: Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.5 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of [1/4 inch.

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.6 SURFACE PREPARATION

A. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.7 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at a minimum temperature of 250 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.8 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints in accordance with Maryland State Highway Standards and Specifications.
5.
6. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
7. Compact asphalt at joints to a density within 2 percent of specified course density.

3.9 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D6927, but not less than 94 percent or greater than 100 percent.
2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D2041/D2041M, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D3549/D3549M.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D979/D979M or AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D2041/D2041M, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D1188 or ASTM D2726/D2726M.

    a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
    b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D2950 and correlated with ASTM D1188 or ASTM D2726/D2726M.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 321216

SECTION 321313

CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Maryland Department of Transportation, State Highway Administration, Standard Specifications for Construction and Materials, latest addition, for materials and methods of construction.

1.2 SUMMARY

A. Section Includes Concrete Paving. Including the Following:

1. Roadways.
2. Curbs and gutters.
3. Walks.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.
b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete paving Subcontractor.
e. Manufacturer's representative of stamped concrete paving system used for stamped detectable warnings.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

C. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Applied finish materials.
6. Bonding agent or epoxy adhesive.
7. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate surface finish, texture, color and standard of workmanship for sidewalk with exposed aggregate finish.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 60 inches by 60 inches Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.9 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from steel wire into flat sheets.

B. Reinforcing Bars: ASTM A615/A615M, Grade 60; deformed.

C. Joint Dowel Bars: ASTM A615/A615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.

D. Tie Bars: ASTM A615/A615M, Grade 60; deformed.

E. Hook Bolts: ASTM A307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

G. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

H. Zinc Repair Material: ASTM A780/A780M.

2.4 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C150/C150M, gray portland cement Type I/II.
2. Fly Ash: ASTM C618, Class C or Class F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
4. Blended Hydraulic Cement: ASTM C595/C595M, Type IP, portland-pozzolan cement.

B. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:

1. Aggregate Sizes: 3/8 to 5/8 inch nominal.
2. Aggregate Source, Shape, and Color: Rounded, tan in color. Obtain color and shape approval from Architect.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

F. Water: Potable and complying with ASTM C94/C94M.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

2.6 RELATED MATERIALS

A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber in preformed strips.

B. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy-Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:

1. Types I and II, nonload bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.

2.7 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Pozzolan: 25 percent.
2. Slag Cement: 50 percent.
3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to [0.15] [0.30] percent by weight of cement.

D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture, high-range, water-reducing admixture, high-range, water-reducing and retarding admixture, plasticizing and retarding admixture in concrete as required for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

E. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength (28 Days): MD SHA Mix No. 3 (3500 psi), Table 902A

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.

3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

   a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

   a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 SPECIAL FINISHES

A. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of 1/16 inch.

1. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.

2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-feet- long; unleveled straightedge not to exceed 1/2 inch.

4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each [100 cu. yd.] [5000 sq. ft.] or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.12 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321373

CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Joint-sealant backer materials.
3. Primers.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Paving-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Product Certificates: For each type of joint sealant and accessory.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D5893M, Type NS.

B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D5893/D5893M, Type SL.

2.3 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.4 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.

3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:

1. Place joint sealants so they fully contact joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.5 PAVING-JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Joints within concrete paving.

1. Joint Location:

a. Expansion and isolation joints in concrete paving.
b. Contraction joints in concrete paving.
c. Other joints as indicated.

2. Joint Sealant: Single-component, nonsag, silicone joint sealant
3. Joint-Sealant Color: Manufacturer's standard.

END OF SECTION 321373

SECTION 321400 - UNIT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

1. Section Includes:
    1. Porcelain Pavers set in mortar.
    2. Edge restraints.

1.3 ACTION SUBMITTALS

1. Product Data: For the following:
    1. Pavers.
    2. Mortar and grout materials.
    3. Edge restraints.
2. Samples for Initial Selection: For the following:
    1. Each type of unit paver indicated.
    2. Joint materials involving color selection.
3. Samples for Verification:
    1. Full-size units of each type of unit paver indicated.
    2. Joint materials.

1.4 QUALITY ASSURANCE

1. Source Limitations: Obtain each type of unit paver, and pedestal from single source with resources to provide materials and products of consistent quality in appearance and physical properties.
2. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
    1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
    2. Mockups shall be a minimum of 10’ X 10’.

3. No paver shall be installed at less than 1/3 of original size.
4. Provide a minimum 3 day notice to Landscape Architect for mockup approval.

3. Pre-installation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

1. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

2. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.6 PROJECT CONDITIONS

1. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Retain first paragraph below if bituminous setting bed is used.

2. Weather Limitations for Mortar and Grout:

    1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
    2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.

        a. When ambient temperature exceeds 100 deg F or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 PAVERS

Basis-of-Design Product:
1. Porcelain Paver by Unilock Porcelain
    a. Face Size: 16” x 32”
    b. Thickness: 7/8”.
    c. Color: Arbor Gray
    d. Mortar in place.

2. Alternate Manufacturers
    a. Techo-bloc; Shale Grey.
    b. Hanover; Barnwood Gray.

2.2 CURBS AND EDGE RESTRAINTS

Basis-of-Design Product:

1. Edge Restraint – Stucturedge; Permaloc Corporation 13505 Barry St. Holland, MI 49424. 616.399.9600 www.permaloc.com
   a. Size: 3/16" X 1-5/8".
   b. Finish: Natural Aluminum
   c. Install per manufacturer's installations guidelines.

2.3 ACCESSORIES

1. Cork Joint Filler: Preformed strips complying with ASTM D1752, Type II.

2. Compressible Foam Filler: Preformed strips complying with ASTM D1056, Grade 2A1.

2.4 MORTAR SETTING-BED MATERIALS

Note: Verify the compatibility of the selected mortar with the pavers before proceeding with mortaring. Consult with the mortar manufacturer's representative for recommendations.

1. Mortar bed or thin-set mortar: Meets ANSI A118.4, Specifications for latex-Portland cement mortar.

Note: Use epoxy mortars when application is subject to freeze-thaw conditions or deicing salts.

2.5 GROUT MATERIALS

Note: Verify the compatibility of the selected pigmented grout with the pavers before proceeding with the grouting. Consult with the grout manufacturer's representative for recommendations.

1. Meets ANSI 118.7, polymer modified cement grouts for tile installation.

Note: Use epoxy grouts in when application is subject to freeze-thaw conditions and deicing salts.

2. Meets ANSI 118.3, Specifications for chemical resistant, water cleanable tile- setting, and-tile grouting epoxy and water cleanable tile-setting epoxy adhesive.
3. Grout colors: selected by the Architect from the manufacturer's complete color range.
4. Acceptance of grout products is subject to the approval of both the Architect and the paver manufacturer prior to bid closing.
5. Water: Potable.

2.7 MORTAR AND GROUT MIXES

1. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimal performance characteristics. Discard mortars and grout if they have reached their initial set before being used.

2. Mortar-Bed Bond Coat: Mix neat cement to a creamy consistency.

3. Portland Cement-Lime Setting-Bed Mortar: Type M complying with ASTM C270, Proportion Specification.

4. Latex-Modified, Portland Cement Setting-Bed Mortar: Proportion and mix Portland cement, sand, and latex additive for setting bed to comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.

5. Latex-Modified, Portland Cement Bond Coat: Proportion and mix Portland cement, aggregate, and liquid latex for bond coat to comply with written instructions of liquid-latex manufacturer.

6. Thinset Mortar Bond Coat: Proportion and mix according to manufacturer's written instructions.

7. Job-Mixed Portland Cement Grout: Proportion and mix job-mixed Portland cement and aggregate grout to match setting-bed mortar except omit hydrated lime and use enough water to produce a pourable mixture.

8. Pigmented Grout: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1 to 10, by weight.
9. Colored-Aggregate Grout: Produce color required by combining colored aggregates with Portland cement of selected color.

10. Packaged Grout: Proportion and mix according to grout manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

1. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

2. Where pavers are to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

1. Remove substances from substrates that could impair pedestal installation.

2. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

3.3 INSTALLATION, GENERAL

1. Do not use pavers with chips, cracks, voids, discolorations, or other visible defects.

2. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

3. Cut pavers as manufacturer identifies to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Do not use less than 1/3 full paver size. Hammer cutting is not acceptable.

4. Pavers over Waterproofing: Exercise care in placing pavers and setting materials over waterproofing so protection materials are not displaced and waterproofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and arrange for repair of damaged waterproofing before covering with paving.

5. Pattern: As indicated.

3.4 MORTAR SETTING-BED APPLICATIONS

1. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing mortar bed. Do not exceed 1/16-inch thickness for bond coat. Limit area of bond coat to avoid its drying out before placing setting bed.

2. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated. Finished grade should be flush with adjacent pedestrian concrete walk.

3. Place reinforcing wire over concrete subbase, lapped at joints by at least one full mesh and supported so mesh becomes embedded in the middle of mortar bed. Hold edges back from vertical surfaces approximately 1/2 inch.

4. Place mortar bed with reinforcing wire fully embedded in middle of mortar bed. Spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.

5. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.

6. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch thick bond coat to mortar bed or to back of each paver with a flat trowel.

7. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.

8. Grouted Joints: Grout paver joints complying with ANSI A108.10.

9. Grout joints as soon as possible after initial set of setting bed.

    1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
    2. Clean pavers as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.
    3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
    4. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.

3.5 REPAIRING, POINTING, AND CLEANING

1. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

END OF SECTION 321400

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Trees.
2. Shrubs.
3. Ground cover.
4. Perennial plants.

1.3 REFERENCES

A. Standards: Comply with applicable recommendations of the following:

1. “Standardized Plant Names”, American Joint Committee on Horticultural Nomenclature.
2. American Standard for Nursery Stock”, American Association of Nurserymen (ANSI 260.1)
3. “Landscape Specifications Guidelines for Baltimore-Washington Metropolitan Areas”, latest edition.

1.4 DEFINITIONS

A. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.

B. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.

C. Bare-Root Stock: Exterior plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for kind and size of exterior plant required.

D. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when

removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plant required.

E. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.

F. Finish Grade: Elevation of finished surface of planting soil.

G. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

H. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

I. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

1.5 SUBMITTALS

A. Comply with the requirements of Division 1 Section Submittals. Incomplete or improper submittals will be returned to the Contractor without change in contract time.

B. Samples for Verification: For each of the following:

1. Submit one pound samples, packaged in plastic bags, to the Landscape Architect for examination and approval prior to any landscape operations:

a. Mulches.

b. Soil mixes.

C. Material Certificates: Submit the following manufacturer’s information and source data:

a. Commercial fertilizers.

b. Chemical additives.

c. Organics.

d. Lime.

e. Iron Sulfate.

f. Filter Cloth/Soil Separator.

g. Erosion Control Fabric.

D. Qualification Data: For landscape installer.

E. Material Test Reports: For existing surface soil and imported topsoil.

F. Planting Schedule: Indicating anticipated planting dates for exterior plants.

G. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Not less than 5 years documented successful experience in installation of work similar to Work in this Project.

B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Planting Soil Analysis: Furnish soil analysis per the requirements of Section 32 9113 Soil Preparation.

D. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."

E. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches aboveground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

F. Observation: Architect may observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

H. Plant Substitutions – Pre-Bid:

1. Make every reasonable effort to find the plant material specified by the Architect.

2. Qualify bid to document any plant suitability or availability problems.

3. Offer substitutions to the Architect for consideration if there are legitimate availability problems.

4. Offer substitutions if there are known diseases or insect resistant species that can be substituted for a pest prone plant, if specified.

5. Submit a Base Bid as per plans and specifications, plus any price changes or clarifications for all recommended plant substitutions.

I. Plant Substitutions – Post-Bid, Pre Installation:

1. It is the intent to reduce or eliminate post-bid substitutions.

2. Substitutions of plant materials will not be permitted unless authorized in writing by Architect.

3. If proof is submitted that any plant accepted during the bidding process is not attainable, a proposal will be considered for use of nearest equivalent size or variety, with corresponding adjustment of Contract price if necessary.

4. These provisions do not relieve Contractor of responsibility for obtaining required materials in advance if special growing conditions or other arrangements can be made in order to provide the required materials.

J. Preliminary Plant Acceptance:

1. Architect or his representative may view plants at their place of growth or upon delivery. Architect reserves the right to tag plants at their place of growth.

2. For distant material, photographs may be submitted in lieu of on-site inspections or for preliminary reviews prior to on-site inspection.

3. Identify place of growth and quantity of plants to be inspected.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver exterior plants freshly dug.

1. Immediately after digging up bare-root stock, pack root system in wet straw, or other suitable material to keep root system moist until planting.

B. Do not prune trees and shrubs before delivery, except as approved by Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.

C. Handle planting stock by root ball.

D. Plants damaged in transit, storage or handling may be rejected at the sole discretion of the Architect. Consideration for plant material damage may not be life threatening, but rather cosmetic such as broken branches or scratched trunks, to qualify plant for rejection.

E. Root balls which are not tight and properly prepared or show signs of damage will be rejected.

F. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants trees in shade, protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots in water for two hours if dried out.

2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.

3. Do not remove container grown stock from containers before time of planting.

4. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

5. If plant material is stored more than three days on site, return it to the nursery for proper care until it can be planted.

1.8 PLANT SEASONS

A. B&B, deciduous trees and shrub materials:

1. Lowest Risk: March 1 to May 30 and September 15 to December 1.

a. Deciduous plants dug and planted while dormant in spring or fall except those listed below.

b. Deciduous plants dug during dormancy and planted after producing leaves providing they have been properly stored.

c. Deciduous plants dug after leaves have fully expanded and harden off.

2. Highest Risk:

a. Deciduous plants dug in the spring during newly expanding leaf production.

B. Evergreen B&B material:

1. Freshly dug evergreen material should not be moved without proper conditioning during active growth.

C. Summer dug B&B material shall be handled in one of the following methods in order to harden off:

1. Properly hardened-off in field 7-10 days prior to digging by a gradual process of trenching and soaking, leaving the bottom surface of the ball attached to soil until shipping.

2. Condition under irrigation in partial shade for at least 4 days prior to shipping.

D. Perennials:

1. May be installed as soon as the ground is workable in Spring after March 1 until November 15.

2. Any plants required to be installed after November 15, will require protective, supplemental mulching applied after December 15 and removed when weather permits around March 1.

E. Annuals:

1. Cold sensitive annuals may be installed after danger of frost has passed and as soon as the ground is workable in the Spring after March 1 and November 15.

F. Spring Flowering Bulbs:

1. May be installed between September 15 to December 31.

G. Excluded Material:

1. The following trees may not be installed between November 15 and March 1: White oak (Quercus alba), Scarlet Oak (Quercus coccinea), Red Oak (Quercus rubra), Willow Oak (Quercus phellos), Flowering Dogwood Varieties (Cornus florida), Sweet Gum (Liquidambar styraciflua) and all conifers with the exception of White Pines (Pinus strobus).

H. Out of season plant installation:

1. A professional horticulturist, nurseryman or arborist shall be consulted to determine the proper time, based on plant species and weather conditions, to move and install particular plant material to minimize plant stress if it is required to move material outside of the preceding guidelines.

2. Should plant material be required to be installed for the contractor’s convenience, it shall be at the Contractor’s full risk and responsibility. However, if plants are required to be installed as per the owner’s direction, plant warranty may be waived.

3. Architect will only allow variance in planting season upon written request.

1.9 WARRANTY

A. Warrant that all trees, shrubs, vines, groundcovers, perennials, and bulbs planted under this Contract will be healthy and in flourishing condition of active growth for a period of 24 Months from date of completion and initial acceptance of the work.

B. Any delay in completion of planting operations which extends the planting into more than one planting season shall extend the Warranty period correspondingly.

C. Provide written warranty certificates to the Architect.

D. Warranty Provisions:

1. Remove plants that are in the opinion of the Architect, at least 25% dead, unsightly, or not in healthy condition.

2. Replace removed plants and plants missing due to Contractor's negligence. Replace when weather conditions permit and within specified planting period, or as directed by Landscape Architect.

3. Provide replacement plants closely matching adjacent specimens of same species.

4. Warrant replacement plants for additional period of one year from date of their acceptance after replacement. Note that failure to replace plants in a timely and responsive manner may result in reduction and/or forfeiture of final payments.

1.10 MAINTENANCE

A. Begin maintenance immediately after plants are installed and continue to maintain for a period of two years. The two-year period begins after approved substantial completion by the Landscape Architect. At the end of the two-year maintenance period a final site walk will be scheduled with the Landscape Architect and representatives of the University and upon acceptance the site will be turned over to the University to their maintenance crews.

B. Maintenance Requirements:

1. Protects plants and planting areas from damage.

2. Keep plants healthy, vigorous, trim and neat.

3. Prune to maintain plants in normal growth pattern.

4. Spray to control disease and insects.

5. Maintain mulch bed to 2-inch depth. Re-mulching of the plant materials is not required as part of the work.

6. Keep beds free of weeds.

7. Provide manpower in order to water all plant materials as required to maintain adequate moisture, and when directed by Architect.

8. Maintain stakes and guys in taut and rigid state with wires in place and safety flags clearly visible. Remove stakes and guys when no longer necessary for plant establishment after one year.

9. Reset plants to proper grade and upright condition if required and add topsoil and mulch to areas of settlement.

10. Provide additional stakes as required to support trees particularly evergreens in areas prone to high winds or settlement.

11. Provide maintenance schedule/ program for UMBC approval at the initial acceptance of the work.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

A. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Grade: Provide trees and shrubs of sizes and grades complying with ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

2.2 PLANTS

A. Annuals: Provide healthy, disease-free plants of species and variety shown or listed. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

B. Perennials: Provide healthy, field-grown plants from a commercial nursery, of species and variety shown or listed.

C. Fast-Growing Vines: Provide vines of species indicated complying with requirements in ANSI Z60.1 as follows:

1. Two-year plants with heavy, well-branched tops, with not less than 3 runners 18 inches or more in length, and with a vigorous well-developed root system.
2. Provide field-grown vines. Vines grown in pots or other containers of adequate size and acclimated to outside conditions will also be acceptable

2.3 TOP SOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1/2 inch or larger in any dimension and other extraneous materials harmful to plant growth.

2.4 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:

1. Class: Class O, with a minimum 95 percent passing through No. 8 sieve and a minimum 55 percent passing through No. 60 sieve.
2. Provide lime in form of dolomitic limestone.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through No. 6 sieve and a maximum 10 percent passing through No. 40 sieve.

C. Aluminum Sulfate: Commercial grade, unadulterated.

D. Perlite: Horticultural perlite, soil amendment grade.

E. Agricultural Gypsum: ground, containing a minimum of 90 percent calcium sulfate.

F. Sand: Clean, washed natural or manufactured, free of toxic materials.

G. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.5 ORGANIC SOIL AMENDMENTS

A. Composted Leaves such as Leaf Gro

2.6 FERTILIZER

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 10 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium.

2.7 MULCHES

A. A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood, mulching grade, uniform in size, and free from foreign matter.

2.8 STAKE AND GUYS

A. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2 by 2 inches by length indicated, pointed at one end.

B. Guy and Tie Wire: ASTM A 641/A 641M, Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 inch in diameter.

C. Guy Cable: 5-strand, 3/16-inch- diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches long, with two 3/8-inch galvanized eyebolts.

D. Hose Chafing Guard: Reinforced rubber or plastic hose at least 1/2 inch in diameter, black, cut to lengths required to protect tree trunks from damage.

E. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

2.9 MISCELLANEOUS PRODUCTS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

2.10 PLANTING SOIL MIX

A. Planting Soil Mix: 2/3 existing soil, 1/3 new topsoil; amend as needed per soil test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Contact ‘MISS UTILITY’ at 800-257-7777 (72) hours prior to digging. Contractor shall take sole responsibility for any cost incurred due to damage due to these utilities.

C. Do not willfully proceed with planting as designed when it is obvious that conditions and/or obstructions exist due to changes in site conditions. Such conditions shall be brought to the immediate attention of the Landscape Architect. The Contractor will be held responsible for all necessary revisions due to failure to give such notification so that material can be relocated or conditions corrected prior to plant installations.

D. Remove any existing plant material necessary for the installation and the completion of the planting designed and contracted as part of this project.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple exterior plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before planting. Make minor adjustments as required.

D. Lay out exterior plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting

3.3 PLANTING BED ESTABLISHMENT

A. Loosen subgrade of planting beds to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter.

1. Apply superphosphate fertilizer directly to subgrade before loosening only if indicated by soil testing.

2. Spread planting soil, apply leaf gro and fertilizer on surface, and thoroughly blend planting soil mix.

a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.

b. Mix lime with dry soil before mixing fertilizer.

B. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

C. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

3.4 TREE AND SHRUB EXCAVATION

A. Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.

1. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.

B. Subsoil removed from excavations may not be used as backfill.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

3.5 SOIL DRAINAGE TEST

A. Before planting, determine that areas to receive plant material have adequate sub-drainage. Contractor is responsible for correcting all drainage conditions which may adversely impact the establishment of specified plantings.

1. Perform water percolation tests for the following areas or as required in low areas where soils may not adequately drain.
2. Test by digging tree and shrub pits to the full depth and dimensions indicated on drawings.
3. Fill excavations to 1/3 depth with water and allow to percolate out before planting.
4. If after 24 hours, water remains in excavation, perform a more detailed percolation test as described below and notify Architect in writing.
5. At bottom of planting pit, excavate rectangular pit 12 inches x 12 inches x 18 inches deep. Pour water into this small pit to a depth of 6 inches (approximately 3 – 3 ¾ gallon). Note time required for water to be completely absorbed. Divide time noted by 6, to achieve average rate of absorption for 1 inch of water.

3.6 SOIL DRAINAGE IMPROVEMENTS

A. Where slope conditions permit, areas that do not drain properly may be drained to daylight with Architect’s approval.

1. Use 3” diameter slotted corrugated polyethylene non-perforated drainage tubing per ASTM F-405 within tree pit or bed areas. Provide non-slotted type beyond plant pits or plant bed areas.

2. Minimum slope on drainage tubing shall not be less than 2%.

3.7 TREE AND SHRUB PLANTING

A. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball one inch above adjacent finish grades.

1. Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.

2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before

placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

B. Set balled and potted container-grown stock plumb and in center of pit or trench with top of root ball 1 inch above adjacent finish grades.

1. Carefully remove root ball from container without damaging root ball or plant.

2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

C. Organic Mulching: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of planting pit or trench. Do not place mulch within 3 inches of trunks or stems.

3.8 TREE AND SHRUB PRUNING

A. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character. Shrub sizes indicated are sizes after pruning.

3.9 GUYING AND STAKING

A. Upright Staking and Tying: Stake trees of 2-inch through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend at least 72 inches above grade. Set vertical stakes and space to avoid penetrating root balls or root masses. Support trees with two strands of tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree. Use the number of stakes as follows:

1. Use two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.

2. Attach flags to each guy wire, 30 inches above finish grade.

3. Paint turnbuckles with luminescent white paint.

3.10 GROUND COVER AND PLANTING

A. Set out and space ground cover and plants as indicated.

B. Dig holes large enough to allow spreading of roots, and backfill with planting soil.

C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.11 PLANTING BED MULCHING

A. Mulch backfilled surfaces of planting beds and other areas indicated.

1. Organic Mulch: Apply 3-inch average thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

3.12 CLEANUP AND PROTECTION

A. During exterior planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

3.13 DISPOSAL

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property

3.14 MAINTENANCE AND ACCEPTANCE

A. The following shall be grounds for final acceptance of planting:

1. Trees, shrubs and woody material shall be in healthy, living condition with no more than 25% dead. Any dead limbs shall be pruned according to accepted arboricultural practices.

2. Perennials, grasses and groundcovers shall be no less than 25% dead.

B. Turn over maintenance of the planting to the Owner after completion of the punch list and Final Acceptance by the Landscape Architect.

C. Provide a maintenance manual to the Owner so that the Owner may document maintenance activities during the warranty period.

END OF SECTION 329300

SECTION 331415

SITE WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water-distribution piping and related components outside the building for domestic water service for the yard hydrants.

1.2 DEFINITIONS

A. CDA: Copper Development Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

B. Field Quality-Control Submittals:

1. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:

1. Ensure that piping, valves, meters, backflow prevention devices, and fire hydrants are dry and internally protected against rust and corrosion.
2. Protect threaded ends and flange faces against damage.
3. Set piping, valves, meters, backflow prevention devices, and fire hydrants in best position for handling and to prevent rattling.

B. During Storage: Use precautions for piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle products if size requires handling by crane or lift. Rig products to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service in accordance with requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.

B. Comply with standards of authorities having jurisdiction for domestic water-service piping, including materials, installation, testing, and disinfection.

C. Piping materials to bear label, stamp, or other markings of specified testing agency.

D. All piping and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372 or are certified in compliance with NSF 61/NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Applications" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and service sizes.

B. Potable-water piping and components comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.3 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B88, Type K, seamless

B. Service Fittings: Copper following high pressure requirements of AWWA C800.

1. Flared Copper tube connections: AWWA C800 for flared connections with straight threads.

2. Brass Nipples: Following NSF 372 and ASTM B43.
   a. Reamed, chamfered with male NPT ends: Following ANSI/ASME B1.20.1.

3. Bronze castings: Manufactured of Copper Development Association (CDA) alloys meeting chemical and physical properties of ASTM D584 and following AWWA C800, NSF 372.

4. Compression copper tube connections: Following AWWA C800.
   a. Elastomer seal to prevent leakage.
   b. Corrosion resistant, e.g. stainless steel, split or gripper ring to restrain joint.
   c. “Tighten to stop” design.

5. Connections with National Pipe Thread connections (NPT): Follow ANSI/ASME B1.20.1, NSF 372, and AWWA C800 or ANSI B16.15.

C. Service Insulator Assemblies (available in flare or compression styles).
1. Ensure thread compatibility
   a. Insulator: Use same style as outlet end of corporation stop.
   b. Compression outlet stops: Use same manufacturer.

2.4 PIPING JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.

B. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.

2.5 CORPORATION VALVES AND CURB VALVES

A. Corporation Valves and Curb Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. A.Y. McDonald Mfg. Co.

b. Ford Meter Box Company, Inc. (The).
c. Mueller Co.

2. Source Limitations: Obtain corporation valves and curb valves from single manufacturer.

B. Corporation Valves: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.

1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
2. Corporation Valve: Bronze body, ground-key plug or ball, with AWWA C800, threaded inlet and outlet matching service piping material.
3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
4. Rated for a minimum service of 150 psi.

C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

1. Service Boxes for Curb Valves: ASTM A48/A48M, Class 25 cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.

a. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.6 YARD HYDRANTS

A. Yard Hydrants - Post Type: Non freeze and drainable, of length required for installation below frost line.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Woodford Manufacturing Company.
b. Hoeptner Products.
c. Murdock Manufacturing.

2. Source Limitations: Obtain yard hydrants - post type, from single manufacturer.
3. Pressure Rating: minimum operating pressure of 20 psi and maximum of 100 psi.
4. Completely sealed to prevent ground water from entering the reservoir or service line.
5. Self-Closing.
6. ASSE 1057 Sanitary Yard Hydrant certified.
7. Includes ASSE 1011 backflow preventer.
8. Riser: 1” schedule 40 galvanized riser
9. ADA Compliant: Comply with ADA requirements for height and 5-pound maximum operating force.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.2 PIPING APPLICATIONS

A. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.

B. Do not use flanges or unions for underground piping.

C. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

D. Underground water-service piping NPS 3/4 to NPS 3 to be any of the following:

1. Soft copper tube, ASTM B88, Type K; copper, pressure-seal fittings; and pressure-sealed joints.

3.3 VALVE APPLICATIONS

A. General Application: Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

3.4 INSTALLATION OF PIPING

A. Water-Main Connection:

1. Tap water main in accordance with requirements of water utility company and of size and in location indicated.

B. Make connections NPS 2 and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

C. Bury piping with depth of cover over top at least 48 inches.

D. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.5 JOINT CONSTRUCTION

A. Make pipe joints according to the following:

1. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools and procedures recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
2. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

a. Dielectric Fittings for NPS 2 and Smaller: Service insulator assembly with nylon dielectric bushing.

3.6 INSTALLATION OF VALVES

A. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.7 INSTALLATION OF YARD HYDRANTS

A. Install in accordance with manufacturer’s recommendations.

3.8 CONNECTIONS

A. Connect water-distribution piping to existing water main. Use service clamp and corporation valve.

3.9 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50 psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.10 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

3.11 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for three hours.
    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 331415

SECTION 334199

STORMWATER MANAGEMENT AS-BUILT CERTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Stormwater Management Plans and Report approved (green stamped) by the Maryland Department of the Environment.

1.2 SUMMARY

A. Section includes requirements for the inspection of stormwater management (SWM) facilities during construction activities as specified and submission of a stormwater management facility as-built certification package for each stormwater management facility constructed to the Maryland Department of the Environment within 45 calendar days of completing construction of all stormwater management facilities.

1.3 INFORMATION SUPPLIED BY THE OWNER

A. Upon written request, the Owner will provide CADD files in AutoCAD format and the approved Final SWM Report in PDF format to facilitate completion of the SWM facility as-built certification package.

1.4 STORMWATER MANAGEMENT CERTIFYING ENGINEER

A. The Contractor shall engage a Maryland registered Professional Engineer to perform the duties in this specification section.

B. The Certifying Engineer is responsible for assembling and certifying the SWM certification package. Duties include adequately documenting that the SWM facilities have been construction as specified and performing inspections during pertinent construction activities for the SWM facilities and practices. The Certifying Engineer shall be a Professional Engineer (P.E.) registered and licensed in the State of Maryland and who has at least three years of experience in SWM facility design and SWM facility construction.

C. The Certifying Engineer shall have the option to use designees, who are under the direct supervision of the Certifying Engineer, to perform the following duties on behalf of the Certifying Engineer.

1. Documenting that the SWM facilities have been constructed as specified including writing activity inspection reports, taking photographs, and obtaining copies of material approvals and material test reports.

2. Performing inspections during pertinent construction activities for the SWM facilities and practices, completing the pertinent portions of the SWM facility as-built certification data tables.

3. When the Certifying Engineer elects to use designees, submit the names and resumes indicating their experience in the design and inspection of SWM facilities, of those designees authorized by the Certifying Engineer to Certifying Engineer. Only authorized designees may represent the Certifying Engineer for the limited duties specified.

1.5 STORMWATER MANAGEMENT FACILITY AS-BUILT CERTIFICATION PACKAGE

A. The SWM facility as-built certification package contains documentation that verifies that all SWM facilities and practices on the Contact have been constructed as specified or are functionally equivalent to the designs in the approved SWM Report.

B. The SWM facility as-built certification shall include the following for each SWM facility in the Contract, presented neatly and legibly, and organized in an easy to follow format.

1. SWM facility construction inspection reports. The inspection reports shall include the following:

   a. The SWM facility deification number and type of SWM facility or practice.
   b. The date and location of the activity.
   c. Photographs, taken during inspections, that clearly show the construction activities as listed on the pertinent SWM facility as-built data tables, with narrative descriptions of what appears in the photographs, the dates of the photographs were taken, and the locations.
   d. Verification of whether SWM facility as-built construction is as specified, noting any deviations from the Contract Documents and how the deviations have been addressed.

2. Photographs of SWM facilities and practices after all landscaping has been installed and established, with narrative descriptions of what appears in the photographs.

3. Copies of pertinent material approval forms.

4. Copies of pertinent materials and installation test reports and results.

5. Completed as-built certifications data tables.

6. Green line as-built surveys of the SWM facilities and practices signed and sealed by a Professional Land Surveyor (PLS) who is registered and licensed in the State of Maryland. The as-built survey data shall be overlaid on the appropriate Contract plan sheet(s) and profile sheets, at the same scale and datum, and are coordinately correct. The as-built survey data shall be green in color, clearly legible and easily distinguishable from the Contract Document information. The SWM facility as-built surveys shall include the following:

a. **Contours.** One-foot contour intervals or otherwise match the contour intervals shown in the Contract Documents. Contours shall cover the entire footprint of the SWM facility or practice as well as inflow and outflow conveyances when ditches or similar features convey runoff into or out of SWM facilities and practices.
b. **Drainage Structures.** Includes all drainage structures within the footprint of the SWM facility, including but not limited to inlets, manholes, flow splitters, risers, weirs, end sections, headwalls, and end walls. As-built data shall include but is not limited to top of structure elevations, structure lengths, and structure widths; pipe inverts; pipe sizes, materials, and flow directions; orifice elevations; opening sizes; weir dimensions and elevations; check dam locations and dimensions; grates; and trash racks.
c. **Riprap and Aggregate.** Includes dimensions of riprap and other areas within the footprint of the SWM facility and practice that show a surface layer of aggregate or riprap, including forebays.
d. **Embankment Information.** Includes embankment heights, widths, and elevations; clay core locations, dimensions, and elevations; cut-off trench locations, dimensions, and elevations; pertinent filter diaphragm information; and pertinent pipe cradle information. Data that cannot be obtained from a field survey shall be provided by the Certifying Engineer for inclusion with the SWM facility as-built survey.
e. SWM Facility Maintenance Access Roads.
f. **Fences.** Includes fence that surrounds the footprint of the SWM facility or practice.
g. **SWM Facility Profiles.** Includes an overlay of green line as-built data on SWM facility profiles and typical sections including but not limited to check dam spacing, check dam top elevations, check dam dimensions, invert elevations, subdrain sizes, subdrain materials, aggregate and soil thicknesses, material types, clay core dimensions, and cut-off trench dimensions. Data that cannot be obtained from a field survey shall be provided by the Certifying Engineer for inclusion with the SWM facility as-built survey.
h. **Certification.** Seal, signature, license number, and date of license expiration of the PLS who completes the SWM facility as-built survey.

7. Applicable supporting computations demonstrating that the functionality of the SWM facilities and practices meet the approved designs as presented in the approved SWM Report. This is only necessary when tolerances are not met and shall include but is not limited to water surface elevations, freeboard, storage volumes, depths, and other pertinent SWM functionality data that demonstrates the SWM facility performances meets the approved design.

8. A narrative of justification for as-built deviations in SWM facilities and practices.

9. Seal, signature, license number, and date of license expiration of the Certifying Engineer.

1.6 SUBMITTALS AND APPROVAL PROCESS

1. Submittals and Approval Process

a. Copies of all submission made to the MDE shall be provided to the Owner and Architect.

b. Partial submittals of the SWM facility as- built package may be made as construction of each individual SWM facility and practice is completed. Otherwise, submit the entire SWM facility as-built package within 45 days of completion of construction activities associated with all SWM facilities and practices but not including establishment of the specified landscaping items. The landscaping phase of SWM facilities and practices need not be completed to submit the SWM facility as-built certification package for Structural Acceptance but is required for Final Approval.

2. Resubmit the SWM facility as-built package with responses to all MDE comments that may be received. Resubmit as many times as necessary, updating the SWM facility as-built package as needed to address all MDE comments, and making any field adjustments as needed to correct deficiencies, until MDE approval is obtained.

1.7 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at **Project site**.

1.8 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Certifying Engineer Documentation: Submit one copy of the Certifying Engineer's resume to the Owner and Architect that includes following information.

1. Name of Certifying Engineer.
2. Maryland professional engineering or professional surveyor license number and expiration date.
3. Name of employer.
4. Contact Information.
5. Relevant work experience.
6. Proof of valid certification of the Maryland Department of the Environment (MDE) Responsible Personnel for Erosion and Sediment Control training course (formerly "Green Card"). Note: All certifications for the former course MDE Responsible Personnel Trailing for Erosion and Sediment Control ("Green Card") expired on December 31, 2016 and are no longer valid.

C. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Weirs and Overflow Structures: Include plans, elevations, sections, and details.
3. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.

D. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Weirs and Overflow Structures: Include plans, elevations, sections, and details.
3. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.

E. LEED Submittals:

1. Product Certificates for Credit MR 5.1: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

1.9 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, testing agency.

B. Material and Product Certificates: For each type of material and product used.

C. Material Test Reports: For each material used, by a qualified testing agency.

D. Field quality-control reports.

1.10 REFERENCE DOCUMENTS

A. Maryland Department of the Maryland Approved Stormwater Management and Erosion Control Plans and Permit.

B. Maryland Department of the Environment General Permit for Stormwater Associated with Construction Related Activities.

1.11 QUALITY CONTROL

A. Inspection Agency: Contractor shall engage an independent Inspection Agency for complete inspection and testing of soils and compaction.

B. Notifications: The Contractor is required to notify the Owner and Architect 72 hours prior to the start of construction of Stormwater Management (SWM) Environmental Site Design (ESD) facilities for the purposes of the Maryland Department of the Environment As-Built requirements as indicated on the plans.

PART 2 - PRODUCTS

2.1 STORMWATER MANAGEMNET PRODUCTS AND MATERIALS

A. As indicated on the Contract Documents and Maryland Department of the Environment Approved Plans.

PART 3 - EXECUTION

3.1 STORMWATER MANAGEMENT CONSTRUCTION

A. Obtain the services from and designate a Certifying Engineer prior to beginning construction of SWM facilities and practices.

B. Failure to receive approval for the Certifying Engineer, failure to submit information about the Certifying Engineer designees, or failure of the Certifying Engineer, or the Certifying Engineer designees, to adequately monitor the specified construction activities will be grounds for replacement of the Certifying Engineer and reconstruction of all work on SWM facilities and practices that may have already been performed.

C. Perform all construction activities on SWM facilities and practices only in the presence of the Certifying Engineer or the Certifying Engineer designee. Failure to perform work in the presence of the Certifying Engineer or the Certifying Engineer designee will be grounds for removal and replacement of the Certifying, and reconstruction of all work that may have already been performed.

D. Prior to beginning or continuing construction activities of SWM facilities and practices, ensure the Certifying Engineer or the Certifying Engineer designee is present. If the Certifying Engineer or Certifying Engineer designee is not present, suspend work on SWM facilities and practices and do not resume until the Certifying Engineer or Certifying Engineer designee is present for the activities.

E. Whenever the Certifying Engineer or the Certifying Engineer designee indicates that SWM facilities and practices under construction do not match the Contract Documents, immediately correct the deficiencies before moving to the next construction activity associated with SWM facilities and practices. If it is not possible to correct deficiencies due to the site conditions or constraints and not due to negligence and inadequate quality of work, cease work on SWM facilities and notify the Owner and Architect.

F. Upon completion of constructing SWM facilities and practices, perform an as-built survey of the completed facility. Complete installation and establishment of landscaping items need not be completed to perform the as-built survey of SWM facilities and practices.

G. Submit the SWM facility as-built certification package. Update SWM facilities as- built surveys when adjustments are made to address comments that may be received.

H. No additional compensation will be considered for addressing comments received on the submitted SWM facilities as-built certification package, revisions to the SWM facility as-built certification package, or any construction activities necessary to address comments that may have been received or necessary to revise the SWM facility as-built certification package.

3.2 RESPONSIBILITY OF THE CERTIFYING ENGINEER

A. Ensure that the Certifying Engineering performs the following:

1. Is present for all activities listed on the SWM as-built certification data tables, performs duties as specified, and records requisite information for the SWM facility as-built certification package. The Certifying Engineer may elect to use a designee as specified in this section. Ensure that the data is available at the Site and on-demand.

2. Prepares written inspection reports for construction activities associated with SWM facilities and practices. The Certifying Engineer may elect to use a designee as specified in this section. The inspection reports must include the following information.

    a. The SWM facility identification number.
    b. The date and location of the activity.
    c. Photographs of the activity with narrative descriptions.
    d. Whether SWM facility construction matches the Contract Documents, noting any deviations from the Contract Documents and how the deviations are addressed. Whenever deviations occur and exceed the specified tolerances, notify the Owner and Architect.

3. Completes the SWM facility as-built certification data tables in the Contract Documents.
4. Takes photographs during construction activities of the SWM facilities and practices and of the completed SWM facilities, including photographs with completed landscape planting installation and establishment. The Certifying Engineer may elect to use a designee as specified in this section.
5. Obtains copies of material approvals for items associated with the SWM facilities and practices. The Certifying Engineer may elect to use a designee as specified in this section.
6. Obtains copies of compaction test results for SWM facility embankments. The Certifying Engineer may elect to use a designee as specified in this section.
7. Alerts the Contractor when the SWM facilities and practices under construction do not match the Contract Documents and MDE approved Plans. The Certifying Engineer may elect to use a designee as specified in this section.
8. When necessary, performs all computations that demonstrate SWM facilities and practices function in the manner as presented in the approved Final SWM Report, including with all revisions to the report that may result from Redline Revisions. At a minimum, the parameters examined by the Certifying Engineer shall include but are not limited to storage volumes, discharge rates, velocities, detention times, water surface elevations, freeboard, and all other information as recommended by the Certifying Engineer and as requested by the Owner, Architect or MDE.
9. Obtains copies of as-built surveys for the SWM facilities and practices.
10. Prepares the SWM facility as-built certification package.

3.3 STORMWATER MANAGEMENT CONSTRUCTION TOLERANCES

A. All stormwater management facilities shall be built with the specified tolerances:

1. Earthwork. Elevations within 3 in. of elevations specified in the Contract Documents.
2. Embankments, Clay Cores and Cut-off trenches. Elevations not less than the values specified.
3. Drainage Structures. Elevations within 1.2 inches (0.1 feet) of the values specified.
4. Pipe Inverts. Elevations with 1.2 inches (0.1 feet) of the values specified.
5. Riprap. Dimensions within 3 inches of dimensions specified.
6. Freeboard. Not less than the values specified.
7. Volumes. Not less than the values specified.
8. Aggregate, Sand, Bioretention Soil Mix and Mulch Thickness. Not less than the values specified.

B. When construction tolerances cannot be met due to unforeseen site conditions or constraints, ensure that calculations are performed by the Certifying Engineer before proceeding with the next construction activity associated with SWM facilities and practices. If, after performing computations, the Certifying Engineer determines that the SWM facilities do not meet the functional parameters in the approved Final SWM Report as constructed, reconstruct the SWM facilities to meet the functional parameters. If this is not possible due to the site conditions or constraints and not due to negligence and inadequate quality of work, cease work on SWM facilities and notify the Owner and Architect.

C. The Contractor shall make all necessary adjustments and repairs, at no additional cost to the owner, to bring each facility in compliance with the approved designs.

3.4 STORMWATER MANAGEMENT FACILITY MAINTENANCE

A. The Contractor shall be solely responsible for maintenance of all stormwater-related facilities until the Maryland Department of the Environment conducts the closeout inspection and releases the permit. The Contractor shall also perform any required maintenance to the facility to ensure full functionality, and any final required punch-list items as required by Owner, prior to final Owner acceptance of the facility.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.

B. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect stormwater management facilities from contamination from sediment.

END OF SECTION 334199

SECTION 334200

STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. PVC pipe and fittings.
   2. Non-pressure transition couplings.
   3. Catch basins.
   4. Pipe outlets.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

   1. Catch basins and drains. Include plans, elevations, sections, details, frames, covers, and grates.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of pipe and fitting, from manufacturer.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle catch basins and drains in accordance with manufacturer's written rigging instructions.

1.8 FIELD CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS FOR STORMWATER MANAGEMENT FACILITIES

A. Source Limitations: Obtain PVC pipe and fittings from single manufacturer.

B. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

C. PVC Type Sewer Piping:

1. Pipe: ASTM D3034, SDR 35 PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D3034, PVC with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.

D. PVC Underdrains for Stormwater Management Facilities:

1. Pipe: ASTM D3034, SDR 35 PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D3034, PVC with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.
4. Perforations: ASTM F758 or AASHTO M-278Locations: As shown on the Drawings.
5. Pipe Stiffness: PS28.

E. Adhesive Primer: ASTM F656.

2.2 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
1. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.

2. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

C. Shielded, Flexible Couplings:
1. Source Limitations: Obtain shielded, flexible couplings from single manufacturer.
2. Description: ASTM C1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

2.3 CLEANOUTS

A. Cleanouts:

1. Source Limitations: Obtain cast-iron cleanouts from single manufacturer.
2. Size and Type: As shown on the Drawings.

2.4 CONCRETE

A. General: Cast-in-place concrete in accordance with ACI 318, ACI 350, and the following:

1. Cement: ASTM C150/C150M, Type II.
2. Fine Aggregate: ASTM C33/C33M, sand.
3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.

2.5 CATCH BASINS

A. Standard PVC Catch Basins:

1. Description: The manufactured drain basin shall be manufactured from PVC pipe stock, utilizing a thermoforming process to reform the pipe stock to the specified configurations. The pipe connection stubs shall be manufactured from PVC stock and formed to provide a watertight connection with the specified pipe system.
2. The raw materials used to manufacture the pipe stock that is to be used to manufacture the main body and pipe stubs of the surface drainage inlets shall conform to ASTM D1784 cell class 12454.
3. ASTM D3212 for pressure requirements for pipe to structure connections using flexible elastomeric seals. These pipe gaskets must meet ASTM F477 requirements.
4. Size and Configuration: As indicated on the Drawings.

B. Frames and Grates: Ductile iron grates with the shape and size indicated on the Drawings. The ductile iron used for the castings shall conform to ASTM A536 grade 70-50-05. Grates and covers shall be provided painted black.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

E. Install gravity-flow, nonpressure drainage piping in accordance with the following:

1. Install piping pitched down in direction of flow.
2. Install piping with minimum cover indicated on the Drawings.
3. Install PVC sewer piping in accordance with ASTM D2321 and ASTM F1668.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping in accordance with the following:

1. Join PVC sewer piping in accordance with ASTM D2321 and ASTM D3034 for elastomeric-seal joints or ASTM D3034 for elastomeric-gasketed joints.
2. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

C. PVC Drain Basins. Install per manufacturer’s recommendations.

3.5 STORMWATER OUTLET INSTALLATION

A. Construct riprap of broken stone, as indicated.

3.6 CONCRETE PLACEMENT

A. Place cast-in-place concrete in accordance with ACI 318.

3.7 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 221413 "Facility Storm Drainage Piping."

3.8 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.9 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

3.10 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION 334200

SUMMARY - AREAS, VOLUME & EFFICIENCY

PROJECT: Greenbrier State Park Charge Station PROJECT NO: P-052-200-002

FACILITY: Greenbrier State Park - South Mountain Recreation Area
21843 National Pike, Boonsboro, MD, 21713 DATE: 23 August 2021

ARCHITECT/ENGINEER: Ziger|Snead Architects

ITEM Charge Station	AREA (SF)			
	PROGRAM	SCHEMATIC	DD	CD
GROSS AREA (Notes 1 & 2)			111 GSF	107 GSF
NET ASSIGNABLE AREA (Notes 1 & 2) (Sh. 3 to __ incl.)			59 SF	58 SF
GROSS VOLUME (Note 1)			1,022 Cu Ft	1,177 Cu Ft
EFFICIENCY FACTOR (Note 3) % EFFICIENCY (Note 4)			1.88 53%	1.84 54%
SUBMISSION DATE (Note 5)			20/10/30	21/08/23

NOTES:

1. Gross Areas, Net Assignable Areas and Volumes shall be calculated in strict accordance with DGS Procedure Manual Appendix D.

2. Attach additional sheets as follows: Sheet 2 - Tabulation of Gross Areas; Sheet 3 (repeated as needed) - Tabulation of Net Assignable Areas (Room by Room).

3. To obtain Efficiency Factor: Divide Gross Area by Net Assignable Area (e.g. 49,209 SF Gross Area divided by 33,705 SF Net Assignable Area = 1.46).

4. To obtain % Efficiency: Divide Net Assignable Area by Gross Area and multiply by 100 (e.g. 33,705 SF Net Assignable Area divided by 49,209 SF Gross Area multiplied by 100 = 68.5% Efficiency).

5. Submit in triplicate to the DGS Project Manager with each phase submission of review documents. Figures shall be shown for all previous phases as well as the current phase submitted.

TABULATION OF GROSS AREA

PROJECT: Greenbrier State Park Charge Station PROJECT NO: P-052-200-002

FACILITY: Greenbrier State Park - South Mountain Recreation Area
21843 National Pike, Boonsboro, MD, 21713 DATE: 23 August 2021

ARCHITECT/ENGINEER: Ziger|Snead Architects

DESCRIPTION	GROSS AREA (SF)			
	PROGRAM	SCHEMATIC	DD	CD
Utility Tunnels (Within 10 feet)				
Crawl Space (6 feet or more high)				
Sub-Basement				
Basement				
Ground Floor				
Mezzanine				
Balcony				
Fixed Bleachers (w/rooms below)				
1st Floor			89 GSF	89 GSF
2nd Floor				
3rd Floor				
4th Floor				
Other				
Other				
Mezzanine (Boiler or Equip. Room)				
Penthouses (Stairs, Elev., Mech.)				
Areaways (1/2)				
Canopies (1/2)				
Roof or Floor				
Overhangs (1/2)			22 GSF	18 GSF
Open piazza under bldg. (1/2)				
Covered Balcony (1/2)				
Loading Dock (1/2)				
TOTALS			**111 GSF**	**107 GSF**

SUMMARY - AREAS, VOLUME & EFFICIENCY

PROJECT: Greenbrier State Park Charge Station
PROJECT NO: P-052-200-002

FACILITY: Greenbrier State Park - South Mountain Recreation Area
21843 National Pike, Boonsboro, MD, 21713
DATE: 23 August 2021

ARCHITECT/ENGINEER: Ziger|Snead Architects

Room No.	DESCRIPTION	NET ASSIGNABLE AREAS (SF)			
		PROGRAM	SCHEMATICS	DD'S	CD'S
200	CHARGE STATION			59	58
Total (This Sheet)					
GRAND TOTAL (Sheet 3 to ____)				**59 SF**	**58 SF**

SUMMARY - AREAS, VOLUME & EFFICIENCY

PROJECT: Greenbrier State Park Charge Station PROJECT NO: P-052-200-002

Greenbrier State Park - South Mountain Recreation Area

FACILITY: 21843 National Pike, Boonsboro, MD, 21713 DATE: 23 August 2021

ARCHITECT/ENGINEER: Ziger|Snead Architects

ITEM Camper Registration Station	AREA (SF)			
	PROGRAM	SCHEMATIC	DD	CD
GROSS AREA (Notes 1 & 2)			1,095 GSF	1,067 GSF
NET ASSIGNABLE AREA (Notes 1 & 2) (Sh. 3 to __ incl.)			650 SF	647 SF
GROSS VOLUME (Note 1)			13,470 Cu Ft	16,005 Cu Ft
EFFICIENCY FACTOR (Note 3)			1.68	1.65
% EFFICIENCY (Note 4)			59%	61%
SUBMISSION DATE (Note 5)			20/10/30	21/08/23

NOTES:

1. Gross Areas, Net Assignable Areas and Volumes shall be calculated in strict accordance with DGS Procedure Manual Appendix D.

2. Attach additional sheets as follows: Sheet 2 - Tabulation of Gross Areas; Sheet 3 (repeated as needed) - Tabulation of Net Assignable Areas (Room by Room).

3. To obtain Efficiency Factor: Divide Gross Area by Net Assignable Area (e.g. 49,209 SF Gross Area divided by 33,705 SF Net Assignable Area = 1.46).

4. To obtain % Efficiency: Divide Net Assignable Area by Gross Area and multiply by 100 (e.g. 33,705 SF Net Assignable Area divided by 49,209 SF Gross Area multiplied by 100 = 68.5% Efficiency).

5. Submit in triplicate to the DGS Project Manager with each phase submission of review documents. Figures shall be shown for all previous phases as well as the current phase submitted.

TABULATION OF GROSS AREA

PROJECT: Greenbrier State Park Charge Station PROJECT NO: P-052-200-002

FACILITY: Greenbrier State Park - South Mountain Recreation Area
21843 National Pike, Boonsboro, MD, 21713 DATE: 23 August 2021

ARCHITECT/ENGINEER: Ziger|Snead Architects

DESCRIPTION	GROSS AREA (SF)			
	PROGRAM	SCHEMATIC	DD	CD
Utility Tunnels (Within 10 feet)				
Crawl Space (6 feet or more high)				
Sub-Basement				
Basement				
Ground Floor				
Mezzanine				
Balcony				
Fixed Bleachers (w/rooms below)				
1st Floor			810 GSF	789 GSF
2nd Floor				
3rd Floor				
4th Floor				
Other				
Other				
Mezzanine (Boiler or Equip. Room)				
Penthouses (Stairs, Elev., Mech.)				
Areaways (1/2)				
Canopies (1/2)				
Roof or Floor				
Overhangs (1/2)			150 GSF	143 GSF
Open piazza under bldg. (1/2)			135 GSF	135 GSF
Covered Balcony (1/2)				
Loading Dock (1/2)				
TOTALS			**1,095 GSF**	**1,067 GSF**

SUMMARY - AREAS, VOLUME & EFFICIENCY

PROJECT: Greenbrier State Park Charge Station
PROJECT NO: P-052-200-002

FACILITY: Greenbrier State Park - South Mountain Recreation Area
21843 National Pike, Boonsboro, MD, 21713

DATE: 23 August 2021

ARCHITECT/ENGINEER: Zigler|Snead Architects

Room No.	DESCRIPTION	NET ASSIGNABLE AREAS (SF)			
		PROGRAM	SCHEMATICS	DD'S	CD'S
100	LOBBY			145	142
101	VENDING/INFORMATION			97	98
102	OPEN OFFICE			132	131
103	ALCOVE				
103A	STORAGE				
104	RESTROOM			49	46
105	OFFICE			227	230
Total (This Sheet)					
GRAND TOTAL (Sheet 3 to ____)				**650 SF**	**647 SF**

BUILDING CODE STUDY DATA

DESIGN PHASE ☐ SD ☐ DD ■ CD DATE: 23 August 2021

1) PROJECT: Greenbrier State Park Charge Station PROJECT NO.: P-052-200-002

FACILITY: Greenbrier State Park - South Mountain Recreation Area
21843 National Pike, Boonsboro, MD, 21713

2) APPLICABLE CODES

A) Building Code:	IBC - 2018
	IRC - 2018
	IEBC - 2018
B) Fire Code:	NFPA - 101 (Life Safety Code) 2018
	NFPA - 1 (Fire Code) 2018
	NFPA - 13 (Sprinkler Code) 2016
C) Fire Alarm	NFPA - 72 - 2016
D) Mechanical Code	IMC - 2018
E) Plumbing Code	International Standard Plumbing Code - 2018
F) Electric Code	NEC - 2017
G) Energy Standard	ASHRAE 90.1 (Latest Edition)
H) Energy Conservation Code	IECC - 2018
I) Elevator and Escalator Safety Code	ANSI/ASME A17.1 2016
J) Accessibility Code	MAC (COMAR 05.02.02)
	ADA Standards - 2010
K) Other	AASHTO/AISC/ACI (Latest Edition)
L) Fuel Gas Code	IFGC - 2018

3) BUILDING USE, CONSTRUCTION CLASSIFICATIONS AND HEIGHT

		IBC 2018	NFPA 2018 (Chapter 6)
Use Group	(Section 302)	Business	6.1.11 - Business
Special use and Occupancy	(Chapter 4)	N/A	
Building Height Allowable	(Table 504.3)	55'	
Number of Stories Allowable	(Table 504.4)	3	
Allowable Area Factor	(Table 506.2)	23,000 SF	
Actual Building Height		19'	
Unlimited Area Building	(Section 507)	N/A	
Required Separation for Mixed Use Occupancy	(Table 508.4)	N/A	
Incidental Use Areas	(Table 509)	N/A	
Fire Separation Distance	(Table 602)	0	

4) BUILDING AREAS

BUILDING ACTUAL GROSS AREAS

First Floor	1,174 GSF
Second Floor	N/A
Third Floor	N/A
Mech. Penthouse	N/A
Total (GSF)	1,174 GSF

MAXIMUM ALLOWABLE AREAS

23,000	+	(23,000 X .75)
Per IBC Table 506.2	Allowable Area Factor	Frontage increase (506.3)

BUILDING AREA MODIFICATION: 40,250
Total Area Per Floor (506.2)

5) OCCUPANCY LOADS

	IBC (Table 1004.5)	LIFE SAFETY (Table - 7.3.1.2)
USE	Business - 150 gross	

6) EGRESS WIDTH

	IBC (Section 1005)	LIFE SAFETY (Table - 7.2.2.2 7.2.2.1)	PROVIDED
Egress Width at Stairs (1005.3.1)	N/A - no stairs	N/A - no stairs	
Egress Width at Doors (1005.3.2)	.2"/occupant	32" minimum	37" and 33"
Egress Width at Corridors (1005.3.4)	N/A - no corridor		

7) OCCUPATION LOADS AND EGRESS REQUIREMENTS

Location (Spaces)	Camper Registration Station	Charge Station
Area in Sq. Feet	810 GSF	90 GSF
Maximum Floor Area Allowance Per Occupant (1004.5)	150 gross	150 gross
Allowance Per Occupant:	6	1
Egress Width Required. (1005)	1.2"	0.2"
Egress Width Provided (In Inches)	37"	33"
Number Exits Required (1006.3.2)	1	1
Number Exits Provided	1	1

8) FIRE PROTECTION AND LIFE SAFETY SYSTEM REQUIREMENTS

	IBC	System Req. (Yes/No)	IBC 2018 Reference	NFPA 101-2018 Reference
Automatic Sprinklers	(Sec. 903)	No	903.2	
Fire Extinguishing System	(Sec. 904)	No	904	
Standpipe System	(Sec. 905)	No	905.3.1-905.3.8	
Portable Fire Extinguishers	(Sec. 906)	Yes	906.1	
Fire Alarm System	(Sec. 907)	No	907.2.2	
Emergency Alarm System	(Sec. 908)	No	908	
Smoke Control System	(Sec. 909)	No	909	
Smoke and Heat Vents	(Sec. 910)	No	910	
Fire Command Center	(Sec. 911)	No	911.1	
Fire Department Connection	(Sec. 912)	No	912	
Fire Pumps	(Sec. 913)	No	913	
Emergency Safety Features	(Sec. 914)	No	914	
Carbon Monoxide Detection	(Sec. 915)	No	915.1.1	

9) MAXIMUM DEAD END / DISTANCE

Use Group	Business
IBC - 2018 (Table 1020.4)	20 ft
NFPA - 2018	20 ft

10) INTERIOR FINISH REQUIREMENTS

		Class	Flame Spread	Smoke Development
IBC – 2018	(Table - 803.13/Sec. 803.1.2)	C	76-200	0-450
NFPA – 2018	(Chapter 10)	C	76-200	0-450

11) MAXIMUM TRAVEL DISTANCE TO EXIT

Actual: Show on Life Safety Plan

	IBC – 2018 (Table – 1017.2)	NFPA - 2018 (Sec. 7.6.1)
Allowable	200 ft	100 ft if there is a single exit

12) MINIMUM CORRIDOR WIDTH REQUIREMENTS

Occupancy (Table 1020.2)	Width	2018 IBC Reference	NFPA – 101 (2018) Reference
<50	36 in	Table 1020.2	

13) CORRIDOR FIRE RESISTANCE RATING (Table 1020.1)

Occupancy Load	Fire Resistance Rating (Sprinkler)	Fire Resistance Rating (Non-Sprinkler)
greater than 30	0	1

14) PANIC HARDWARE

Location	Required	IBC – 2018 Reference (1010.1.10)	NFPA- 101 - 2018 Reference (7.2.1.7)
Main exit	not required - low occupancy	occupant load <50	

15) STAIR DATA

	IBC 2018	NFPA - 101 2018 (Table 7.2.1.7)
Stair Width (Section 1009.3)	N/A - no stairs	
Capacity		
Rated Enclosure (1023.2)		

16) AREA OF REFUGE

(Section 1009.6) ☐ Yes ■ No
(NFPA Sec. 7.2.12.3.5.1)

17) ELEVATOR

IBC 2018	NFPA 2018	ASME A17.1 2018
N/A - no elevator		

18) BUILDING FIRE RATINGS

	IBC – 2018 (Table 601 - 602)	NFPA - 2018 (Table 8.3.3.2.2)
STRUCTURAL FRAME		
Including Columns, Girders, Trusses	0	0
EXTERIOR BEARING WALL	0	0
EXTERIOR NON-BEARING WALL	0	0
INTERIOR BEARING WALL	0	0
INTERIOR NON-BEARING WALL	0	0
FLOOR CONSTRUCTION		
Including Supporting Beams and Joists	0	0
ROOF CONSTRUCTION		
Including Supporting Beams and Joists	0	0
FIRE WALLS - USE GROUP		
Fire Barrier Assemblies (Table 707.3.10)	N/A - not req'd.	N/A - not req'd.
Fire Resistance Rating (Table 706.4)	N/A - not req'd.	N/A - not req'd.
VERTICAL EXIT ENCLOSURES		
Fire Resistance Rating (IBC Section 1023.2)		
(NFPA 2018 - Table 8.3.3.2.2)	N/A - no stairs	N/A - no stairs
SHAFTS AND ELEVATOR HOISTWAYS		
Fire Resistance Rating (IBC Section 712 & 713)		
(NFPA 2018 - Table 8.3.3.2.2)	N/A - no elevator	N/A - no elevator
EXIT PASSAGEWAY *(Section 1024)*	N/A - not req'd.	N/A - not req'd.
SMOKE BARRIER *(Section 709)*	N/A - not req'd.	N/A - not req'd.
EXIT DISCHARGE *(Section 1028)*	N/A - not req'd.	N/A - not req'd.
PROTECTIVE OPENING RATING	N/A - not req'd.	N/A - not req'd.
FIRE DOOR		
Fire Resistance Rating (Table 716.5)	N/A - not req'd.	N/A - not req'd.
FIRE WINDOWS		
Fire Resistance Rating (Table 716.1)	N/A - not req'd.	N/A - not req'd.
DRAFT STOPPING		
Concealed Spaces (Section 718)	N/A - not req'd.	N/A - not req'd.

19) MARYLAND HIGH PERFORMANCE BUILDING ACT

New public construction and major renovation projects of 7,500 square feet or greater, shall be designed to earn a LEED Silver Certification from the U.S. Green Building Council.

20) ENERGY CODE

IECC - 2018

MARYLAND CLIMATE ZONE 4A
EXCEPT GARRETT COUNTY 5A

BUILDING ENVELOPE REQUIREMENT

	'U' Value U=1/R	'R' Value R=1/U	Provided
Roofs			
Insulation entirely above deck	U 0.032	R 30 CI*	-
Metal Building	U 0.035	I9+11	-
Attic Insulation	U 0.027	R 38	R38 minimum
Walls			
Mass	U 0.104	R 9.5 CI*	-
Metal Framed	U 0.064	R 13+R7.5 CI	-
Metal Building	U 0.052	R 13+R13 CI	-
Wood Framed	U 0.064	R 13+R3.8 CI or R20	R20
Below-Grade Wall	U 0.119	R 7.5 CI*	-
Joist Framing (steel or wood)	U 0.033	R 30	-
Slab on Grade			
Heated Slab	F 0.65	R 15 for 24" below	-
Unheated Slab	F 0.54	R 10 for 24" below	R10 for 24" below
Doors			
Entrance Door	U 0.77	R 1.29	-
Un-Insulated Metal Door	1.20	R 1.66	-
Insulated Metal Door	0.60		
Wood Door	0.50	R 2.00	R2 minimum
Windows			
Fixed Fenestration	U 0.38	R 2.63	R2.63 minimum
Operable Fenestration	U 0.45	R 2.22	R2.22 minimum
Skylight	U 0.50	R 2.0	
Curb	U 0.20	R 5.0	
Minimum Roof Reflectance/Emittance			
(3 yr. Aged) Solar Reflectance	0.55		.55 minimum
(3 yr. Aged) Thermal Emittance	0.75		.75 minimum

**CI=Insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings)*

NOTE: The building thermal envelope shall be represented on the Construction Drawings.

PROJECT DESCRIPTION SHEET

DESIGN PHASE: ☐ DD ☐ 95% CD ■ 100%CD **DATE:** 23 August 2021

PROJECT: Greenbrier State Park Charge Station **PROJECT NO:** P-052-200-002

FACILITY: Greenbrier State Park - South Mountain Recreation Area
21843 National Pike, Boonsboro, MD, 21713

ARCHITECT: Ziger|Snead Architects

ENGINEERS: Civil: A. Morton Thomas and Associates; Landscape: Floura Teeter Landscape Architects;
MEP: James Posey Associates; Structural: Albrecht Engineering; Geotechnical: Schnabel Engineering

A. DESCRIPTION New Charge Station: Wd-framed building above SOG, with stone veneer cladding and asphalt shingle roof. 2 total - data below references single building.

B. OCCUPANCY: Ticket collection - staffed by one (1).

C.	GROSS AREA (SF)	NET ASSIGNABLE AREA (SF)	PERIMETER WALLS (SF)
Basement			
Floor 1	107 GSF	58 GSF	385 SF
Mezzanine			
Floor 2			
Floor 3			
Penthouse			
Covered Atrium			
TOTALS	107 GSF	58 GSF	385 SF

D. TOTAL VOLUME 1,177 Cu Ft **cubic feet**

E. EFFICIENCY: 1.84

ASSIGNABLE AREA / GROSS AREA = X .54 100 = 54 % E EFF.

GROSS AREA / ASSIGNABLE AREA = 1.84 Efficiency Factor

F. REMARKS: The project includes an automated pay station and articulating arm for lane control.

G. ADA: The facility will be ADA accessible.

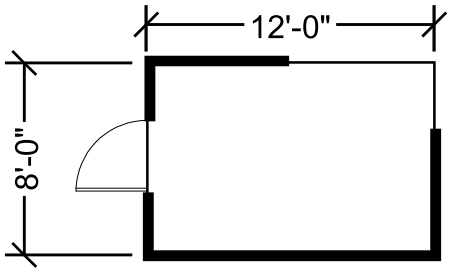
H. HAZMAT REMOVAL REQUIRED: N/A - new construction

PROJECT DESCRIPTION SHEET

CONSTRUCTION

1. Foundations	CIP Slab on grade with turned-down slab edges
2. Structural	Wd framing
3. Exterior Walls	Bearing, wood with continuous insulation, stone veneer with air space.
4. Partitions	N/A
5. Floors	Slab-on-grade
6. Floor Finish	Sealed Concrete
7. Ceilings	Gypsum Board
8. Roof	Pitched wood framed roof
9. Roof Finish	asphalt shingles
10. Wall Finish	abuse-resistant gypsum bd
11. Doors & Frames	solid core wd doors, Wd frames
12. Windows	Aluminum-clad wood windows, fixed and sliding
13. Toilet Room Partitions	N/A
14. Plumbing	0 Total # Fixtures _____ WC _____ SH _____ DF _____ OTHER _____ LAV _____ SS _____ UR
15. Sewers	Sanitary: N/A Storm: _____ Septic:
16. Water Supply	N/A
17. Fire Protection	Fire Extinguishers
18. Heating	
19. Heating Plant	
20. Ventilation	
21. Air Conditioning	Tons: %
22. Electric	
23. Special Electric	
24. Site Electric	
25. Elevators	N/A
26. Parking Lots	
27. Roads	**Curbs**
28. Walks & Steps	
29. Built-in Equipment	Countertop for work station
30. Site Specialties	

SKETCH



PROJECT DESCRIPTION SHEET

DESIGN PHASE: ☐ DD ☐ 95% CD ■ 100%CD **DATE:** 23 August 2021

PROJECT: Greenbrier State Park Charge Station **PROJECT NO:** P-052-200-002

FACILITY: Greenbrier State Park - South Mountain Recreation Area
21843 National Pike, Boonsboro, MD, 21713

ARCHITECT: Ziger|Snead Architects

ENGINEERS: Civil: A. Morton Thomas and Associates; Landscape: Floura Teeter Landscape Architects;
MEP: James Posey Associates; Structural: Albrecht Engineering; Geotechnical: Schnabel Engineering

A. DESCRIPTION Renovated Camper Registration Building: CMU and wd-framed building above SOG, with stone veneer cladding and asphalt shingle roof.

B. OCCUPANCY: Office and Registration building - staffing 2-3 people

C.	GROSS AREA (SF)	NET ASSIGNABLE AREA (SF)	PERIMETER WALLS (SF)
Basement			
Floor 1	1,067 GSF	647 GSF	1,206 SF
Mezzanine			
Floor 2			
Floor 3			
Penthouse			
Covered Atrium			
TOTALS	1,067 GSF	647 GSF	1,206 SF

D. TOTAL VOLUME 16,005 Cu Ft **cubic feet**

E. EFFICIENCY: 1.65

ASSIGNABLE AREA / GROSS AREA = X .61 100 = 61 % E EFF.

GROSS AREA / ASSIGNABLE AREA = 1.65 Efficiency Factor

F. REMARKS: The project includes a covered porch to provide a protected location for campers to procure firewood and ice.

G. ADA: One accessible restroom will be provided.

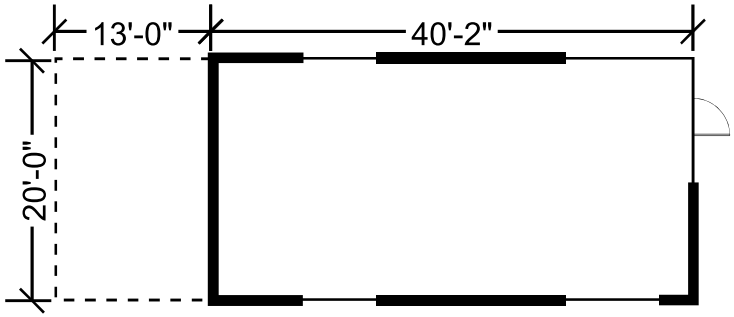
H. HAZMAT REMOVAL REQUIRED: Unknown - existing drawings show asbestos floor tile.

PROJECT DESCRIPTION SHEET

CONSTRUCTION

1. Foundations	Existing
2. Structural	Exist CMU, new CMU, wd framing
3. Exterior Walls	Bearing, block and stone veneer, interior furring with insulation,
4. Partitions	Fixed - mixed bearing, wood stud with abuse-resistant gypsum bd
5. Floors	2" topping slab above existing slab-on-grade
6. Floor Finish	Sealed Concrete
7. Ceilings	Gypsum bd
8. Roof	Pitched wood framed roof
9. Roof Finish	asphalt shingles
10. Wall Finish	abuse-resistant gypsum bd
11. Doors & Frames	solid core wd doors, wd frames
12. Windows	Aluminum-clad wd windows, fixed and casement
13. Toilet Room Partitions	Tile at wet wall only, water-resistant gypsum board
14. Plumbing	3 Total # Fixtures 1 WC ____ SH ____ DF 1 HB (exist) OTHER 1 LAV ____ SS ____ UR
15. Sewers	Sanitary: 6" Existing Storm: ____ Septic:
16. Water Supply	Existing 2" service
17. Fire Protection	Fire Extinguishers
18. Heating	
19. Heating Plant	
20. Ventilation	
21. Air Conditioning	Tons: %
22. Electric	
23. Special Electric	
24. Site Electric	
25. Elevators	N/A
26. Parking Lots	
27. Roads	**Curbs**
28. Walks & Steps	
29. Built-in Equipment	Cabinetry
30. Site Specialties	

SKETCH



APPENDIX B: CODE ANALYSIS

APPLICABLE CODES AND STANDARDS

State of Maryland, Department of Labor, in compliance with COMAR 09.12.50.

International Building Code (IBC), 2018 Edition
International Existing Building Code (IEBC) 2018 Edition

International Mechanical Code (IMC), 2018 Edition, COMAR 09.15.02,
International Standard Plumbing Code, 2018 Edition, COMAR 09.20.01.01, COMAR 09.20.01.02
National Electrical Code, 2017 Edition
International Fuel Gas Code, 2018 Edition
International Energy Conservation Code (IECC), 2018 Edition

NFPA 101: Life Safety Code, 2018 Edition
NFPA 1: Fire Code, 2018 Edition
NFPA 13: Sprinkler Code, 2016 Edition
NFPA 72: 2016 Edition

ASHRAE 90.1 - Latest Edition
ANSI/ASME A17.1, 2016 Edition
Accessibility Code: MAC COMAR 05.02.02 and ADA Standards - 2010
AASHTO/AISC/ACI (Latest Edition)

Occupational Safety and Health Act (OSHA)
SMACNA HVAC Duct Construction Standards - Metal and Flexible
SMACNA Rectangular Industrial Duct Construction Standards
SMACNA Round Industrial Duct Construction Standards

A. BUILDING STATISTICS

Areas in Square Feet:

Camper Registration Station =	810 GSF
Charge Station =	89 GSF
Charge Station =	89 GSF
Total =	988 GSF

B. FIRE SAFETY FEATURES

Automatic Fire Detection System
Fire Extinguishers

C. IBC CODE ANALYSIS

1) USE AND OCCUPANCY CLASSIFICATION (IBC CHAPTER 3)

Office:
IBC Section 304.1 Business Group B.

2) GENERAL BUILDING HEIGHTS AND AREAS (IBC CHAPTER 5)

a) IBC table 504.3 (Group B – Type IIB)

Non-sprinklered:

Height and Area Limitations - Type IIB:
55' Height
3 Stories
23,000 SF per Level

Actual Height and Area - Registration Station:
19'-0" Height
810 SF Footprint

Actual Height and Area - Charge Station:
14'-0" Height
89 SF Footprint

3) TYPES OF CONSTRUCTION (IBC CHAPTER 6)

a) Fire Resistance (Table 601 – Type IIB)
i. Structural Frame = 0 Hrs
ii. Bearing Walls Exterior = 0 Hrs
iii. Bearing Walls Interior = 0 Hrs
iv. Non-Bearing Walls Exterior = 0 Hrs (Table 602, X ≥ 30)
v. Non-Bearing Walls Interior = 0 Hrs
vi. Floor Construction = 0 Hrs
vii. Roof Construction = 0 Hrs

4) FIRE AND SMOKE PROTECTION FEATURES (IBC CHAPTER 7)

a) Exterior Walls (Section 705)
i. (705.2.1) Projections from Type I or II Construction shall be of noncombustible materials or combustible materials as allowed by Sections 1406.3 and 1406.4.
ii. (705.8.1, Exception 2) Buildings whose exterior bearing walls, exterior nonbearing walls and exterior primary structural frame are not required to be fire-resistance rated shall be permitted to have unlimited unprotected openings.
iii. (705.8.3) Unprotected openings. Where unprotected openings are permitted, windows and doors shall be constructed of any approved materials. Glazing shall conform to the requirements of Chapters 24 and 26.

5) INTERIOR FINISHES (IBC CHAPTER 8)

a) Wall and Ceiling Finishes (Table 803.11) For B in Non-Sprinklered Buildings
   i. Interior exit stairways & exit passageways: A
   ii. Corridors and enclosure for exit access stairways: B
   iii. Rooms and enclosed spaces: C

Class A: Flame spread index 0-25; smoke developed index 0-450.
Class B: Flame spread index 26-75; smoke developed index 0-450.
Class C: Flame spread index 76-200; smoke developed index 0-450.

6) MEANS OF EGRESS (CHAPTER 10)

a) Table 1004.1.1 Maximum Floor Area Allowances Per Occupant:

FLOOR LEVEL	AREA	OCCUPANCY CLASSIFICATION	TOTAL OCCUPANTS
Registration Station	810	Business - Office 150 gross	6
Charge Station 1	89	Business - Office 150 gross	1
Charge Station 2	89	Business - Office 150 gross	1

b) Means of Egress Sizing (Section 1005)
   i. Other egress components: 0.2"/occupant
c) Number of Exits and Exit Access Doorways (Section 1006)
   i. Occupancy B - One Exit or Exit Access Doorway (Table 1006.2.1)
      - Maximum Occupant Load of Space: 49
      - Maximum Common Path of Egress Travel Distance, Occupant load ≤30: 100 Feet
d) Accessible Means of Egress (Section 1009)
   i. Shall be provided with not less than one accessible means of egress.
   ii. (1009.2) Each required accessible means of egress shall be continuous to a public way and shall consist of one or more of the following components:
      1. Accessible routes complying with Section 1104.
      2. Interior exit stairways complying with Sections 1009.3 and 1023.
      3. Exit access stairways complying with Sections 1009.3 and 1019.3 or 1019.4.
      4. Exterior exit stairways complying with Sections 1009.3 and 1027 and serving levels other than the level of exit discharge.
      5. Elevators complying with Section 1009.4.
      6. Platform lifts complying with Section 1009.5.
      7. Horizontal exits complying with Section 1026.
      8. Ramps complying with Section 1012.
      9. Areas of refuge complying with Section 1009.6.
      10. Exterior areas for assisted rescue complying with Section 1009.7 serving exits at the level of exit discharge.

e) Exit Access Travel Distance (Section 1017)
    i. Exit Access Travel Distance for B without sprinkler system: 200'-0"
f) Corridors (Section 1020)
    i. A fire resistance rating is not required for corridors in an occupancy in Group B that is a space requiring only a single means of egress complying with Section 1006.2 (less than 30 people).
    ii. Corridors shall be a minimum width of 44" (1020.2).
    iii. Corridors may be minimum width of 36" with an occupant load less than 50 (1020.2).
    iv. Where more than one exit or exit access doorway is required, the exit access shall be arranged such that there are no dead ends in corridors more than 20'-0.

E. PLUMBING

1) PLUMBING FIXTURE SCHEDULE (IBC TABLE 2902.1)

BUILDING TYPE	REGISTRATION STATION	CHARGE STATION	TOTAL OCCUPANTS
OCCUPANTS	6	2	8

TYPE	NUMBER OF OCCUPANTS	W.C. Male	W.C. Female	LAVS Male	LAVS Female	DRINKING FOUNTAIN	SERVICE SINK
B	100/2 = 50 Occupants per gender	.16	.16	.16	.16	-	
	LEVEL 1 – TOTAL FIXTURES	1		1		-	-

Table 403.1.e - For Business and Mercantile classifications with an occupant load of 15 or fewer, service sinks shall not be required.

410.2 - Small Occupancies - Drinking Fountains shall not be required for an occupant load of 15 or fewer.

APPENDIX C:

GREENBRIER STATE PARK
REGISTRATION AND CHARGE STATION

Structural Design Calculations

For DGS Review

Structural Engineer: Albrecht Engineering, Inc

Table of Contents

Albrecht Engineering Project # 2019-031.01

Date: July 30, 2021

Designed by: Evelyn Bravo, PE

ALBRECHT ENGINEERING INC

3500 Boston Street
Suite 329 MS-12
Baltimore, MD 21224
410-522-5870

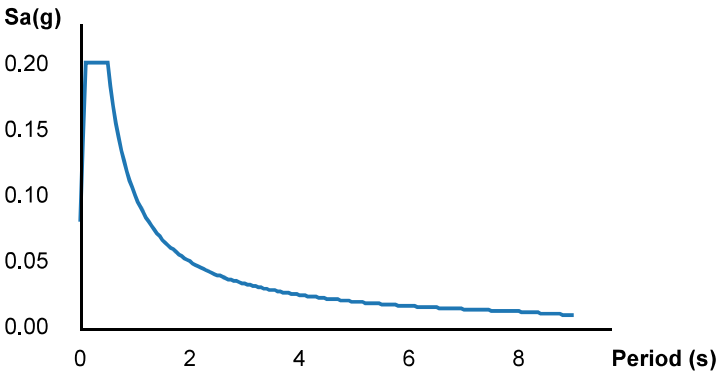
Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 23393, Expiration Date: 8/25/2016.

Hazards by Location

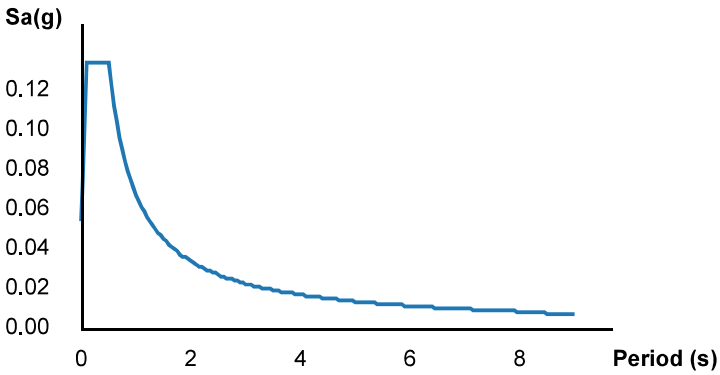
Search Information

Address:	21843 National Pike, Boonsboro, MD 21713, USA
Coordinates:	39.5350224, -77.61799529999999
Elevation:	901 ft
Timestamp:	2021-03-25T16:14:50.166Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	II
Site Class:	D-default

MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	0.126	MCE_R ground motion (period=0.2s)
S_1	0.042	MCE_R ground motion (period=1.0s)
S_{MS}	0.202	Site-modified spectral acceleration value
S_{M1}	0.101	Site-modified spectral acceleration value
S_{DS}	0.134	Numeric seismic design value at 0.2s SA
S_{D1}	0.067	Numeric seismic design value at 1.0s SA

Additional Information

Name	Value	Description
SDC	B	Seismic design category
F_a	1.6	Site amplification factor at 0.2s
F_v	2.4	Site amplification factor at 1.0s

CR_S	0.944	Coefficient of risk (0.2s)
CR_1	0.925	Coefficient of risk (1.0s)
PGA	0.065	MCE_G peak ground acceleration
F_{PGA}	1.6	Site amplification factor at PGA
PGA_M	0.103	Site modified peak ground acceleration
T_L	8	Long-period transition period (s)
SsRT	0.126	Probabilistic risk-targeted ground motion (0.2s)
SsUH	0.134	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.042	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.046	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.5	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

While the information presented on this website is believed to be correct, ATC and its sponsors and contributors assume no responsibility or liability for its accuracy. The material presented in the report should not be used or relied upon for any specific application without competent examination and verification of its accuracy, suitability and applicability by engineers or other licensed professionals. ATC does not intend that the use of this information replace the sound judgment of such competent professionals, having experience and knowledge in the field of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the results of the report provided by this website. Users of the information from this website assume all liability arising from such use. Use of the output of this website does not imply approval by the governing building code bodies responsible for building code approval and interpretation for the building site described by latitude/longitude location in the report.

Hazards by Location

Search Information

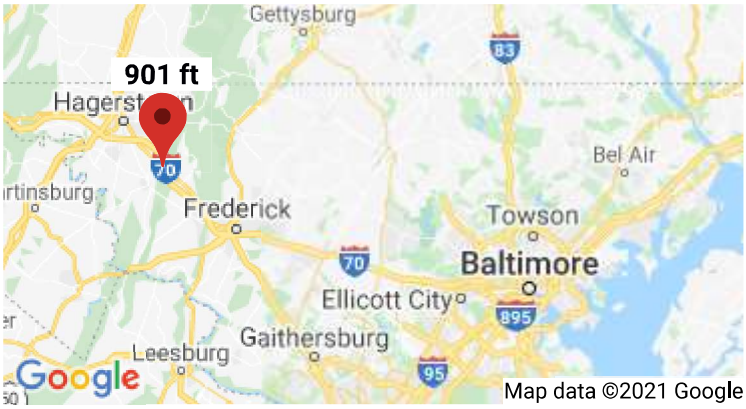
Address: 21843 National Pike, Boonsboro, MD 21713, USA

Coordinates: 39.5350224, -77.61799529999999

Elevation: 901 ft

Timestamp: 2021-03-25T16:12:56.964Z

Hazard Type: Wind



ASCE 7-16

MRI 10-Year	75 mph
MRI 25-Year	80 mph
MRI 50-Year	87 mph
MRI 100-Year	93 mph
Risk Category I	101 mph
Risk Category II	110 mph
Risk Category III	118 mph
Risk Category IV	124 mph

ASCE 7-10

MRI 10-Year	76 mph
MRI 25-Year	84 mph
MRI 50-Year	90 mph
MRI 100-Year	96 mph
Risk Category I	105 mph
Risk Category II	115 mph
Risk Category III-IV	120 mph

ASCE 7-05

ASCE 7-05 Wind Speed	90 mph

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

While the information presented on this website is believed to be correct, ATC and its sponsors and contributors assume no responsibility or liability for its accuracy. The material presented in the report should not be used or relied upon for any specific application without competent examination and verification of its accuracy, suitability and applicability by engineers or other licensed professionals. ATC does not intend that the use of this information replace the sound judgment of such competent professionals, having experience and knowledge in the field of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the results of the report provided by this website. Users of the information from this website assume all liability arising from such use. Use of the output of this website does not imply approval by the governing building code bodies responsible for building code approval and interpretation for the

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Charge Station				
Subject	Design Loads			Job No.	2019-031.01
				Sheet No.	1 of
Computed By	EB	Date	3/25/2021	Checked By	Date

DESIGN LOADS

Design Basis: ASCE 7-16

Roof Dead Load

Weight of roofing & insulation =	2	psf
Weight of plywood deck =	2.5	psf
Weight of wood framing =	2.5	psf
Weight of collateral =	1	psf
Roof DL, W_{DL} =	8	psf

Ceiling Dead Load

Weight of wood framing =	2.5	psf
Weight of gypboard ceiling =	2.5	psf
Weight of MEP piping and lighting =	2	psf
Weight of collateral =	0	psf
Roof DL, W_{DL} =	7	psf

Roof Live Load

Roof, W_{LL} =	30	psf

Wall Dead Load

Weight of 5" stone veneer =	50	psf
Weight of 4" stud wall =	10	psf
Wall W_{DL} =	60	psf

Snow Load

Ground Snow Load, p_g =	40	psf	
Snow Importance Factor, I_s =	1.0		
Roof Design Snow Load, W_s =	30.3	psf	*See TEDDS*

Wind Load

Basic Wind Speed, V =	110	mph
Basic Wind Speed, Vasd =	90	mph

Seismic Load

Seismic Design Category, SDC =	B

SNOW LOADING

In accordance with ASCE7-10

Tedds calculation version 1.0.09

Building details

Roof type	Hip and gable
Width of roof (left on elevation)	b_1 = **5.00** ft
Width of roof (right on elevation)	b_2 = **5.00** ft
Slope of roof (left on elevation)	α_1 = **37.00** deg
Slope of roof (right on elevation)	α_2 = **37.00** deg

Ground snow load

Ground snow load (Figure 7-1)	p_g = **40.00** lb/ft^2
Density of snow	γ = min(0.13 × p_g / 1ft + 14lb/ft^3, 30lb/ft^3) = **19.20** lb/ft^3
Terrain typeSect. 26.7	C
Exposure condition (Table 7-2)	Partially exposed
Exposure factor (Table 7-2)	C_e = **1.00**
Thermal condition (Table 7-3)	Others with cold roofs
Thermal factor (Table 7-3)	C_t = **1.10**
Importance category (Table 1.5-1)	II
Importance factor (Table 1.5-2)	I_s = **1.00**
Flat roof snow load (Sect 7.3)	p_f = 0.7 × C_e × C_t × I_s × p_g = **30.80** lb/ft^2

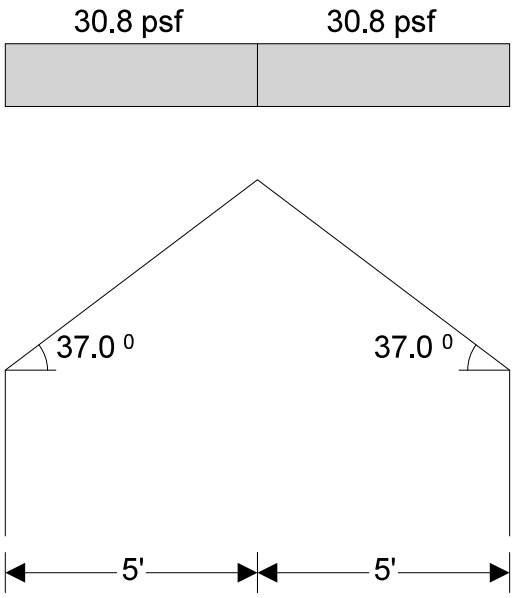
Cold roof slope factor (C_t > 1.0)

Roof surface type	Non slippery
Ventilation	Ventilated
Thermal resistance (R-value)	R = **49.00** °F h ft^2 / Btu
Roof slope factor - left Fig 7-2b (solid line)	C_{s_l} = **1.00**
Roof slope factor - right Fig 7-2b (solid line)	C_{s_r} = **1.00**

Hip and gable roof loads

Balanced sloped snow load - left (Cl.7.4)	p_{s_l} = C_{s_l} × p_f = **30.80** lb/ft^2
Balanced sloped snow load - right (Cl.7.4)	p_{s_r} = C_{s_r} × p_f = **30.80** lb/ft^2
Slope of left roof	S_l = 1 / tan(α_1) = **1.33**
Slope of right roof	S_r = 1 / tan(α_2) = **1.33**

Balanced load



Roof elevation

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Charge Station				
Subject	Conventional Light Frame Construction		Job No.	2019-031.01	
	Gravity Framing		Sheet No.	1	of
Computed By	EB	Date 3/25/2021	Checked By		Date

CONVENTIONAL LIGHT FRAME CONSTRUCTION

Design Basis: 2018 IBC Section 2308

Wall Studs 2x4 @ 16"oc

Stud Height **10** ft

TABLE 2308.5.1 SIZE, HEIGHT AND SPACING OF WOOD STUDS[c]

STUD SIZE (inches)	BEARING WALLS			
	Laterally unsupported stud height[a] (feet)	Supporting roof and ceiling only	Supporting one floor, roof and ceiling	Supporting two floors, roof and ceiling
		Spacing (inches)		
2 × 3[b]	—	—	—	—
2 × 4	10	24	16	—
3 × 4	10	24	24	16
2 × 5	10	24	24	—
2 × 6	10	24	24	16

Headers (2) 2x8 (1) jack stud

Header Span **7.0** ft *interpolated for pg = 40psf*

Roof Span **12** ft

TABLE 2308.4.1.1(1)

HEADER AND GIRDER SPANS[a, b] FOR EXTERIOR BEARING WALLS (Maximum spans for Douglas fir-larch, hem-fir, Southern pine and spruc

GIRDERS AND HEADERS SUPPORTING	SIZE	GROUND SNOW LOAD (psf)[e]											
		30						50					
		Building width[c] (feet)											
		12		24		36		12		24		36	
		Span[f]	NJ[d]	Span[f]	NJ[d]	Span[f]	NJ[d]	Span[f]	NJ[d]	Span[f]	NJ[d]	Span[f]	NJ[d]
Roof and ceiling	1-2 × 6	4-0	1	3-1	2	2-7	2	3-5	1	2-8	2	2-3	2
	1-2 × 8	5-1	2	3-11	2	3-3	2	4-4	2	3-4	2	2-10	2
	1-2 × 10	6-0	2	4-8	2	3-11	2	5-2	2	4-0	2	3-4	3
	1-2 × 12	7-1	2	5-5	2	4-7	3	6-1	2	4-8	3	3-11	3
	2-2 × 4	4-0	1	3-1	1	2-7	1	3-5	1	2-7	1	2-2	1
	2-2 × 6	6-0	1	4-7	1	3-10	1	5-1	1	3-11	1	3-3	2
	2-2 × 8	7-7	1	5-9	1	4-10	2	6-5	1	5-0	2	4-2	2
	2-2 × 10	9-0	1	6-10	2	5-9	2	7-8	2	5-11	2	4-11	2
	2-2 × 12	10-7	2	8-1	2	6-10	2	9-0	2	6-11	2	5-10	2
	3-2 × 8	9-5	1	7-3	1	6-1	1	8-1	1	6-3	1	5-3	2
	3-2 × 10	11-3	1	8-7	1	7-3	2	9-7	1	7-4	2	6-2	2
	3-2 × 12	13-2	1	10-1	2	8-6	2	11-3	2	8-8	2	7-4	2
	4-2 × 8	10-11	1	8-4	1	7-0	1	9-4	1	7-2	1	6-0	1
	4-2 × 10	12-11	1	9-11	1	8-4	1	11-1	1	8-6	1	7-2	2
	4-2 × 12	15-3	1	11-8	1	9-10	2	13-0	1	10-0	2	8-5	2

Ceiling Joists 2x4 @ 16"oc

Span Length **8** ft

TABLE 2308.7.1(1) CEILING JOIST SPANS FOR COMMON LUMBER SPECIES (Uninhabitable attics without storage, live load = 10 psf, L/Δ = 240)

CEILING JOIST SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 5 psf		
			2 × 4	2 × 6	2 × 8
			Maximum ceiling joist spans		
			(ft. - in.)	(ft. - in.)	(ft. - in.)
16	Hem-Fir	SS	11-3	17-8	23-4
	Hem-Fir	#1	11-0	17-4	22-10
	Hem-Fir	#2	10-6	16-6	21-9
	Hem-Fir	#3	9-5	13-9	17-5
	Southern Pine	SS	11-9	18-5	24-3
	Southern Pine	#1	11-3	17-8	23-4

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Charge Station				
Subject	Conventional Light Frame Construction		Job No.	2019-031.01	
	Gravity Framing		Sheet No.	1	of
Computed By	EB	Date 3/25/2021	Checked By		Date

Roof Rafters

2x6 @ 16"oc

Span Length **8** ft *along the horizontal projection*

TABLE 2308.7.2(6) RAFTER SPANS FOR COMMON LUMBER SPECIES (Ground snow load = 50 psf, ceiling attached to rafters, L/Δ = 240)

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf					DEAD LOAD = 20 psf				
			2 × 4	2 × 6	2 × 8	2 × 10	2 × 12	2 × 4	2 × 6	2 × 8	2 × 10	2 × 12
			Maximum rafter spans[a]									
			(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
16	Hem-Fir	SS	6-7	10-4	13-8	17-5	21-2	6-7	10-4	13-8	17-5	20-5
	Hem-Fir	#1	6-5	10-2	12-10	15-8	18-2	6-5	9-5	11-11	14-6	16-10
	Hem-Fir	#2	6-2	9-7	12-2	14-10	17-3	6-1	8-11	11-3	13-9	15-11
	Hem-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-8	6-10	8-8	10-6	12-3
	Southern Pine	SS	6-10	10-9	14-2	18-1	22-0	6-10	10-9	14-2	18-1	21-10
	Southern Pine	#1	6-7	10-4	13-5	15-9	18-8	6-7	9-10	12-5	14-7	17-3

Ceiling Joist to Rafter Connection

(3) 16d nails

Roof Span **12** ft

Tie Spacing **16** in

TABLE 2308.7.3.1 RAFTER TIE CONNECTIONS[b]

RAFTER SLOPE	TIE SPACING (inches)	NO SNOW LOAD				GROUND SNOW LOAD (pound per square foot)							
						30 pounds per square foot				50 pounds per square foot			
		Roof span (feet)											
		12	20	28	36	12	20	28	36	12	20	28	36
9:12	12	3	3	3	3	3	3	3	4	3	3	4	5
	16	3	3	3	4	3	3	4	5	3	4	5	7
	24	3	3	5	6	3	4	6	7	3	6	8	10
	32	3	4	6	8	4	6	8	10	5	8	10	14
	48	4	6	9	11	5	8	12	14	7	12	16	20

Roof Sheathing

19/32" APA rated sheathing

Max span **16** in

TABLE 2304.8(5)
ALLOWABLE LOAD (PSF) FOR WOOD STRUCTURAL PANEL ROOF SHEATHING CONTINUOUS OVER TWO OR MORE SPANS AND STRENGTH AXIS PARALLEL TO SUPPORTS (Plywood structural panels are five-ply, five-layer unless otherwise noted)[a]

PANEL GRADE	THICKNESS (inch)	MAXIMUM SPAN (inches)	LOAD AT MAXIMUM SPAN (psf)	
			Live	Total
Structural I sheathing	7/16	24	20	30
	15/32	24	35[b]	45[b]
	1/2	24	40[b]	50[b]
	19/32, 5/8	24	70	80
	23/32, 3/4	24	90	100
Sheathing, other grades covered in DOC PS 1 or DOC PS 2	7/16	16	40	50
	15/32	24	20	25
	1/2	24	25	30
	19/32	24	40[b]	50[b]
	5/8	24	45[b]	55[b]
	23/32, 3/4	24	60[b]	65[b]

Uplift Connection

H3

Roof Span **12** ft

Required uplift **= 91+43.2** **134** lb

TABLE 2308.7.5 REQUIRED RATING OF APPROVED UPLIFT CONNECTORS (pounds)[a, b, c, e, f, g, h]

NOMINAL DESIGN WIND SPEED, V_{asd}[i]	ROOF SPAN (feet)							OVERHANGS (pounds/feet)[d]
	12	20	24	28	32	36	40	
85	-72	-120	-145	-169	-193	-217	-241	-38.55
90	-91	-151	-181	-212	-242	-272	-302	-43.22
100	-131	-281	-262	-305	-349	-393	-436	-53.36
110	-175	-292	-351	-409	-467	-526	-584	-64.56

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Charge Station				
Subject	Conventional Light Frame Construction		Job No.	2019-031.01	
	Lateral Framing		Sheet No.	1	of
Computed By	EB	Date 3/25/2021	Checked By		Date

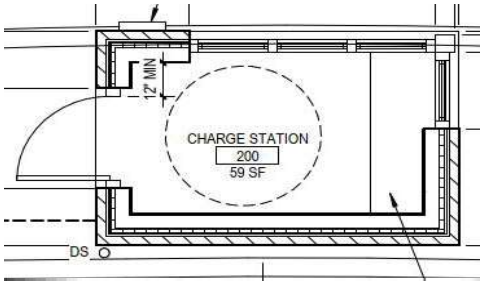
CONVENTIONAL LIGHT FRAME CONSTRUCTION

Design Basis: 2018 IBC Section 2308

Wall Bracing

BWL Spacing	10	ft
Bracing Method	WSP	
Max dim from end	6	ft
WSP Min panel L	4	ft

WSP



ENGRD

WSP

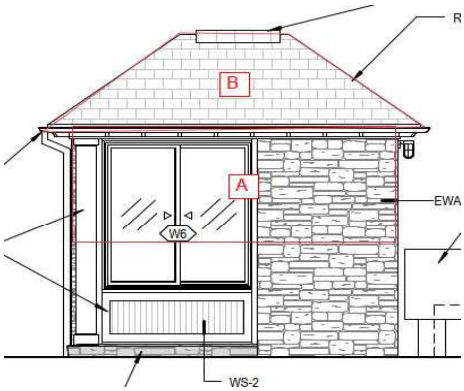
TABLE 2308.6.1[a] WALL BRACING REQUIREMENTS

SEISMIC DESIGN CATEGORY	STORY CONDITION (SEE SECTION 2308.2)	MAXIMUM SPACING OF BRACED WALL LINES	BRACED PANEL LOCATION, SPACING (O.C.) AND MINIMUM PERCENTAGE (X)			MAXIMUM DISTANCE OF BRACED WALL PANELS FROM EACH END OF BRACED WALL LINE
			Bracing method[b]			
			LIB	DWB, WSP	SFB, PBS, PCP, HPS, GB[c, d]	
A and B		35' - 0"	Each end and ≤ 25'- 0" o.c.	Each end and ≤ 25'- 0" o.c.	Each end and ≤ 25'- 0" o.c.	12'- 6"
		35'- 0"	Each end and ≤ 25'- 0" o.c.	Each end and ≤ 25'- 0" o.c.	Each end and ≤ 25'- 0" o.c.	12'- 6"
		35'- 0"	NP	Each end and ≤ 25'- 0" o.c.	Each end and ≤ 25'- 0" o.c.	12'- 6"

ALBRECHT ENGINEERING INC

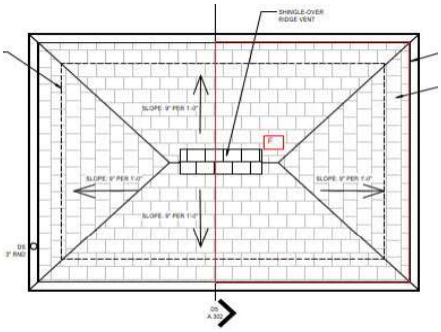
Project	Greenbrier State Park - Charge Station						
Subject	Conventional Light Frame Construction				Job No.	2019-031.01	
	Lateral Framing				Sheet No.	1	of
Computed By	EB	Date	3/25/2021	Checked By		Date	

Y-direction Wind Load - Walls



	p	A	F	
Zone A	26.1	30	0.78	k
Zone B	17.9	16	0.29	k
Zone C	20.8	30	0.62	k
Zone D	14.3	16	0.23	k
Total:			1.92	k

Y-direction Wind Load - Roof



	p	A	F		DL	A	F	
Zone F	-13.1	48	-628.80	lb	15.0	48	720.00	lb
Zone Goh	-8.7	12	-104.40	lb	15.0	12	180.00	lb
Total:			-733.20	lb			900.00	lb
Uniform Load:		10.00	**-73.32**	plf		10.00	**90.00**	plf

For load combination 0.6D-0.6W, 0.6D = 54.00 > 0.6W = -43.99 *so no net uplift*

Check shear capacity

Shear wall loading:

	F		L		v = F/L
v_w =	1.92	k	3.50	ft	549

Shear capacity:

The shear capacity of unblocked wood diaphragm with 1/2" Structural I rated sheathing and 8d common nails at 6" OC with 2x framing from NDS Table 4.2C: v_w = 715.00 plf

ϕr_n = 0.80 * v_w = 572 plf **OK**

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Charge Station				
Subject	Conventional Light Frame Construction		Job No.	2019-031.01	
	Lateral Framing		Sheet No.	1	of
Computed By	EB	Date 3/25/2021	Checked By		Date

Anchor bolt loading:

N = 3

V = F / N = 641 k

Anchor bolt capacity:

The shear capacity of 5/8"anchor bolts in 1-1/2" sill plate to concrete, G = 0.42

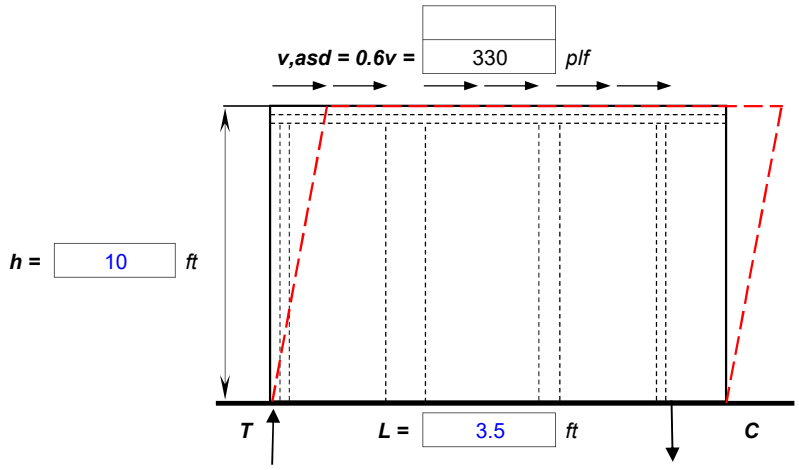
from NDS Table 4.2C: Z = 410.00 lb

Z' = Cd * Z

where Cd = 1.6 wind

Z' = 656 lbs **OK**

Check overturning



Chord loading:

F = L * v = 1153 lb

T/C = F * h / L = 3295 lb

Compression chord capaity: see spreadsheet for (2) 2x6 studs

Tension chord capaity:

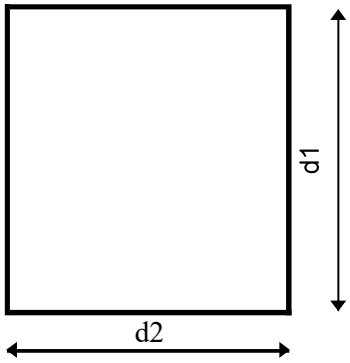
For Simpson STHD10:

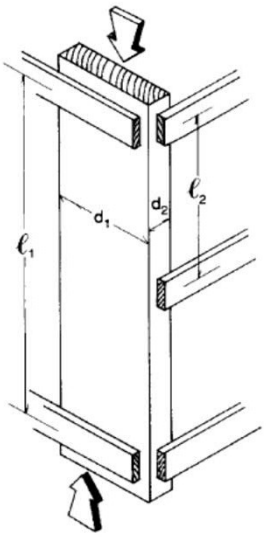
Uplift = 3535 lbs

ALBRECHT ENGINEERING INC

Project	GSP Charge Station				
Subject	Shear Wall Chord Design			Job No.	
	(2) 2x6 studs			Sheet No.	of
Computed By	EB	Date	7/26/2021	Checked By	Date

ASD Design of Wood Column (2005 NDS)





Geometry

Beam Width, d2 =	3	inches
Depth of Beam, d1 =	5.5	inches
unbraced column length, l_1 =	120	inches
unbraced column length, l_2 =	12	inches
effective length factor, K_e =	1.0	
Sx =	15.13	in3
A =	16.50	in2

Design Loads

Axial tension, T =	3295.0	lbs
Axial compression, P =	3295.0	lbs
Moment, M =	0.0	ft-lbs

Check column slenderness

effective column length, le_1 =	120.00	
effective column length, le_2 =	12.00	
slenderness ratio, le_1/d_1 =	21.82	< 50 OK
slenderness ratio, le_2/d_2 =	4.00	< 50 OK
USE le/d =	21.82	

Column stability factor

c = 0.80 for sawn lumber

$$F_{ce} = \frac{0.822\ E_{min}'}{(l_e/d)^2} = 811.58 \text{ psi}$$

$$F_c^* = F_c * C_D * C_M * C_t * C_F * C_i = 2080.00 \text{ psi}$$

$$C_p = \frac{[1+(Fce/Fc^*)/2c]}{} - \sqrt{[1+(Fce/Fc^*)/2c]\ (Fce/Fc^*)/c}$$

C_p = **0.352**

Adjustment Factors

Load duration, C_D =	1.60
Wet service, C_M =	1.0
Temperature, C_t =	1.0
Size, C_F =	1.0
Flat use, C_{fu} =	1.0
Incising, C_i =	1.0
Repetitive member, C_r =	1.0
Buckling stiffness, C_T =	1.0
Bearing Area, C_b =	1.0

Material Properties

	Hem Fir #2	
F_b =	850	psi
F_t =	525	psi
F_{cb} =	405	psi
F_c =	1300	psi
E_{min} =	470000	psi

ALBRECHT ENGINEERING INC

Project	GSP Charge Station				
Subject	Shear Wall Chord Design			Job No.	
	(2) 2x6 studs			Sheet No.	of
Computed By	EB	Date	7/26/2021	Checked By	Date

Beam stability factor

effective beam length, $l_e = 2.06 l_u =$ 36.06 for simple span, uniform loads

slenderness ratio $R_B = \sqrt{(l_e * d)/b^2} =$ 4.69 **< 50 OK**

$$F_{be} = \frac{1.20\ E_{min}'}{(R_b)^2} = 25593.71 \text{ psi}$$

$F_b^* = F_b * C_D * C_M * C_t * C_F * C_{fu} * C_i * C_r =$ 1360.00 psi

$$C_L = \frac{[1+(Fbe/Fb^*)/1.9] - \sqrt{[1+(Fbe/Fb^*)/1.9]^2 - (Fbe/Fb^*)/0.95}}{}$$

$C_L =$ **1.000**

Allowable Stresses

$F_b' = F_b^* \times C_L =$	1360	psi
$F_t' = F_t * C_D * C_M * C_t * C_F * C_i =$	840	psi
$F_{cb}' = F_{cb} * C_M * C_t * C_i * C_b =$	405	psi
$F_c' = F_c^* \times C_p =$	732	psi
$E_{min}' = E_{min} * C_M * C_t * C_i * C_T =$	470000	psi

Bearing on Sill Plate

$f_c = P / A =$	200	psi
$f_{cb} / F_{cb}' =$	0.493	**< 1.0 OK**

Combined Bending and Tension

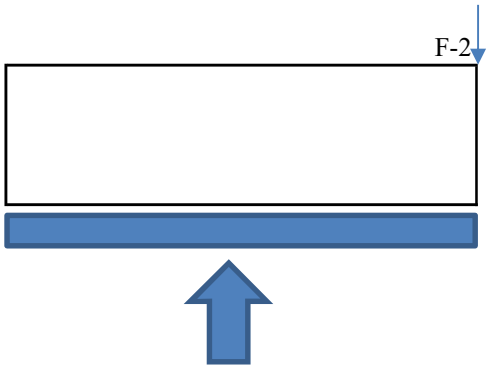
$f_t = T / A =$	200	psi
$f_b = M / S =$	0	psi
$f_t / F_t' + f_b / F_b' =$	0.238	**< 1.0 OK**
$f_t / F_t' =$	0.238	**< 1.0 OK**

Combined Bending and Compression

$f_c = P / A =$	200	psi
$f_b = M / S =$	0	psi
$[f_c/F_c']^2 + [f_b / F_b'(1-f_c/F_{ce})] =$	0.074	**< 1.0 OK**
$f_c / F_c' =$	0.273	**< 1.0 OK**

ALBRECHT ENGINEERING INC	Project	Greenbrier State Park - Charge Station			
	Subject	Wind Load Calculations MWFRS		Job No.	2019-031.01
		Diaphragm Analysis		Sheet No.	of
	Computed By	EB	Date 4/19/2021 Checked By		Date

DIAPHRAGM ANALYSIS (X-Direction)



Roof diaphragm loading:

	F		L		v = F/L	
F-2	1.92	k	6.00	ft	320	plf

The shear capacity of unblocked wood diaphragm with 1/2" APA rated sheathing and 8d common nails at 6" OC with 2x framing from NDS Table 4.2C: v_w = 505.00 plf

Adjustment factor for species = [1-(0.5-G)] where G = 0.42 for HF = 0.92

ϕr_n = 0.80 * v_w * factor = 372 plf **OK**

Collector Forces:

	v		L		Fcoll		
F-2	320.00	plf	3.00	ft	960	lb	continuous 2x6 top plate

Check deflection

Shear Wall Deflection =	0.525	in	see spreadsheet
Diaphragm Deflection =	0.069	in	see spreadsheet
Total Deflection =	0.594	in	

Deflection Limit

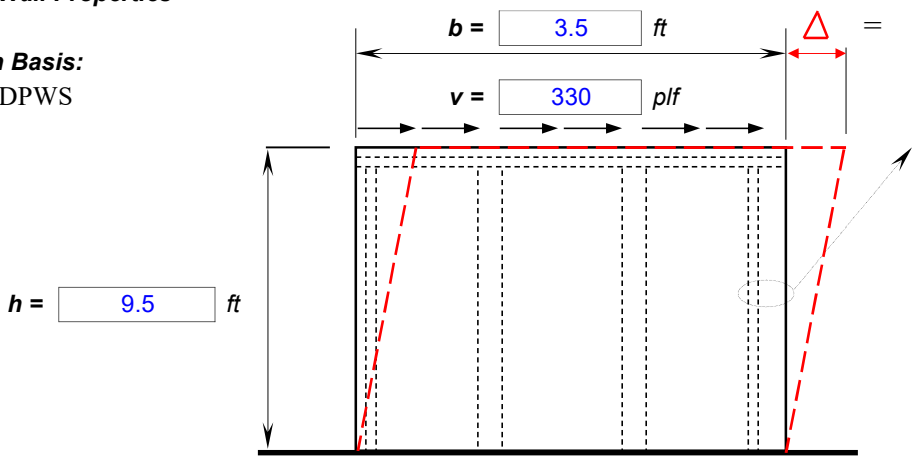
H	10.00	ft				
2H/ 360	→	*Δ lim =*	0.667	in	*OK*	
L	8.00	ft				
W	12.00	ft				
Deflection L/W ratio for open front =			1.50	: 1	**OK**	

ALBRECHT ENGINEERING INC

Project	GSP Charge Station				
Subject	Wood Shear Wall Deflection			Job No.	2019-031.01
				Sheet No.	of
Computed By	EB	Date	4/19/2021	Checked By	Date

Shear Wall Properties

Design Basis:
2015 SDPWS



Boundary Element		
Species	Douglas Fir-Larch	
Grade	No. 1	
#	2	
nominal b	2	(in)
nominal d	6	(in)
actual b	3.0	(in)
actual d	5.5	(in)
S	30.25	(in^3)
A	33.00	(in^2)
I	83.19	(in^4)
E	1600000	(psi)

Wood Panel Grades and Stiffness

Exterior C-C and C-D → G = 13 kips/in (See Table 4.3A)

Holddown Selection

Holddown connecting to → Foundation

STHD10 → d_a = 0.100 in

$$\Delta = \frac{8\,v\,h^3}{E\,A\,b} + \frac{v\,h}{1000\,Ga} + \frac{h\,d_a}{b}$$

(bending) (shear and nail deformation) (anchorage slip)

$$= 0.0122 + 0.2412 + 0.2714$$

$$= 0.5248$$

Deflection Limit

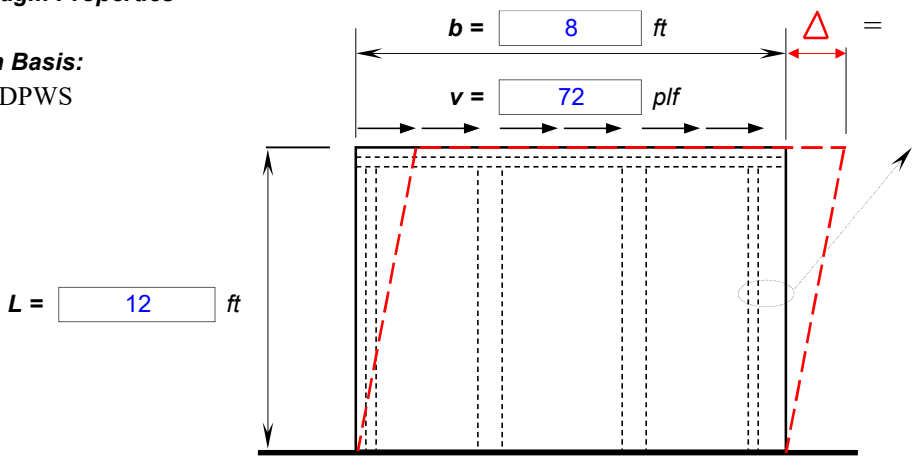
2H/ 360 → Δlim = 0.633 in OK

ALBRECHT ENGINEERING INC

Project	GSP Charge Station				
Subject	Diaphragm Deflection			Job No.	2019-031.01
				Sheet No.	of
Computed By	EB	Date	4/19/2021	Checked By	Date

Diaphragm Properties

Design Basis:
2015 SDPWS



Boundary Element		
Species	Douglas Fir-Larch	
Grade	No. 1	
#	2	
nominal b	2	(in)
nominal d	6	(in)
actual b	3.0	(in)
actual d	5.5	(in)
S	30.25	(in^3)
A	33.00	(in^2)
I	83.19	(in^4)
E	1600000	(psi)

Wood Panel Grades and Stiffness

Exterior C-C and C-D → G = 13 kips/in (See Table 4.3A)

$$\Delta = \frac{8\,v\,L^3}{E\,A\,b} + \frac{v\,L}{1000\,Ga} + \frac{N/A}{}$$

(bending) (shear and nail deformation) (anchorage slip)

$$= 0.0024 + 0.0665 +$$

$$= 0.0688 \text{ in}$$

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Charge Station				
Subject	Foundation Loads			Job No.	2019-031.01
				Sheet No.	of
Computed By	EB	Date	3/26/2021	Checked By	Date

Foundation Loads

	p	trib W	w	
Roof DL	8.00	5	40	plf
Ceiling DL	7.00	3	21	plf
Roof LL	30.00	5	150	plf
Ceiling LL	10.00	3	30	plf
Snow	30.30	5	152	plf
Wall DL	60.00	10	600	plf

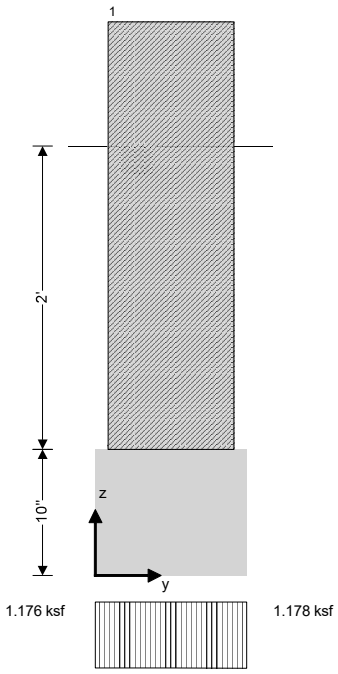
DL =	661	plf
LL =	30	plf
RLL =	150	plf
SL =	152	plf

SEE TEDDS output

Tedds calculation version 3.2.09

FOOTING ANALYSIS

Length of foundation	L_x = **1** ft	Width of foundation	L_y = **1** ft
Foundation area	A = **1** ft^2	Depth of foundation	h = **10** in
Depth of soil over foundation	h_{soil} = **24** in	Density of concrete	γ_{conc} = **150.0** lb/ft^3



Wall no.1 details

Width of wall	l_{y1} = **10** in	position in y-axis	y_1 = **6.002** in

Soil properties

Net allow. bearing press.	q_{allow_Net} = **3** ksf	Density of soil	γ_{soil} = **120.0** lb/ft^3
Angle of internal friction	ϕ_b = **30.0** deg	Design base friction angle	δ_{bb} = **30.0** deg
Coefficient of base friction	tan(δ_{bb}) = **0.577**		

Foundation loads

Self weight	F_{swt} = **125** psf	Soil weight	F_{soil} = **240** psf

Wall no.1 loads per linear foot

Dead load in z	F_{Dz1} = **0.7** kips	Live load in z	F_{Lz1} = **0.0** kips
Live roof load in z	F_{Lrz1} = **0.2** kips	Snow load in z	F_{Sz1} = **0.2** kips

Footing analysis for soil and stability

Load combinations per ASCE 7-10

1.0D (0.307)

1.0D + 1.0L (0.316)
1.0D + 1.0Lr (0.352)
1.0D + 1.0S (0.353)
1.0D + 0.75L + 0.75Lr (0.348)
1.0D + 0.75L + 0.75S (0.348)
1.0D + 0.75L + 0.75R (0.314)

Combination 4 results: 1.0D + 1.0S

Forces on foundation per linear foot

Force in z-axis F_{dz} = **1.2** kips

Moments on foundation per linear foot

Moment in y-axis, about y is 0 M_{dy} = **0.6** kip_ft

Uplift verification

Vertical force F_{dz} = **1.177** kips

PASS - Foundation is not subject to uplift

Stability against sliding

Resistance due to base friction $F_{RFriction}$ = **0.68** kips

Bearing resistance

Eccentricity of base reaction

Eccentricity of base reaction in y-axis e_{dy} = **0.001** in

Strip base pressures

Min base pressure q_{min} = **1.176** ksf Max base pressure q_{max} = **1.178** ksf

Allowable bearing capacity

Allowable bearing capacity q_{allow} = **3.34** ksf q_{max} / q_{allow} = **0.353**

PASS - Allowable bearing capacity exceeds design base pressure

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Registration Station				
Subject	Design Loads			Job No.	2019-031.01
				Sheet No.	1 of
Computed By	EB	Date	3/25/2021	Checked By	Date

DESIGN LOADS

Design Basis: ASCE 7-16

Roof Dead Load

Weight of roofing & insulation =	2	psf
Weight of plywood deck =	2.5	psf
Weight of MEP piping and lighting =	2	psf
Weight of wood framing =	2.5	psf
Weight of collateral =	1	psf
Roof DL, W_{DL} =	**10**	psf

Ceiling Dead Load

Weight of plywood deck =	2.5	psf
Weight of wood framing =	2.5	psf
Weight of gypboard ceiling =	2.5	psf
Weight of MEP piping and lighting =	2	psf
Weight of collateral =	0.5	psf
Roof DL, W_{DL} =	**10**	psf

Roof Live Load

Roof, W_{LL} =	30	psf

Attic Floor Live Load

Attic Floor, W_{LL} =	30	psf

Wall Dead Load

Weight of 5" stone veneer =	50	psf
Weight of 6" CMU wall =	50	psf
Wall W_{DL} =	**100**	psf

Snow Load

Ground Snow Load, p_g =	40	psf	
Snow Importance Factor, I_s =	1.0		
Roof Design Snow Load, W_s =	33.6	psf	*See TEDDS*

Wind Load

Basic Wind Speed, V =	110	mph
Basic Wind Speed, Vasd =	90	mph

Seismic Load

Seismic Design Category, SDC =	B

SNOW LOADING

In accordance with ASCE7-16

Tedds calculation version 1.0.09

Building details

Roof type	Hip and gable
Width of roof (left on elevation)	b_1 = **10.00** ft
Width of roof (right on elevation)	b_2 = **10.00** ft
Slope of roof (left on elevation)	α_1 = **37.00** deg
Slope of roof (right on elevation)	α_2 = **37.00** deg

Ground snow load

Ground snow load (Figure 7.2-1)	p_g = **40.00** lb/ft^2
Density of snow	γ = min(0.13 × p_g / 1ft + 14lb/ft^3, 30lb/ft^3) = **19.20** lb/ft^3
Terrain typeSect. 26.7	C
Exposure condition (Table 7.3-1)	Partially exposed
Exposure factor (Table 7.3-1)	C_e = **1.00**
Thermal condition (Table 7.3-2)	Unheated structures
Thermal factor (Table 7.3-2)	C_t = **1.20**
Importance category (Table 1.5-1)	II
Importance factor (Table 1.5-2)	I_s = **1.00**
Flat roof snow load (Sect 7.3)	p_f = 0.7 × C_e × C_t × I_s × p_g = **33.60** lb/ft^2

Cold roof slope factor (C_t > 1.0)

Roof surface type	Non slippery
Ventilation	Ventilated
Thermal resistance (R-value)	R = **0.00** ^{o}F h ft^2 / Btu
Roof slope factor - left Fig 7.4-1c (solid line)	C_{s_l} = **1.00**
Roof slope factor - right Fig 7.4-1c (solid line)	C_{s_r} = **1.00**

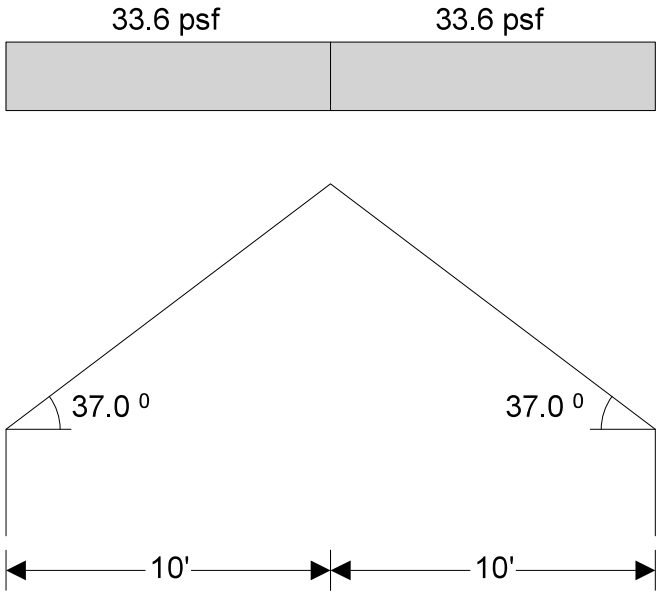
Hip and gable roof loads

Balanced sloped snow load - left (Cl.7.4)	p_{s_l} = C_{s_l} × p_f = **33.60** lb/ft^2
Balanced sloped snow load - right (Cl.7.4)	p_{s_r} = C_{s_r} × p_f = **33.60** lb/ft^2
Slope of left roof	S_l = 1 / tan(α_1) = **1.33**
Slope of right roof	S_r = 1 / tan(α_2) = **1.33**

Albrecht Engineering Inc
3500 Boston Street
Suite 329. MS-12
Baltimore, Maryland 21224

Project				Job Ref.	22
Greenbrier State Park				2019-031.01	
Section				Sheet no./rev.	
Snow Loads - Registration Station				2	
Calc. by	Date	Chk'd by	Date	App'd by	Date
EB	3/26/2021				

Balanced load



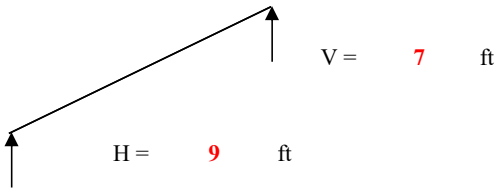
Roof elevation

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Registration Station				
Subject	Gravity Loading			Job No.	2019-031.01
				Sheet No.	1 of
Computed By	EB	Date	3/25/2021	Checked By	Date

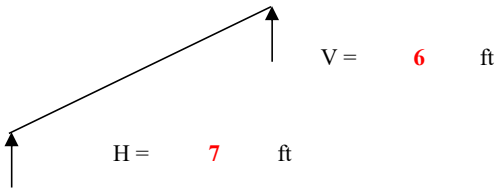
Typical Rafter

Span L	11.4	ft
Spacing (Trib Width)	1.33	ft
Roof DL	13	plf
Roof LL (projected horizontal)	32	plf
Snow (projected horizontal)	35	plf



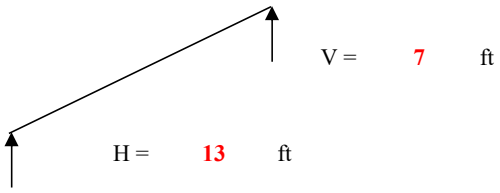
Rafter at Dormer

Span L	8.9	ft
Spacing (Trib Width)	3.17	ft
Roof DL	32	plf
Roof LL (projected horizontal)	75	plf
Snow (projected horizontal)	84	plf



Hip Rafter

Span L	14.8	ft
Spacing (Max Trib Width at diagonal)	6.43	ft
Roof DL	64	plf
Roof LL (projected horizontal)	170	plf
Snow (projected horizontal)	190	plf

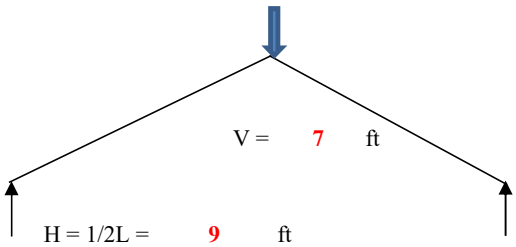


Ridge at Porch

DL from typical rafter (x2) =	196	lb
SL from typical rafter (x2) =	384	lb
Rafter spacing =	16	in
w DL = RDL / s =	147	plf
w SL = RSL / s =	288	plf

Rafter Truss at Porch Hip

Span L	11.4	ft
Spacing (Trib Width)	1.33	ft
Roof DL	13	plf
Roof LL (projected horizontal)	32	plf
Snow (projected horizontal)	35	plf
DL from hip rafter (x2) =	630	lb
SL from hip rafter (x2) =	1868	lb
DL from ridge =	300	lb
SL from ridge =	600	lb

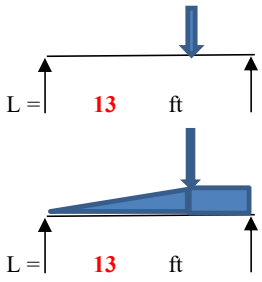


Steel Thrust Plate at Porch

DL from rafter truss at porch hip =	0.72	k
SL from rafter truss at porch hip =	1.84	k

Typical Header at Porch

DL from rafter truss at porch hip =	0.65	k
SL from rafter truss at porch hip =	1.63	k
DL from typical rafter =	98	lb
SL from typical rafter =	192	lb
Rafter spacing =	16	in
w DL = RDL / s =	74	plf
w SL = RSL / s =	144	plf

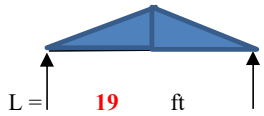


ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Registration Station				
Subject	Gravity Loading			Job No.	2019-031.01
				Sheet No.	1 of
Computed By	EB	Date	3/25/2021	Checked By	Date

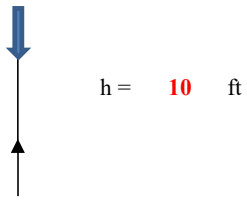
Long Header at Porch

DL from typical rafter =	98	lb
SL from typical rafter =	192	plf
Rafter spacing =	16	in
w DL = RDL / s =	74	plf
w SL = RSL / s =	144	plf



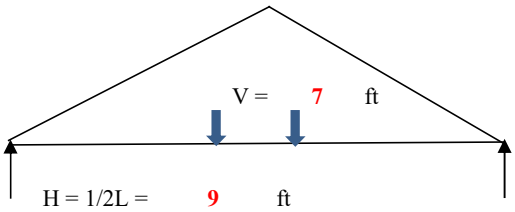
Post at Porch

DL from typical header =	499	lb	0.02	ft-k
SL from typical header =	939	lb	0.05	ft-k
DL from long header =	461	lb	0.07	ft-k
SL from long header =	684	lb	0.10	ft-k
DL =	960	lb	0.09	ft-k
SL =	1623	lb	0.15	ft-k



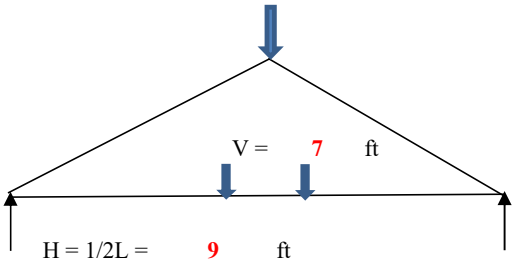
Rafter Truss Typical

Span L	11.4	ft
Spacing (Trib Width)	1.33	ft
Roof DL	13	plf
Roof LL (projected horizontal)	32	plf
Snow (projected horizontal)	35	plf
Attic DL =	13	plf
Attic LL =	40	plf
RTU DL =	75	lb



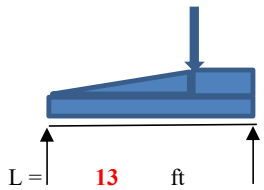
Rafter Truss at Typical Hip

Span L	11.4	ft
Spacing (Trib Width)	1.33	ft
Roof DL	13	plf
Roof LL (projected horizontal)	32	plf
Snow (projected horizontal)	35	plf
Attic DL =	13	plf
Attic LL =	40	plf
RTU DL =	75	lb
DL from hip rafter (x2) =	630	lb
SL from hip rafter (x2) =	1868	lb



Typical Header

DL from rafter truss at typ hip =	0.65	k
SL from rafter truss at typ hip =	1.63	k
DL from typical rafter =	98	lb
SL from typical rafter =	192	lb
Rafter spacing =	16	in
w DL = RDL / s =	74	plf
w SL = RSL / s =	144	plf
Joist span =	18	ft
DL from attic =	90	plf
LL from attic =	270	plf



ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Registration Station		
Subject	Gravity Loading	Job No.	2019-031.01
		Sheet No.	1 of
Computed By	EB	Date	3/25/2021
Checked By		Date	

Typical Post

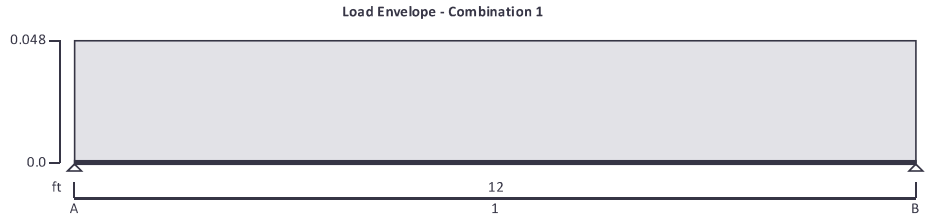
DL from typical header =	**1084**	lb	**0.05**	ft-k
SL from typical header =	**939**	lb	**0.09**	ft-k
LL from typical header =	**1755**	lb		
DL from long header =	**461**	lb	**0.10**	ft-k
SL from long header =	**684**	lb	**0.23**	ft-k
DL =	**1545**	lb	**0.15**	ft-k
SL =	**2439**	lb	**0.31**	ft-k

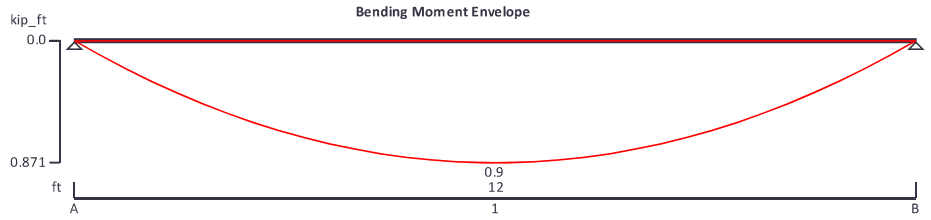
h = **10** ft

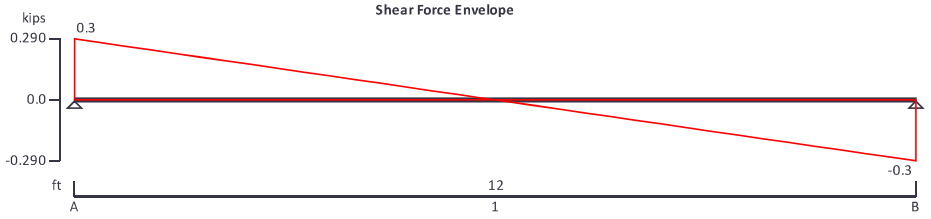
STRUCTURAL WOOD MEMBER ANALYSIS & DESIGN (NDS)

In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

Tedds calculation version 1.7.09







Applied loading

Beam loads

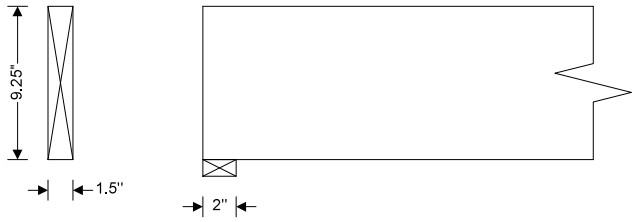
	Dead self weight of beam × 1
DL	Dead full UDL 13 lb/ft
LL	Snow full UDL 32 lb/ft

Load combinations

Load combination 1	Support A	Dead × 1.00
		Snow × 1.00
	Span 1	Dead × 1.00
		Snow × 1.00
	Support B	Dead × 1.00
		Snow × 1.00

Analysis results

Maximum moment	M_{max} = **871** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **871** lb_ft	
Maximum shear	F_{max} = **290** lb	F_{min} = **-290** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **290** lb	
Total load on member	W_{tot} = **580** lb	
Reaction at support A	R_{A_max} = **290** lb	R_{A_min} = **290** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **98** lb	
Unfactored snow load reaction at support A	R_{A_Snow} = **192** lb	
Reaction at support B	R_{B_max} = **290** lb	R_{B_min} = **290** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **98** lb	
Unfactored snow load reaction at support B	R_{B_Snow} = **192** lb	



Sawn lumber section details

Nominal breadth of sections	b_{nom} = **2** in
Dressed breadth of sections	b = **1.5** in
Nominal depth of sections	d_{nom} = **10** in
Dressed depth of sections	d = **9.25** in
Number of sections in member	N = **1**
Overall breadth of member	b_b = N × b = **1.5** in
Species, grade and size classification	Hem-Fir, No.2 grade, 2" & wider
Bending parallel to grain	F_b = **850** lb/in^2
Tension parallel to grain	F_t = **525** lb/in^2
Compression parallel to grain	F_c = **1300** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **405** lb/in^2
Shear parallel to grain	F_v = **150** lb/in^2
Modulus of elasticity	E = **1300000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **470000** lb/in^2
Mean shear modulus	G_{def} = E / 16 = **81250** lb/in^2

Member details

Service condition	**Dry**
Length of span	L_{s1} = **12** ft
Length of bearing	L_b = **2** in
Load duration	**Ten years**

The beam is one of three or more repetitive members

Section properties

Cross sectional area of member	A = N × b × d = **13.87** in^2

Section modulus	$S_x = N \times b \times d^2 / 6 =$ **21.39** in^3
	$S_y = d \times (N \times b)^2 / 6 =$ **3.47** in^3
Second moment of area	$I_x = N \times b \times d^3 / 12 =$ **98.93** in^4
	$I_y = d \times (N \times b)^3 / 12 =$ **2.60** in^4

Adjustment factors

Load duration factor - Table 2.3.2	$C_D =$ **1.00**
Temperature factor - Table 2.3.3	$C_t =$ **1.00**
Size factor for bending - Table 4A	$C_{Fb} =$ **1.10**
Size factor for tension - Table 4A	$C_{Ft} =$ **1.10**
Size factor for compression - Table 4A	$C_{Fc} =$ **1.00**
Flat use factor - Table 4A	$C_{fu} =$ **1.20**
Incising factor for modulus of elasticity - Table 4.3.8	
	$C_{iE} =$ **1.00**
Incising factor for bending, shear, tension & compression - Table 4.3.8	
	$C_i =$ **1.00**
Incising factor for perpendicular compression - Table 4.3.8	
	$C_{ic\_perp} =$ **1.00**
Repetitive member factor - cl.4.3.9	$C_r =$ **1.15**
Bearing area factor - cl.3.10.4	$C_b =$ **1.00**
Depth-to-breadth ratio	$d_{nom} / (N \times b_{nom}) =$ **5.00**
- Beam is fully restrained	
Beam stability factor - cl.3.3.3	$C_L =$ **1.00**

Bearing perpendicular to grain - cl.3.10.2

Design compression perpendicular to grain	$F_{c\_perp}' = F_{c\_perp} \times C_t \times C_{ic\_perp} \times C_b =$ **405** lb/in^2
Applied compression stress perpendicular to grain	$f_{c\_perp} = R_{A\_max} / (N \times b \times L_b) =$ **97** lb/in^2
	$f_{c\_perp} / F_{c\_perp}' =$ **0.239**

PASS - Design compressive stress exceeds applied compressive stress at bearing

Strength in bending - cl.3.3.1

Design bending stress	$F_b' = F_b \times C_D \times C_t \times C_L \times C_{Fb} \times C_i \times C_r =$ **1075** lb/in^2
Actual bending stress	$f_b = M / S_x =$ **488** lb/in^2
	$f_b / F_b' =$ **0.454**

PASS - Design bending stress exceeds actual bending stress

Strength in shear parallel to grain - cl.3.4.1

Design shear stress	$F_v' = F_v \times C_D \times C_t \times C_i =$ **150** lb/in^2
Actual shear stress - eq.3.4-2	$f_v = 3 \times F / (2 \times A) =$ **31** lb/in^2
	$f_v / F_v' =$ **0.209**

PASS - Design shear stress exceeds actual shear stress

Deflection - cl.3.5.1

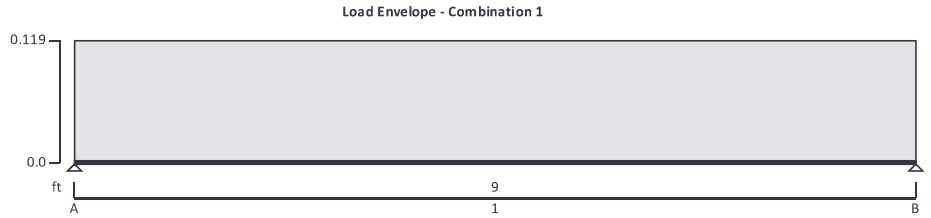
Modulus of elasticity for deflection	$E' = E \times C_{ME} \times C_t \times C_{iE} =$ **1300000** lb/in^2
Design deflection	$\delta_{adm} = 0.003 \times L_{s1} =$ **0.432** in
Total deflection	$\delta_{b\_s1} =$ **0.175** in
	$\delta_{b\_s1} / \delta_{adm} =$ **0.406**

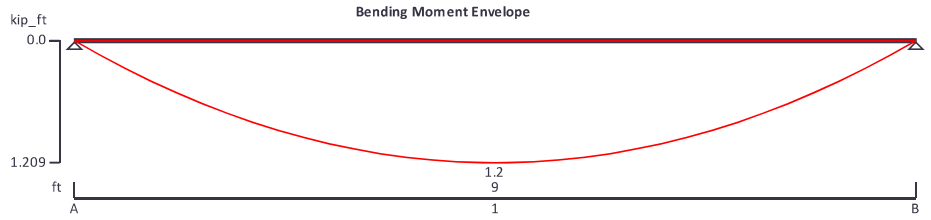
PASS - Total deflection is less than design deflection

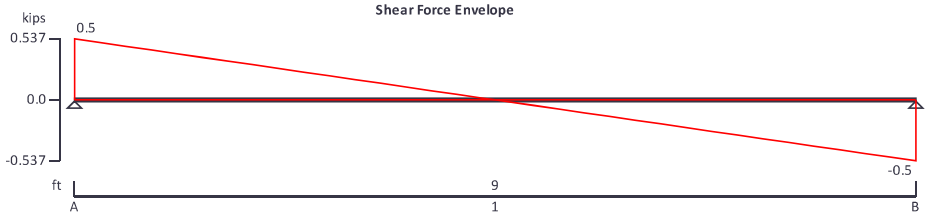
STRUCTURAL WOOD MEMBER ANALYSIS & DESIGN (NDS)

In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

Tedds calculation version 1.7.09







Applied loading

Beam loads

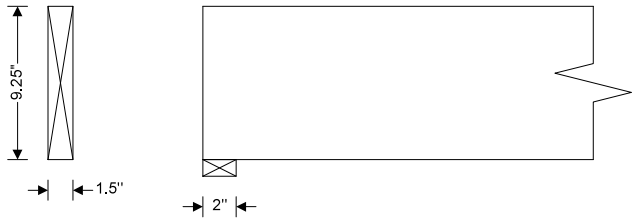
	Dead self weight of beam × 1
DL	Dead full UDL 32 lb/ft
LL	Snow full UDL 84 lb/ft

Load combinations

Load combination 1	Support A	Dead × 1.00
		Snow × 1.00
	Span 1	Dead × 1.00
		Snow × 1.00
	Support B	Dead × 1.00
		Snow × 1.00

Analysis results

Maximum moment	M_{max} = **1209** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **1209** lb_ft	
Maximum shear	F_{max} = **537** lb	F_{min} = **-537** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **537** lb	
Total load on member	W_{tot} = **1074** lb	
Reaction at support A	R_{A_max} = **537** lb	R_{A_min} = **537** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **159** lb	
Unfactored snow load reaction at support A	R_{A_Snow} = **378** lb	
Reaction at support B	R_{B_max} = **537** lb	R_{B_min} = **537** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **159** lb	
Unfactored snow load reaction at support B	R_{B_Snow} = **378** lb	



Sawn lumber section details

Nominal breadth of sections	b_{nom} = **2** in
Dressed breadth of sections	b = **1.5** in
Nominal depth of sections	d_{nom} = **10** in
Dressed depth of sections	d = **9.25** in
Number of sections in member	N = **1**
Overall breadth of member	b_b = N × b = **1.5** in
Species, grade and size classification	Hem-Fir, No.2 grade, 2" & wider
Bending parallel to grain	F_b = **850** lb/in^2
Tension parallel to grain	F_t = **525** lb/in^2
Compression parallel to grain	F_c = **1300** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **405** lb/in^2
Shear parallel to grain	F_v = **150** lb/in^2
Modulus of elasticity	E = **1300000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **470000** lb/in^2
Mean shear modulus	G_{def} = E / 16 = **81250** lb/in^2

Member details

Service condition	**Dry**
Length of span	L_{s1} = **9** ft
Length of bearing	L_b = **2** in
Load duration	**Ten years**

The beam is one of three or more repetitive members

Section properties

Cross sectional area of member	A = N × b × d = **13.87** in^2

Section modulus $S_x = N \times b \times d^2 / 6 =$ **21.39** in^3

$S_y = d \times (N \times b)^2 / 6 =$ **3.47** in^3

Second moment of area $I_x = N \times b \times d^3 / 12 =$ **98.93** in^4

$I_y = d \times (N \times b)^3 / 12 =$ **2.60** in^4

Adjustment factors

Load duration factor - Table 2.3.2 $C_D =$ **1.00**

Temperature factor - Table 2.3.3 $C_t =$ **1.00**

Size factor for bending - Table 4A $C_{Fb} =$ **1.10**

Size factor for tension - Table 4A $C_{Ft} =$ **1.10**

Size factor for compression - Table 4A $C_{Fc} =$ **1.00**

Flat use factor - Table 4A $C_{fu} =$ **1.20**

Incising factor for modulus of elasticity - Table 4.3.8

$C_{iE} =$ **1.00**

Incising factor for bending, shear, tension & compression - Table 4.3.8

$C_i =$ **1.00**

Incising factor for perpendicular compression - Table 4.3.8

$C_{ic\_perp} =$ **1.00**

Repetitive member factor - cl.4.3.9 $C_r =$ **1.15**

Bearing area factor - cl.3.10.4 $C_b =$ **1.00**

Depth-to-breadth ratio $d_{nom} / (N \times b_{nom}) =$ **5.00**

- Beam is fully restrained

Beam stability factor - cl.3.3.3 $C_L =$ **1.00**

Bearing perpendicular to grain - cl.3.10.2

Design compression perpendicular to grain $F_{c\_perp}' = F_{c\_perp} \times C_t \times C_{ic\_perp} \times C_b =$ **405** lb/in^2

Applied compression stress perpendicular to grain $f_{c\_perp} = R_{A\_max} / (N \times b \times L_b) =$ **179** lb/in^2

$f_{c\_perp} / F_{c\_perp}' =$ **0.442**

PASS - Design compressive stress exceeds applied compressive stress at bearing

Strength in bending - cl.3.3.1

Design bending stress $F_b' = F_b \times C_D \times C_t \times C_L \times C_{Fb} \times C_i \times C_r =$ **1075** lb/in^2

Actual bending stress $f_b = M / S_x =$ **678** lb/in^2

$f_b / F_b' =$ **0.631**

PASS - Design bending stress exceeds actual bending stress

Strength in shear parallel to grain - cl.3.4.1

Design shear stress $F_v' = F_v \times C_D \times C_t \times C_i =$ **150** lb/in^2

Actual shear stress - eq.3.4-2 $f_v = 3 \times F / (2 \times A) =$ **58** lb/in^2

$f_v / F_v' =$ **0.387**

PASS - Design shear stress exceeds actual shear stress

Deflection - cl.3.5.1

Modulus of elasticity for deflection $E' = E \times C_{ME} \times C_t \times C_{iE} =$ **1300000** lb/in^2

Design deflection $\delta_{adm} = 0.003 \times L_{s1} =$ **0.324** in

Total deflection $\delta_{b\_s1} =$ **0.137** in

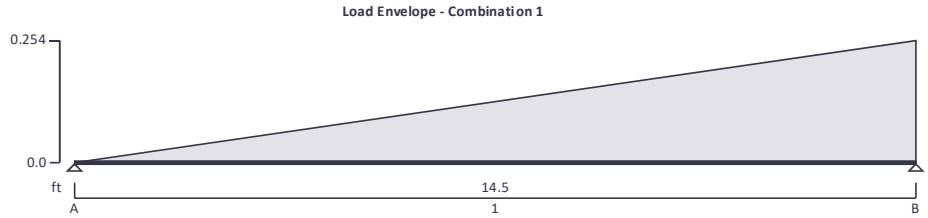
$\delta_{b\_s1} / \delta_{adm} =$ **0.423**

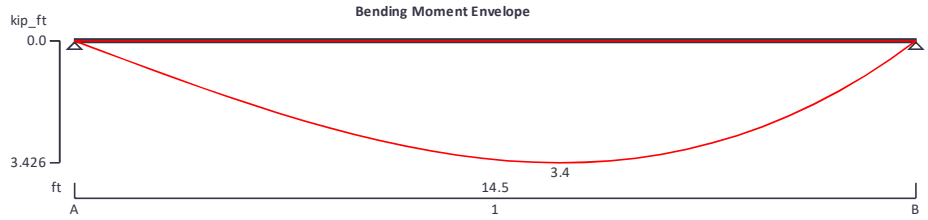
PASS - Total deflection is less than design deflection

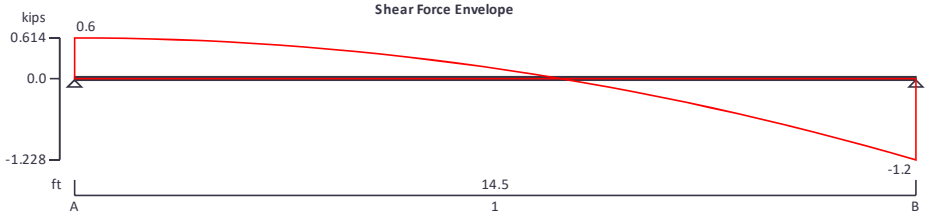
STRUCTURAL WOOD MEMBER ANALYSIS & DESIGN (NDS)

In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

Tedds calculation version 1.7.09







Applied loading

Beam loads

DL	Dead partial VDL 0 lb/ft at 0.00 in to 64 lb/ft at 174.00 in
LL	Snow partial VDL 0 lb/ft at 0.00 in to 190 lb/ft at 174.00 in

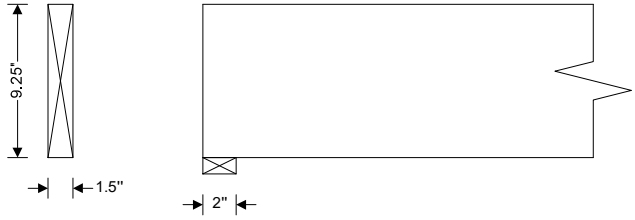
Load combinations

Load combination 1	Support A	Dead × 1.00
		Snow × 1.00
	Span 1	Dead × 1.00
		Snow × 1.00
	Support B	Dead × 1.00
		Snow × 1.00

Analysis results

Maximum moment	M_{max} = **3426** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **3426** lb_ft	

Maximum shear	F_{max} = **614** lb	F_{min} = **-1228** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **1228** lb	
Total load on member	W_{tot} = **1841** lb	
Reaction at support A	R_{A_max} = **614** lb	R_{A_min} = **614** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **155** lb	
Unfactored snow load reaction at support A	R_{A_Snow} = **459** lb	
Reaction at support B	R_{B_max} = **1228** lb	R_{B_min} = **1228** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **309** lb	
Unfactored snow load reaction at support B	R_{B_Snow} = **918** lb	



Sawn lumber section details

Nominal breadth of sections	b_{nom} = **2** in
Dressed breadth of sections	b = **1.5** in
Nominal depth of sections	d_{nom} = **10** in
Dressed depth of sections	d = **9.25** in
Number of sections in member	N = **1**
Overall breadth of member	b_b = N × b = **1.5** in
Species, grade and size classification	Southern Pine, Select Structural grade, 10" wide
Bending parallel to grain	F_b = **1700** lb/in^2
Tension parallel to grain	F_t = **1150** lb/in^2
Compression parallel to grain	F_c = **1650** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **565** lb/in^2
Shear parallel to grain	F_v = **175** lb/in^2
Modulus of elasticity	E = **1800000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **660000** lb/in^2
Mean shear modulus	G_{def} = E / 16 = **112500** lb/in^2

Member details

Service condition	**Dry**
Length of span	L_{s1} = **14.5** ft
Length of bearing	L_b = **2** in
Load duration	**Seven days**

Section properties

Cross sectional area of member	A = N × b × d = **13.87** in^2
Section modulus	S_x = N × b × d^2 / 6 = **21.39** in^3
	S_y = d × (N × b)^2 / 6 = **3.47** in^3
Second moment of area	I_x = N × b × d^3 / 12 = **98.93** in^4
	I_y = d × (N × b)^3 / 12 = **2.60** in^4

Adjustment factors

Load duration factor - Table 2.3.2 C_D = **1.25**

Temperature factor - Table 2.3.3 C_t = **1.00**

Size factor for bending - Table 4B C_{Fb} = **1.00**

Size factor for tension - Table 4B C_{Ft} = **1.00**

Size factor for compression - Table 4B C_{Fc} = **1.00**

Flat use factor - Table 4B C_{fu} = **1.20**

Incising factor for modulus of elasticity - Table 4.3.8

C_{iE} = **1.00**

Incising factor for bending, shear, tension & compression - Table 4.3.8

C_i = **1.00**

Incising factor for perpendicular compression - Table 4.3.8

C_{ic_perp} = **1.00**

Repetitive member factor - cl.4.3.9 C_r = **1.00**

Bearing area factor - cl.3.10.4 C_b = **1.00**

Depth-to-breadth ratio $d_{nom} / (N \times b_{nom})$ = **5.00**

- Beam is fully restrained

Beam stability factor - cl.3.3.3 C_L = **1.00**

Bearing perpendicular to grain - cl.3.10.2

Design compression perpendicular to grain $F_{c\_perp}' = F_{c\_perp} \times C_t \times C_{ic\_perp} \times C_b$ = **565** lb/in^2

Applied compression stress perpendicular to grain $f_{c\_perp} = R_{B\_max} / (N \times b \times L_b)$ = **409** lb/in^2

f_{c_perp} / F_{c_perp}' = **0.724**

PASS - Design compressive stress exceeds applied compressive stress at bearing

Strength in bending - cl.3.3.1

Design bending stress $F_b' = F_b \times C_D \times C_t \times C_L \times C_{Fb} \times C_i \times C_r$ = **2125** lb/in^2

Actual bending stress $f_b = M / S_x$ = **1922** lb/in^2

f_b / F_b' = **0.904**

PASS - Design bending stress exceeds actual bending stress

Strength in shear parallel to grain - cl.3.4.1

Design shear stress $F_v' = F_v \times C_D \times C_t \times C_i$ = **219** lb/in^2

Actual shear stress - eq.3.4-2 $f_v = 3 \times F / (2 \times A)$ = **133** lb/in^2

f_v / F_v' = **0.607**

PASS - Design shear stress exceeds actual shear stress

Deflection - cl.3.5.1

Modulus of elasticity for deflection $E' = E \times C_{ME} \times C_t \times C_{iE}$ = **1800000** lb/in^2

Design deflection $\delta_{adm} = 0.0042 \times L_{s1}$ = **0.731** in

Total deflection δ_{b_s1} = **0.711** in

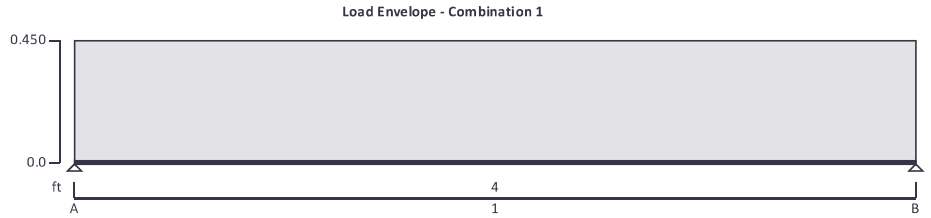
$\delta_{b\_s1} / \delta_{adm}$ = **0.972**

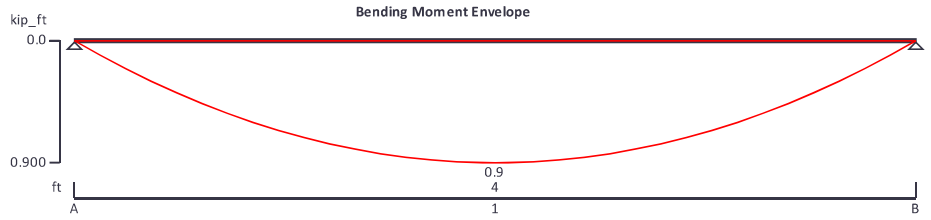
PASS - Total deflection is less than design deflection

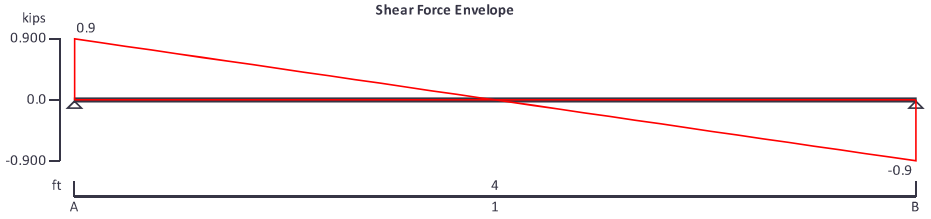
STRUCTURAL WOOD MEMBER ANALYSIS & DESIGN (NDS)

In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

Tedds calculation version 1.7.09







Applied loading

Beam loads

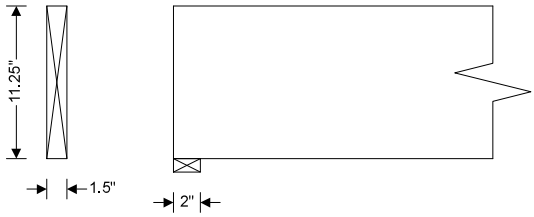
	Dead self weight of beam × 0
DL	Dead full UDL 150 lb/ft
LL	Snow full UDL 300 lb/ft

Load combinations

Load combination 1	Support A	Dead × 1.00
		Snow × 1.00
	Span 1	Dead × 1.00
		Snow × 1.00
	Support B	Dead × 1.00
		Snow × 1.00

Analysis results

Maximum moment	M_{max} = **900** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **900** lb_ft	
Maximum shear	F_{max} = **900** lb	F_{min} = **-900** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **900** lb	
Total load on member	W_{tot} = **1800** lb	
Reaction at support A	R_{A_max} = **900** lb	R_{A_min} = **900** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **300** lb	
Unfactored snow load reaction at support A	R_{A_Snow} = **600** lb	
Reaction at support B	R_{B_max} = **900** lb	R_{B_min} = **900** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **300** lb	
Unfactored snow load reaction at support B	R_{B_Snow} = **600** lb	



Sawn lumber section details

Nominal breadth of sections	b_{nom} = **2** in
Dressed breadth of sections	b = **1.5** in
Nominal depth of sections	d_{nom} = **12** in
Dressed depth of sections	d = **11.25** in
Number of sections in member	N = **1**
Overall breadth of member	b_b = N × b = **1.5** in
Species, grade and size classification	Southern Pine, No.1 grade, 12" wide
Bending parallel to grain	F_b = **1000** lb/in^2
Tension parallel to grain	F_t = **650** lb/in^2
Compression parallel to grain	F_c = **1400** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **565** lb/in^2
Shear parallel to grain	F_v = **175** lb/in^2
Modulus of elasticity	E = **1600000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **580000** lb/in^2
Mean shear modulus	G_{def} = E / 16 = **100000** lb/in^2

Member details

Service condition	**Dry**
Length of span	L_{s1} = **4** ft
Length of bearing	L_b = **2** in
Load duration	**Seven days**

The beam is one of three or more repetitive members

Section properties

Cross sectional area of member	A = N × b × d = **16.87** in^2

Section modulus	$S_x = N \times b \times d^2 / 6 =$ **31.64** in^3
	$S_y = d \times (N \times b)^2 / 6 =$ **4.22** in^3
Second moment of area	$I_x = N \times b \times d^3 / 12 =$ **177.98** in^4
	$I_y = d \times (N \times b)^3 / 12 =$ **3.16** in^4

Adjustment factors

Load duration factor - Table 2.3.2	$C_D =$ **1.25**
Temperature factor - Table 2.3.3	$C_t =$ **1.00**
Size factor for bending - Table 4B	$C_{Fb} =$ **1.00**
Size factor for tension - Table 4B	$C_{Ft} =$ **1.00**
Size factor for compression - Table 4B	$C_{Fc} =$ **1.00**
Flat use factor - Table 4B	$C_{fu} =$ **1.20**
Incising factor for modulus of elasticity - Table 4.3.8	
	$C_{iE} =$ **1.00**
Incising factor for bending, shear, tension & compression - Table 4.3.8	
	$C_i =$ **1.00**
Incising factor for perpendicular compression - Table 4.3.8	
	$C_{ic\_perp} =$ **1.00**
Repetitive member factor - cl.4.3.9	$C_r =$ **1.15**
Bearing area factor - cl.3.10.4	$C_b =$ **1.00**
Depth-to-breadth ratio	$d_{nom} / (N \times b_{nom}) =$ **6.00**
- Beam is fully restrained	
Beam stability factor - cl.3.3.3	$C_L =$ **1.00**

Bearing perpendicular to grain - cl.3.10.2

Design compression perpendicular to grain	$F_{c\_perp}' = F_{c\_perp} \times C_t \times C_{ic\_perp} \times C_b =$ **565** lb/in^2
Applied compression stress perpendicular to grain	$f_{c\_perp} = R_{B\_max} / (N \times b \times L_b) =$ **300** lb/in^2
	$f_{c\_perp} / F_{c\_perp}' =$ **0.531**

PASS - Design compressive stress exceeds applied compressive stress at bearing

Strength in bending - cl.3.3.1

Design bending stress	$F_b' = F_b \times C_D \times C_t \times C_L \times C_{Fb} \times C_i \times C_r =$ **1437** lb/in^2
Actual bending stress	$f_b = M / S_x =$ **341** lb/in^2
	$f_b / F_b' =$ **0.237**

PASS - Design bending stress exceeds actual bending stress

Strength in shear parallel to grain - cl.3.4.1

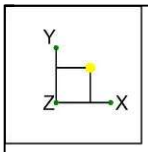
Design shear stress	$F_v' = F_v \times C_D \times C_t \times C_i =$ **219** lb/in^2
Actual shear stress - eq.3.4-2	$f_v = 3 \times F / (2 \times A) =$ **80** lb/in^2
	$f_v / F_v' =$ **0.366**

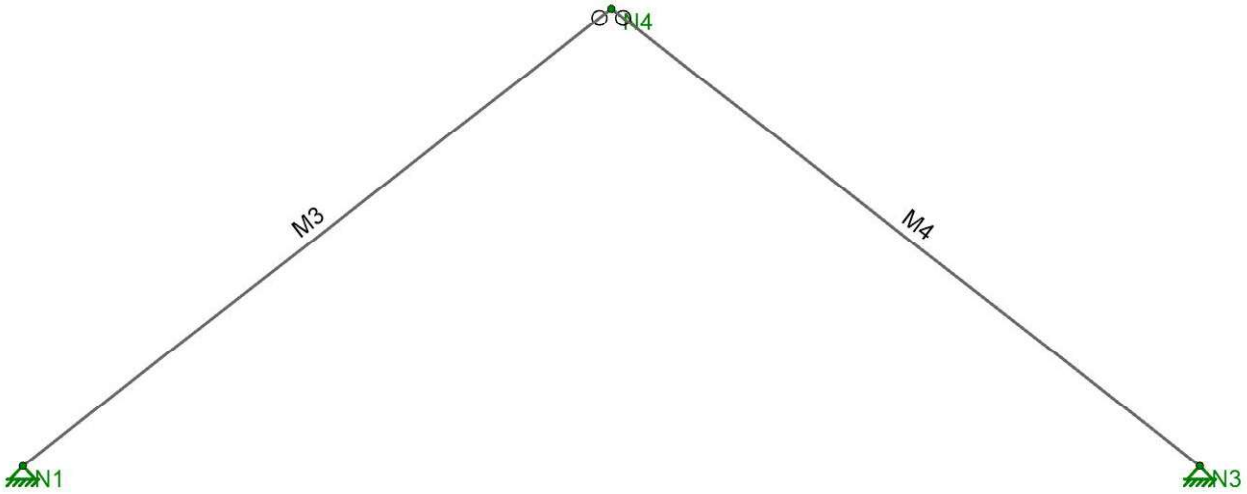
PASS - Design shear stress exceeds actual shear stress

Deflection - cl.3.5.1

Modulus of elasticity for deflection	$E' = E \times C_{ME} \times C_t \times C_{iE} =$ **1600000** lb/in^2
Design deflection	$\delta_{adm} = 0.003 \times L_{s1} =$ **0.144** in
Total deflection	$\delta_{b\_s1} =$ **0.009** in
	$\delta_{b\_s1} / \delta_{adm} =$ **0.063**

PASS - Total deflection is less than design deflection





Albrecht Engineering	GSP Rafters at porch hip	1
EB		Apr 14, 2021
		Rafter Truss at porch hip.r3d

Node Coordinates

	Label	X [ft]	Y [ft]	Z [ft]	Detach From Diaphragm
1	N1	0	0	0	
2	N3	18	0	0	
3	N4	9	7	0	

Member Primary Data

	Label	I Node	J Node	Section/Shape	Type	Design List	Material	Design Rule
1	M3	N1	N4	2X10	Beam	Rectangular Double	SP	Typical
2	M4	N4	N3	2X10	Beam	Rectangular Double	SP	Typical

Member Distributed Loads (BLC 1 : DL)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, k-ft/ft]	End Magnitude [k/ft, F, ksf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M3	Y	-0.013	-0.013	0	%100
2	M4	Y	-0.013	-0.013	0	%100

Member Distributed Loads (BLC 2 : SL)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, k-ft/ft]	End Magnitude [k/ft, F, ksf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M3	Y	-0.035	-0.035	0	%100
2	M4	Y	-0.035	-0.035	0	%100

Node Loads and Enforced Displacements (BLC 1 : DL)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N4	L	Y	-0.63
2	N4	L	Y	-0.3

Node Loads and Enforced Displacements (BLC 2 : SL)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N4	L	Y	-1.868
2	N4	L	Y	-0.6

Load Combinations

	Description	Solve	PDelta	BLC	Factor	BLC	Factor
1	IBC 16-8	Yes	Y	DL	1		
2	IBC 16-10 (b)	Yes	Y	DL	1	SL	1

Envelope AWC NDS-18: ASD Member Wood Code Checks

	Member	Shape	Code Check	Loc[ft]	LC	Shear Check	Loc[ft]	Dir	LC	Fc' [ksi]	Ft' [ksi]	Fb1' [ksi]	Fb2' [ksi]	Fv' [ksi]	RB	CL	CP	Eqn
1	M3	2X10	0.236	5.701	2	0.124	11.402	y	2	1.468	1.323	1.942	1.955	0.201	7.024	0.993	0.774	3.9-3
2	M4	2X10	0.236	5.701	2	0.124	11.402	y	2	1.468	1.323	1.942	1.955	0.201	7.024	0.993	0.774	3.9-3

Envelope Maximum Member Section Forces

	Member		Axial[k]	Loc[ft]	LC	y Shear[k]	Loc[ft]	LC	z Shear[k]	Loc[ft]	LC	Torque[k-ft]	Loc[ft]	LC	y-y Moment[k-ft]	Loc[ft]	LC	z-z Moment[k-ft]	Loc[ft]	LC
1	M3	max	3.425	0	2	0.231	0	2	0	11.402	2	0	11.402	2	0	11.402	2	0	11.402	2
2		min	0.852	11.402	1	-0.231	11.402	2	0	0	1	0	0	1	0	0	1	-0.659	5.701	2
3	M4	max	3.425	11.402	2	0.231	0	2	0	11.402	2	0	11.402	2	0	11.402	2	0	11.402	2
4		min	0.852	0	1	-0.231	11.402	2	0	0	1	0	0	1	0	0	1	-0.659	5.701	2

Envelope Member End Reactions

	Member	Member End		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
1	M3	I	max	3.425	2	0.231	2	0	2	0	2	0	2	0	2
2			min	0.967	1	0.074	1	0	1	0	1	0	1	0	1
3		J	max	3.065	2	-0.074	1	0	2	0	2	0	2	0	2
4			min	0.852	1	-0.231	2	0	1	0	1	0	1	0	1
5	M4	I	max	3.065	2	0.231	2	0	2	0	2	0	2	0	2
6			min	0.852	1	0.074	1	0	1	0	1	0	1	0	1
7		J	max	3.425	2	-0.074	1	0	2	0	2	0	2	0	2
8			min	0.967	1	-0.231	2	0	1	0	1	0	1	0	1

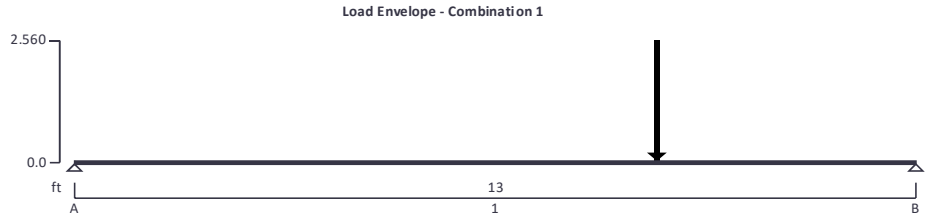
Envelope Node Reactions

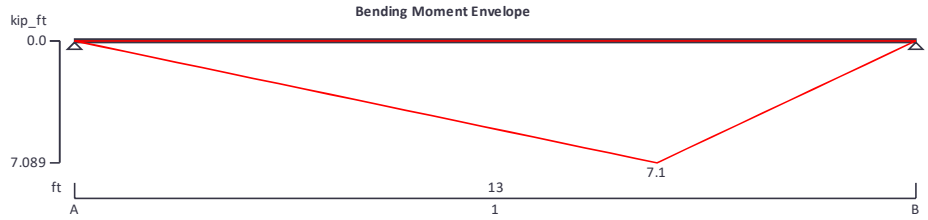
	Node Label		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N1	max	2.562	2	2.285	2	0	2	0	2	0	2	0	2
2		min	0.718	1	0.652	1	0	1	0	1	0	1	0	1
3	N3	max	-0.718	1	2.285	2	0	2	0	2	0	2	0	2
4		min	-2.562	2	0.652	1	0	1	0	1	0	1	0	1
5	N4	max	NC		NC		LOCKED		LOCKED		LOCKED		LOCKED	
6		min	NC		NC		LOCKED		LOCKED		LOCKED		LOCKED	
7	Totals:	max	0	2	4.569	2	0	2						
8		min	0	1	1.303	1	0	1						

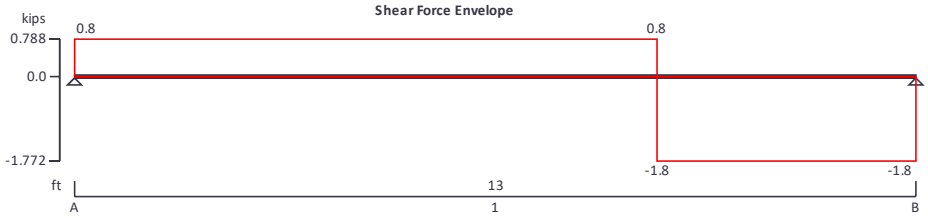
STEEL BEAM ANALYSIS & DESIGN (AISC360-10)

In accordance with AISC360-10 using the ASD method

Tedds calculation version 3.0.15







Support conditions

Support A	Vertically restrained
	Rotationally free
Support B	Vertically restrained
	Rotationally free

Applied loading

Beam loads	D - Dead point load 0.71 kips at 108.00 in
	L - Snow point load 1.85 kips at 108.00 in

Load combinations

Load combination 1 - D+S	Support A	Dead × 1.00
		Live × 1.00
		Roof live × 1.00
		Snow × 1.00
		Dead × 1.00

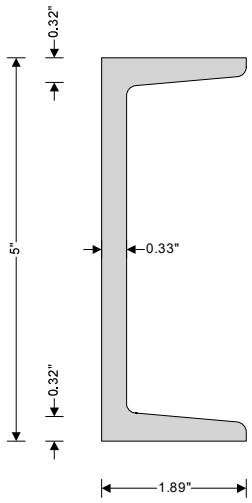
		Live × 1.00
		Roof live × 1.00
		Snow × 1.00
	Support B	Dead × 1.00
		Live × 1.00
		Roof live × 1.00
		Snow × 1.00

Analysis results

Maximum moment	M_{max} = **7.1** kips_ft	M_{min} = **0** kips_ft
Maximum shear	V_{max} = **0.8** kips	V_{min} = **-1.8** kips
Deflection	δ_{max} = **0.6** in	δ_{min} = **0** in
Maximum reaction at support A	R_{A_max} = **0.8** kips	R_{A_min} = **0.8** kips
Unfactored dead load reaction at support A	R_{A_Dead} = **0.2** kips	
Unfactored snow load reaction at support A	R_{A_Snow} = **0.6** kips	
Maximum reaction at support B	R_{B_max} = **1.8** kips	R_{B_min} = **1.8** kips
Unfactored dead load reaction at support B	R_{B_Dead} = **0.5** kips	
Unfactored snow load reaction at support B	R_{B_Snow} = **1.3** kips	

Section details

Section type	**C 5x9 (AISC 15th Edn (v15.0))**
ASTM steel designation	**A992**
Steel yield stress	F_y = **50** ksi
Steel tensile stress	F_u = **65** ksi
Modulus of elasticity	E = **29000** ksi



Safety factors

Safety factor for tensile yielding	Ω_{ty} = **1.67**
Safety factor for tensile rupture	Ω_{tr} = **2.00**
Safety factor for compression	Ω_c = **1.67**
Safety factor for flexure	Ω_b = **1.67**

Lateral bracing

Span 1 has continuous lateral bracing

Classification of sections for local buckling - Section B4.1

Classification of flanges in flexure - Table B4.1b (case 10)

Width to thickness ratio	b_f / t_f = **5.91**	
Limiting ratio for compact section	$\lambda_{pff} = 0.38 \times \sqrt{[E / F_y]}$ = **9.15**	
Limiting ratio for non-compact section	$\lambda_{rff} = 1.0 \times \sqrt{[E / F_y]}$ = **24.08**	Compact

Classification of web in flexure - Table B4.1b (case 15)

Width to thickness ratio	$(d - 2 \times k) / t_w$ = **10.77**	
Limiting ratio for compact section	$\lambda_{pwf} = 3.76 \times \sqrt{[E / F_y]}$ = **90.55**	
Limiting ratio for non-compact section	$\lambda_{rwf} = 5.70 \times \sqrt{[E / F_y]}$ = **137.27**	Compact

Section is compact in flexure

Design of members for shear - Chapter G

Required shear strength	$V_r = \max(\text{abs}(V_{max}), \text{abs}(V_{min}))$ = **1.772** kips
Web area	$A_w = d \times t_w$ = **1.625** in^2
Web plate buckling coefficient	k_v = **5**
Web shear coefficient - eq G2-3	C_v = **1**
Nominal shear strength – eq G2-1	$V_n = 0.6 \times F_y \times A_w \times C_v$ = **48.750** kips
Safety factor for shear	Ω_v = **1.67**
Allowable shear strength	$V_c = V_n / \Omega_v$ = **29.192** kips

PASS - Allowable shear strength exceeds required shear strength

Design of members for flexure in the major axis - Chapter F

Required flexural strength $M_r = \max(\text{abs}(M_{s1\_max}), \text{abs}(M_{s1\_min}))$ = **7.089** kips_ft

Yielding - Section F2.1

Nominal flexural strength for yielding - eq F2-1	$M_{nyld} = M_p = F_y \times Z_x$ = **18.292** kips_ft
Nominal flexural strength	$M_n = M_{nyld}$ = **18.292** kips_ft
Allowable flexural strength	$M_c = M_n / \Omega_b$ = **10.953** kips_ft

PASS - Allowable flexural strength exceeds required flexural strength

Design of members for vertical deflection

Consider deflection due to dead, live, roof live and snow loads

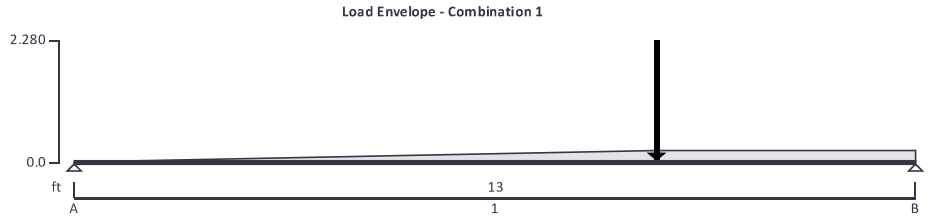
Limiting deflection	$\delta_{lim} = L_{s1} / 240$ = **0.65** in
Maximum deflection span 1	$\delta = \max(\text{abs}(\delta_{max}), \text{abs}(\delta_{min}))$ = **0.641** in

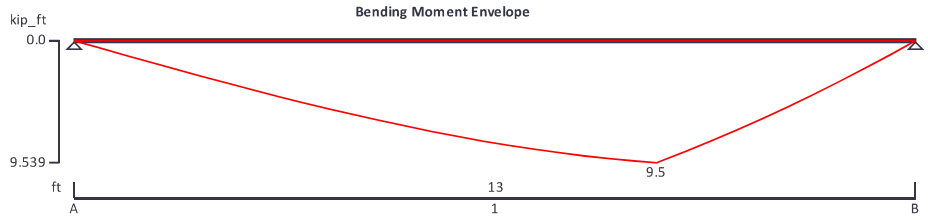
PASS - Maximum deflection does not exceed deflection limit

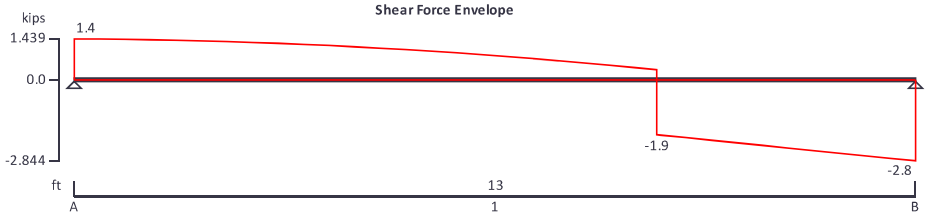
STRUCTURAL COMPOSITE LUMBER MEMBER ANALYSIS & DESIGN (NDS)

In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

Tedds calculation version 1.7.09







Applied loading

Beam loads

	Dead self weight of beam × 1
P(D)	Dead point load 650 lb at 108.00 in
P(S)	Snow point load 1630 lb at 108.00 in
wDLt	Dead partial VDL 0 lb/ft at 0.00 in to 74 lb/ft at 108.00 in
WSLt	Snow partial VDL 0 lb/ft at 0.00 in to 144 lb/ft at 108.00 in
wDL	Dead partial UDL 74 lb/ft from 108.00 in to 156.00 in
WSL	Snow partial UDL 144 lb/ft from 108.00 in to 156.00 in

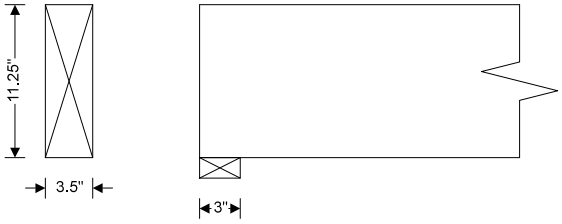
Load combinations

Load combination 1	Support A	Dead × 1.00
		Snow × 1.00
		Live × 1.00
	Span 1	Dead × 1.00

		Snow × 1.00
		Live × 1.00
	Support B	Dead × 1.00
		Snow × 1.00
		Live × 1.00

Analysis results

Maximum moment	M_{max} = **9539** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **9539** lb_ft	
Maximum shear	F_{max} = **1439** lb	F_{min} = **-2844** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **2844** lb	
Total load on member	W_{tot} = **4282** lb	
Reaction at support A	R_{A_max} = **1439** lb	R_{A_min} = **1439** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **499** lb	
Unfactored snow load reaction at support A	R_{A_Snow} = **939** lb	
Reaction at support B	R_{B_max} = **2844** lb	R_{B_min} = **2844** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **929** lb	
Unfactored snow load reaction at support B	R_{B_Snow} = **1915** lb	



Composite section details

Breadth of composite section	b = **3.5** in
Depth of composite section	d = **11.25** in
Number of composite sections in member	N = **1**
Overall breadth of composite member	b_b = N × b = **3.5** in
Composite type and grade	Microllam LVL, 2.0E-2600Fb grade
Bending parallel to grain	F_b = **2600** lb/in^2
Tension parallel to grain	F_t = **1555** lb/in^2
Compression parallel to grain	F_c = **2510** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **750** lb/in^2
Shear parallel to grain	F_v = **285** lb/in^2
Modulus of elasticity	E = **2000000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **1017000** lb/in^2
Mean shear modulus	G_{def} = E / 16 = **125000** lb/in^2
Average density	ρ = **42** lb/ft^3

Member details

Service condition	**Dry**
Length of span	L_{s1} = **13** ft
Length of bearing	L_b = **3** in

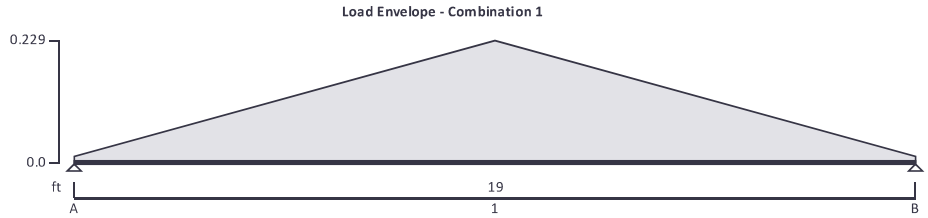
Load duration	**Ten years**
Section properties	
Cross sectional area of member	$A = N \times b \times d =$ **39.38** in^2
Section modulus	$S_x = N \times b \times d^2 / 6 =$ **73.83** in^3
	$S_y = d \times (N \times b)^2 / 6 =$ **22.97** in^3
Second moment of area	$I_x = N \times b \times d^3 / 12 =$ **415.28** in^4
	$I_y = d \times (N \times b)^3 / 12 =$ **40.20** in^4
Adjustment factors	
Load duration factor - Table 2.3.2	$C_D =$ **1.00**
Temperature factor - Table 2.3.3	$C_t =$ **1.00**
Volume factor	$C_V = (12\ in / \max(d, 3.5\ in))^{0.136} =$ **1.01**
Repetitive member factor - cl.8.3.7	$C_r =$ **1.00**
Length factor	$C_{Len} = (4\ ft / L_{s1})^{0.085} =$ **0.90**
Bearing area factor - cl.3.10.4	$C_b =$ **1.00**
Depth-to-breadth ratio	$d / (N \times b) =$ **3.21**
Effective laterally unsupported span length	$l_e =$ **1.333** ft
Slenderness ratio for bending members - eq.3.3-5	$R_b = \sqrt{[l_e \times d / (N \times b)^2]} =$ **3.833**
Adjusted bending design value for bending	$F_b^* = F_b \times C_D \times C_M \times C_t \times C_r =$ **2600** lb/in^2
Adjusted modulus of elasticity for member stability	$E_{min}' = E_{min} \times C_M \times C_t =$ **1017000** lb/in^2
Critical buckling design value for bending	$F_{bE} = 1.2 \times E_{min}' / R_b^2 =$ **83076** lb/in^2
Beam stability factor - eq.3.3-6	
	$C_L = [1 + (F_{bE} / F_b^*)] / 1.9 - \sqrt{[([1 + (F_{bE} / F_b^*)] / 1.9)^2 - (F_{bE} / F_b^*) / 0.95]} =$ **1.00**
Bearing perpendicular to grain - cl.3.10.2	
Design compression perpendicular to grain	$F_{c\_perp}' = F_{c\_perp} \times C_t \times C_b =$ **750** lb/in^2
Applied compression stress perpendicular to grain	$f_{c\_perp} = R_{B\_max} / (N \times b \times L_b) =$ **271** lb/in^2
	$f_{c\_perp} / F_{c\_perp}' =$ **0.361**
	PASS - Design compressive stress exceeds applied compressive stress at bearing
Strength in bending - cl.3.3.1	
Design bending stress	$F_b' = F_b \times C_D \times C_t \times C_L \times C_V \times C_r =$ **2619** lb/in^2
Actual bending stress	$f_b = M / S_x =$ **1550** lb/in^2
	$f_b / F_b' =$ **0.592**
	PASS - Design bending stress exceeds actual bending stress
Strength in shear parallel to grain - cl.3.4.1	
Design shear stress	$F_v' = F_v \times C_D \times C_t =$ **285** lb/in^2
Actual shear stress - eq.3.4-2	$f_v = 3 \times F / (2 \times A) =$ **108** lb/in^2
	$f_v / F_v' =$ **0.380**
	PASS - Design shear stress exceeds actual shear stress
Deflection - cl.3.5.1	
Modulus of elasticity for deflection	$E' = E \times C_M \times C_t =$ **2000000** lb/in^2
Design deflection	$\delta_{adm} = 0.004 \times L_{s1} =$ **0.624** in
Total deflection	$\delta_{b\_s1} =$ **0.302** in
	$\delta_{b\_s1} / \delta_{adm} =$ **0.484**

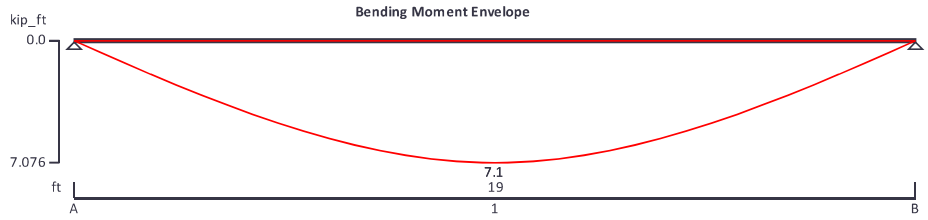
PASS - Total deflection is less than design deflection

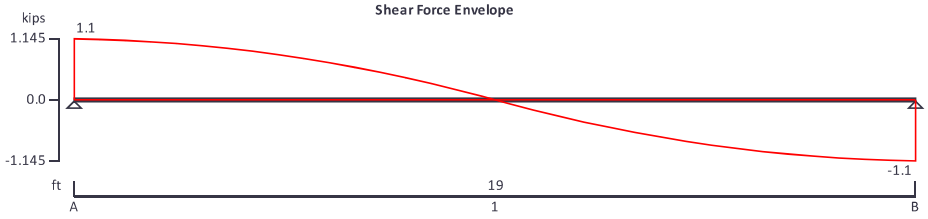
STRUCTURAL COMPOSITE LUMBER MEMBER ANALYSIS & DESIGN (NDS)

In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

Tedds calculation version 1.7.09







Applied loading

Beam loads

	Dead self weight of beam × 1
wDLt	Dead partial VDL 0 lb/ft at 0.00 in to 74 lb/ft at 114.00 in
WSLt	Snow partial VDL 0 lb/ft at 0.00 in to 144 lb/ft at 114.00 in
wDL	Dead partial VDL 74 lb/ft at 114.00 in to 0 lb/ft at 228.00 in
WSL	Snow partial VDL 144 lb/ft at 114.00 in to 0 lb/ft at 228.00 in

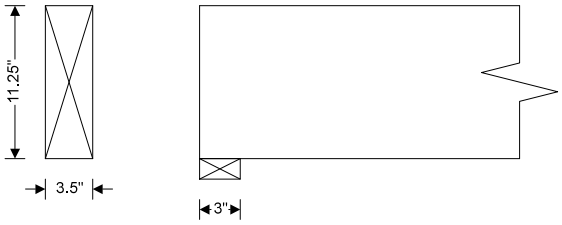
Load combinations

Load combination 1	Support A	Dead × 1.00
		Snow × 1.00
		Live × 1.00
	Span 1	Dead × 1.00
		Snow × 1.00
		Live × 1.00

	Support B	Dead × 1.00
		Snow × 1.00
		Live × 1.00

Analysis results

Maximum moment	M_{max} = **7076** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **7076** lb_ft	
Maximum shear	F_{max} = **1145** lb	F_{min} = **-1145** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **1145** lb	
Total load on member	W_{tot} = **2289** lb	
Reaction at support A	R_{A_max} = **1145** lb	R_{A_min} = **1145** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **461** lb	
Unfactored snow load reaction at support A	R_{A_Snow} = **684** lb	
Reaction at support B	R_{B_max} = **1145** lb	R_{B_min} = **1145** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **461** lb	
Unfactored snow load reaction at support B	R_{B_Snow} = **684** lb	



Composite section details

Breadth of composite section	b = **3.5** in
Depth of composite section	d = **11.25** in
Number of composite sections in member	N = **1**
Overall breadth of composite member	b_b = N × b = **3.5** in
Composite type and grade	Microllam LVL, 2.0E-2600Fb grade
Bending parallel to grain	F_b = **2600** lb/in^2
Tension parallel to grain	F_t = **1555** lb/in^2
Compression parallel to grain	F_c = **2510** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **750** lb/in^2
Shear parallel to grain	F_v = **285** lb/in^2
Modulus of elasticity	E = **2000000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **1017000** lb/in^2
Mean shear modulus	G_{def} = E / 16 = **125000** lb/in^2
Average density	ρ = **42** lb/ft^3

Member details

Service condition	**Dry**
Length of span	L_{s1} = **19** ft
Length of bearing	L_b = **3** in
Load duration	**Ten years**

Section properties

Cross sectional area of member $A = N \times b \times d =$ **39.38** in^2

Section modulus $S_x = N \times b \times d^2 / 6 =$ **73.83** in^3

$S_y = d \times (N \times b)^2 / 6 =$ **22.97** in^3

Second moment of area $I_x = N \times b \times d^3 / 12 =$ **415.28** in^4

$I_y = d \times (N \times b)^3 / 12 =$ **40.20** in^4

Adjustment factors

Load duration factor - Table 2.3.2 $C_D =$ **1.00**

Temperature factor - Table 2.3.3 $C_t =$ **1.00**

Volume factor $C_V = (12 \text{ in} / \max(d, 3.5 \text{ in}))^{0.136} =$ **1.01**

Repetitive member factor - cl.8.3.7 $C_r =$ **1.00**

Length factor $C_{Len} = (4 \text{ ft} / L_{s1})^{0.085} =$ **0.88**

Bearing area factor - cl.3.10.4 $C_b =$ **1.00**

Depth-to-breadth ratio $d / (N \times b) =$ **3.21**

Effective laterally unsupported span length $l_e =$ **1.333** ft

Slenderness ratio for bending members - eq.3.3-5 $R_b = \sqrt{[l_e \times d / (N \times b)^2]} =$ **3.833**

Adjusted bending design value for bending $F_b^* = F_b \times C_D \times C_M \times C_t \times C_r =$ **2600** lb/in^2

Adjusted modulus of elasticity for member stability $E_{min}' = E_{min} \times C_M \times C_t =$ **1017000** lb/in^2

Critical buckling design value for bending $F_{bE} = 1.2 \times E_{min}' / R_b^2 =$ **83076** lb/in^2

Beam stability factor - eq.3.3-6

$C_L = [1 + (F_{bE} / F_b^*)] / 1.9 - \sqrt{[([1 + (F_{bE} / F_b^*)] / 1.9)^2 - (F_{bE} / F_b^*) / 0.95]} =$ **1.00**

Bearing perpendicular to grain - cl.3.10.2

Design compression perpendicular to grain $F_{c\_perp}' = F_{c\_perp} \times C_t \times C_b =$ **750** lb/in^2

Applied compression stress perpendicular to grain $f_{c\_perp} = R_{A\_max} / (N \times b \times L_b) =$ **109** lb/in^2

$f_{c\_perp} / F_{c\_perp}' =$ **0.145**

PASS - Design compressive stress exceeds applied compressive stress at bearing

Strength in bending - cl.3.3.1

Design bending stress $F_b' = F_b \times C_D \times C_t \times C_L \times C_V \times C_r =$ **2619** lb/in^2

Actual bending stress $f_b = M / S_x =$ **1150** lb/in^2

$f_b / F_b' =$ **0.439**

PASS - Design bending stress exceeds actual bending stress

Strength in shear parallel to grain - cl.3.4.1

Design shear stress $F_v' = F_v \times C_D \times C_t =$ **285** lb/in^2

Actual shear stress - eq.3.4-2 $f_v = 3 \times F / (2 \times A) =$ **44** lb/in^2

$f_v / F_v' =$ **0.153**

PASS - Design shear stress exceeds actual shear stress

Deflection - cl.3.5.1

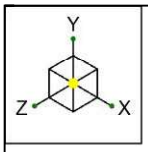
Modulus of elasticity for deflection $E' = E \times C_M \times C_t =$ **2000000** lb/in^2

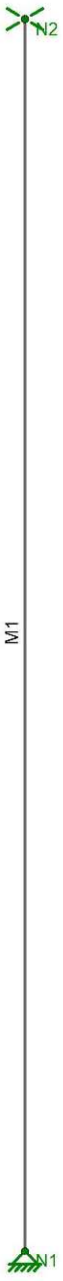
Design deflection $\delta_{adm} = 0.004 \times L_{s1} =$ **0.912** in

Total deflection $\delta_{b\_s1} =$ **0.533** in

$\delta_{b\_s1} / \delta_{adm} =$ **0.585**

PASS - Total deflection is less than design deflection





Albrecht Engineering	Post at Porch	SK-1
EB		Jul 27, 2021
2019-031.01		Post at porch.r3d

Node Coordinates

	Label	X [ft]	Y [ft]	Z [ft]	Detach From Diaphragm
1	N1	0	0	0	
2	N2	0	10	0	

Member Primary Data

	Label	I Node	J Node	Section/Shape	Type	Design List	Material	Design Rule
1	M1	N1	N2	4X4	Column	Posts	SP	Typical

Node Loads and Enforced Displacements (BLC 1 : D)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	Y	-0.96
2	N2	L	MX	0.09

Node Loads and Enforced Displacements (BLC 2 : S)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	Y	-1.623
2	N2	L	MX	0.15

Load Combinations

	Description	Solve	P-Delta	BLC	Factor	BLC	Factor
1	IBC 16-8	Yes	Y	DL	1		
2	IBC 16-10 (b)	Yes	Y	DL	1	SL	1

Envelope Node Reactions

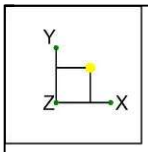
	Node Label		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N2	max	0	2	0	2	-0.009	1	0	2	0	2	0	2
2		min	0	1	0	1	-0.024	2	0	1	0	1	0	1
3	N1	max	0	2	2.613	2	0.024	2	0	2	LOCKED		0	2
4		min	0	1	0.99	1	0.009	1	0	1	LOCKED		0	1
5	Totals:	max	0	2	2.613	2	0	2						
6		min	0	1	0.99	1	0	1						

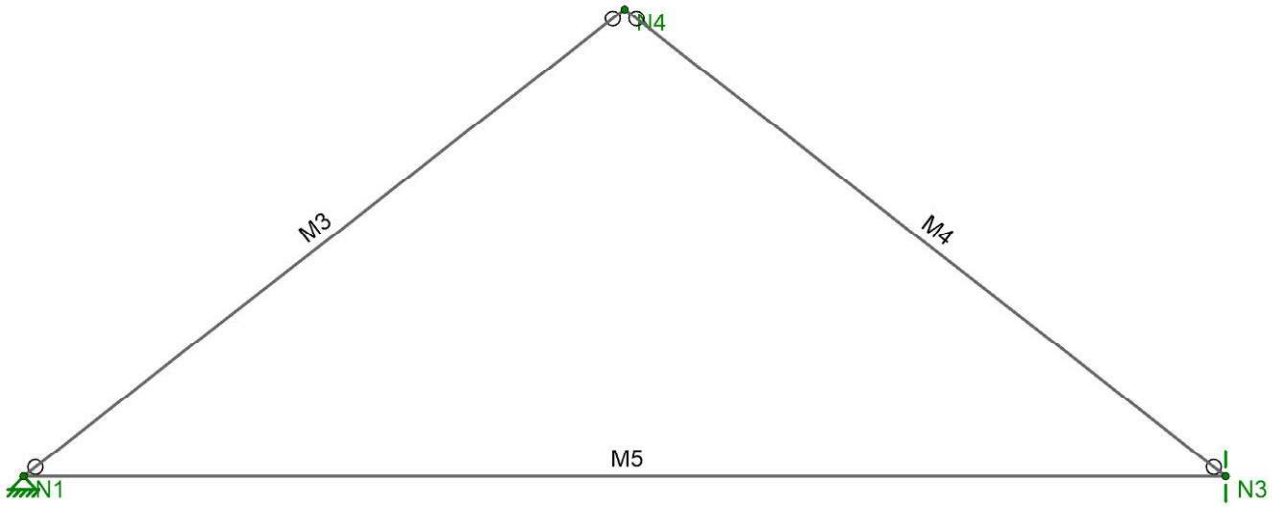
Envelope Member Section Forces

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
1	M1	1	max	2.613	2	0	2	0.024	2	0	2	0	2	0	2
2			min	0.99	1	0	1	0.009	1	0	1	0	1	0	1
3		2	max	2.605	2	0	2	0.024	2	0	2	0.06	2	0	2
4			min	0.982	1	0	1	0.009	1	0	1	0.022	1	0	1
5		3	max	2.598	2	0	2	0.024	2	0	2	0.12	2	0	2
6			min	0.975	1	0	1	0.009	1	0	1	0.045	1	0	1
7		4	max	2.59	2	0	2	0.024	2	0	2	0.18	2	0	2
8			min	0.967	1	0	1	0.009	1	0	1	0.067	1	0	1
9		5	max	2.583	2	0	2	0.024	2	0	2	0.24	2	0	2
10			min	0.96	1	0	1	0.009	1	0	1	0.09	1	0	1

Envelope Member End Reactions

	Member	Member End		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
1	M1	I	max	2.613	2	0	2	0.024	2	0	2	0	2	0	2
2			min	0.99	1	0	1	0.009	1	0	1	0	1	0	1
3		J	max	2.583	2	0	2	0.024	2	0	2	0.24	2	0	2
4			min	0.96	1	0	1	0.009	1	0	1	0.09	1	0	1





Albrecht Engineering	Typical Rafter Truss	1
EB		Apr 15, 2021
2019-031.01		Rafter Truss Typical.r3d

Node Coordinates

	Label	X [ft]	Y [ft]	Z [ft]	Detach From Diaphragm
1	N1	0	0	0	
2	N3	18	0	0	
3	N4	9	7	0	

Member Primary Data

	Label	I Node	J Node	Section/Shape	Type	Design List	Material	Design Rule
1	M3	N1	N4	2X10	Beam	Rectangular Double	SP	Typical
2	M4	N4	N3	2X10	Beam	Rectangular Double	SP	Typical
3	M5	N1	N3	2X10	Beam	Rectangular Double	SP	Typical

Member Point Loads (BLC 1 : DL)

	Member Label	Direction	Magnitude [k, k-ft]	Location [(ft, %)]
1	M5	Y	-0.075	7.5
2	M5	Y	-0.075	10.5

Member Distributed Loads (BLC 1 : DL)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, k-ft/ft]	End Magnitude [k/ft, F, ksf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M3	Y	-0.013	-0.013	0	%100
2	M4	Y	-0.013	-0.013	0	%100
3	M5	Y	-0.013	-0.013	0	%100

Member Distributed Loads (BLC 2 : SL)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, k-ft/ft]	End Magnitude [k/ft, F, ksf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M3	Y	-0.035	-0.035	0	%100
2	M4	Y	-0.035	-0.035	0	%100

Member Distributed Loads (BLC 3 : LL)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, k-ft/ft]	End Magnitude [k/ft, F, ksf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M5	Y	-0.04	-0.04	0	%100

Load Combinations

	Description	Solve	PDelta	BLC	Factor	BLC	Factor	BLC	Factor
1	IBC 16-8	Yes	Y	DL	1				
2	IBC 16-9	Yes	Y	DL	1	LL	1		
3	IBC 16-10 (b)	Yes	Y	DL	1	SL	1		
4	IBC 16-11 (b)	Yes	Y	DL	1	LL	0.75	SL	0.75

Node Reactions

	LC	Node Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	1	N1	0	0.409	0	0	0	0
2	1	N3	0	0.409	0	0	0	0
3	1	N4	NC	NC	LOCKED	LOCKED	NC	LOCKED
4	1	Totals:	0	0.818	0			
5	1	COG (ft):	X: 9	Y: 1.597	Z: 0			
6	2	N1	0	0.769	0	0	0	0
7	2	N3	0	0.769	0	0	0	0
8	2	N4	NC	NC	LOCKED	LOCKED	NC	LOCKED
9	2	Totals:	0	1.538	0			
10	2	COG (ft):	X: 9	Y: 0.85	Z: 0			
11	3	N1	0	0.808	0	0	0	0
12	3	N3	0	0.808	0	0	0	0
13	3	N4	NC	NC	LOCKED	LOCKED	NC	LOCKED
14	3	Totals:	0	1.616	0			
15	3	COG (ft):	X: 9	Y: 2.537	Z: 0			
16	4	N1	0	0.978	0	0	0	0
17	4	N3	0	0.978	0	0	0	0
18	4	N4	NC	NC	LOCKED	LOCKED	NC	LOCKED
19	4	Totals:	0	1.957	0			
20	4	COG (ft):	X: 9	Y: 1.739	Z: 0			

Maximum Member Section Forces

	LC	Member Label		Axial[k]	Loc[ft]	y Shear[k]	Loc[ft]	z Shear[k]	Loc[ft]	Torque[k-ft]	Loc[ft]	y-y Moment[k-ft]	Loc[ft]	z-z Moment[k-ft]	Loc[ft]
1	1	M3	max	0.209	0	0.074	0	0	11.402	0	11.402	0	11.402	0	11.402
2			min	0.095	11.402	-0.074	11.402	0	0	0	0	0	0	-0.21	5.701
3	1	M4	max	0.209	11.402	0.074	0	0	11.402	0	11.402	0	11.402	0	11.402
4			min	0.095	0	-0.074	11.402	0	0	0	0	0	0	-0.21	5.701
5	1	M5	max	-0.12	18	0.222	0	0	18	0	18	0	18	0	18
6			min	-0.12	0	-0.222	18	0	0	0	0	0	0	-1.226	9

Maximum Member Section Forces (Continued)

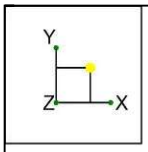
	LC	Member Label		Axial[k]	Loc[ft]	y Shear[k]	Loc[ft]	z Shear[k]	Loc[ft]	Torque[k-ft]	Loc[ft]	y-y Moment[k-ft]	Loc[ft]	z-z Moment[k-ft]	Loc[ft]
7	2	M3	max	0.209	0	0.074	0	0	11.402	0	11.402	0	11.402	0	11.402
8			min	0.095	11.402	-0.074	11.402	0	0	0	0	0	0	-0.21	5.701
9	2	M4	max	0.209	11.402	0.074	0	0	11.402	0	11.402	0	11.402	0	11.402
10			min	0.095	0	-0.074	11.402	0	0	0	0	0	0	-0.21	5.701
11	2	M5	max	-0.12	18	0.582	0	0	18	0	18	0	18	0	18
12			min	-0.12	0	-0.582	18	0	0	0	0	0	0	-2.846	9
13	3	M3	max	0.657	0	0.231	0	0	11.402	0	11.402	0	11.402	0	11.402
14			min	0.297	11.402	-0.231	11.402	0	0	0	0	0	0	-0.659	5.701
15	3	M4	max	0.657	11.402	0.231	0	0	11.402	0	11.402	0	11.402	0	11.402
16			min	0.297	0	-0.231	11.402	0	0	0	0	0	0	-0.659	5.701
17	3	M5	max	-0.377	18	0.222	0	0	18	0	18	0	18	0	18
18			min	-0.377	0	-0.222	18	0	0	0	0	0	0	-1.226	9
19	4	M3	max	0.545	0	0.192	0	0	11.402	0	11.402	0	11.402	0	11.402
20			min	0.247	11.402	-0.192	11.402	0	0	0	0	0	0	-0.547	5.701
21	4	M4	max	0.545	11.402	0.192	0	0	11.402	0	11.402	0	11.402	0	11.402
22			min	0.247	0	-0.192	11.402	0	0	0	0	0	0	-0.547	5.701
23	4	M5	max	-0.312	18	0.492	0	0	18	0	18	0	18	0	18
24			min	-0.312	0	-0.492	18	0	0	0	0	0	0	-2.441	9

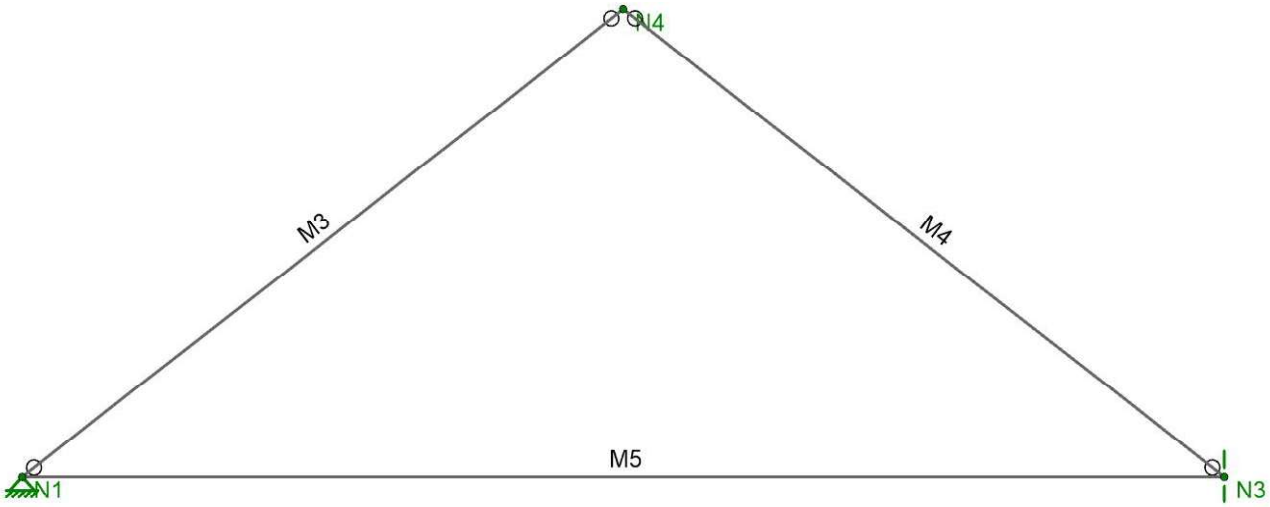
AWC NDS-18: ASD Member Wood Code Checks

	LC	Member	Shape	UC Max	Loc[ft]	Shear UC	Loc[ft]	Dir	Fc' [ksi]	Ft' [ksi]	Fb1' [ksi]	Fb2' [ksi]	Fv' [ksi]	RB	CL	CP	Eqn
1	1	M3	2X10	0.078	5.701	0.051	11.402	y	1.237	1.035	1.522	1.53	0.158	7.024	0.995	0.833	3.9-3
2	1	M4	2X10	0.078	5.701	0.051	11.402	y	1.237	1.035	1.522	1.53	0.158	7.024	0.995	0.833	3.9-3
3	1	M5	2X10	0.458	9	0.153	18	y	0.803	1.035	1.522	1.53	0.158	7.024	0.995	0.54	3.9-1
4	2	M3	2X10	0.07	5.701	0.046	11.402	y	1.336	1.15	1.69	1.7	0.175	7.024	0.994	0.809	3.9-3
5	2	M4	2X10	0.07	5.701	0.046	11.402	y	1.336	1.15	1.69	1.7	0.175	7.024	0.994	0.809	3.9-3
6	2	M5	2X10	0.947	9	0.36	18	y	0.826	1.15	1.69	1.7	0.175	7.024	0.994	0.5	3.9-1
7	3	M3	2X10	0.194	5.701	0.124	11.402	y	1.468	1.323	1.942	1.955	0.201	7.024	0.993	0.774	3.9-3
8	3	M4	2X10	0.194	5.701	0.124	11.402	y	1.468	1.323	1.942	1.955	0.201	7.024	0.993	0.774	3.9-3
9	3	M5	2X10	0.372	9	0.119	18	y	0.852	1.323	1.942	1.955	0.201	7.024	0.993	0.449	3.9-1
10	4	M3	2X10	0.16	5.701	0.103	11.402	y	1.468	1.323	1.942	1.955	0.201	7.024	0.993	0.774	3.9-3
11	4	M4	2X10	0.16	5.701	0.103	11.402	y	1.468	1.323	1.942	1.955	0.201	7.024	0.993	0.774	3.9-3
12	4	M5	2X10	0.717	9	0.264	18	y	0.852	1.323	1.942	1.955	0.201	7.024	0.993	0.449	3.9-1

Envelope Member End Reactions

	Member	Member End		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
1	M3	I	max	0.657	3	0.231	3	0	4	0	4	0	4	0	4
2			min	0.209	1	0.074	1	0	1	0	1	0	1	0	1
3		J	max	0.297	3	-0.074	2	0	4	0	4	0	4	0	4
4			min	0.095	1	-0.231	3	0	1	0	1	0	1	0	1
5	M4	I	max	0.297	3	0.231	3	0	4	0	4	0	4	0	4
6			min	0.095	1	0.074	1	0	1	0	1	0	1	0	1
7		J	max	0.657	3	-0.074	2	0	4	0	4	0	4	0	4
8			min	0.209	1	-0.231	3	0	1	0	1	0	1	0	1
9	M5	I	max	-0.12	2	0.582	2	0	4	0	4	0	4	0	4
10			min	-0.377	3	0.222	1	0	1	0	1	0	1	0	1
11		J	max	-0.12	2	-0.222	3	0	4	0	4	0	4	0	4
12			min	-0.377	3	-0.582	2	0	1	0	1	0	1	0	1





Albrecht Engineering	Typical Rafter Truss at Hip	SK-1
EB		Apr 15, 2021
2019-031.01		Rafter Truss Typical at Hip.r3d

Node Coordinates

	Label	X [ft]	Y [ft]	Z [ft]	Detach From Diaphragm
1	N1	0	0	0	
2	N3	18	0	0	
3	N4	9	7	0	

Member Primary Data

	Label	I Node	J Node	Section/Shape	Type	Design List	Material	Design Rule
1	M3	N1	N4	2X10	Beam	Rectangular Double	SP	Typical
2	M4	N4	N3	2X10	Beam	Rectangular Double	SP	Typical
3	M5	N1	N3	2X10	Beam	Rectangular Double	SP	Typical

Node Loads and Enforced Displacements (BLC 1 : DL)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N4	L	Y	-0.63

Node Loads and Enforced Displacements (BLC 2 : SL)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N4	L	Y	-1.868

Member Point Loads (BLC 1 : DL)

	Member Label	Direction	Magnitude [k, k-ft]	Location [(ft, %)]
1	M5	Y	-0.075	%38.9
2	M5	Y	-0.075	%61.1

Member Distributed Loads (BLC 1 : DL)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, k-ft/ft]	End Magnitude [k/ft, F, ksf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M3	Y	-0.013	-0.013	0	%100
2	M4	Y	-0.013	-0.013	0	%100
3	M5	Y	-0.013	-0.013	0	%100

Member Distributed Loads (BLC 2 : SL)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, k-ft/ft]	End Magnitude [k/ft, F, ksf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M3	Y	-0.035	-0.035	0	%100
2	M4	Y	-0.035	-0.035	0	%100

Member Distributed Loads (BLC 3 : LL)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, k-ft/ft]	End Magnitude [k/ft, F, ksf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M5	Y	-0.04	-0.04	0	%100

Load Combinations

	Description	Solve	PDelta	BLC	Factor	BLC	Factor	BLC	Factor
1	IBC 16-8	Yes	Y	DL	1				
2	IBC 16-9	Yes	Y	DL	1	LL	1		
3	IBC 16-10 (b)	Yes	Y	DL	1	SL	1		
4	IBC 16-11 (b)	Yes	Y	DL	1	LL	0.75	SL	0.75

Envelope Node Reactions

	Node Label		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N1	max	0	2	1.988	3	0	4	0	4	0	4	0	4
2		min	0	3	0.655	1	0	1	0	1	0	1	0	1
3	N3	max	0	4	1.988	3	0	4	0	4	0	4	0	4
4		min	0	1	0.655	1	0	1	0	1	0	1	0	1
5	N4	max	NC		NC		LOCKED		LOCKED		NC		LOCKED	
6		min	NC		NC		LOCKED		LOCKED		NC		LOCKED	
7	Totals:	max	0	2	3.977	3	0	4						
8		min	0	3	1.31	1	0	1						

Envelope Maximum Member Section Forces

	Member		Axial[k]	Loc[ft]	LC	y Shear[k]	Loc[ft]	LC	z Shear[k]	Loc[ft]	LC	Torque[k-ft]	Loc[ft]	LC	y-y Moment[k-ft]	Loc[ft]	LC	z-z Moment[k-ft]	Loc[ft]	LC
1	M3	max	2.649	0	3	0.216	0	3	0	11.402	4	0	11.402	4	0	11.402	4	0	11.402	4
2		min	0.588	11.402	1	-0.216	11.402	3	0	0	1	0	0	1	0	0	1	-0.616	5.701	3
3	M4	max	2.649	11.402	3	0.216	0	3	0	11.402	4	0	11.402	4	0	11.402	4	0	11.402	4
4		min	0.588	0	1	-0.216	11.402	3	0	0	1	0	0	1	0	0	1	-0.616	5.701	3
5	M5	max	-0.5	18	2	0.552	0	2	0	18	4	0	18	4	0	18	4	0	18	4
6		min	-1.959	0	3	-0.552	18	2	0	0	1	0	0	1	0	0	1	-2.672	9	2

Envelope Member End Reactions

	Member	Member End		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
1	M3	I	max	2.649	3	0.216	3	0	4	0	4	0	4	0	4
2			min	0.679	1	0.059	1	0	1	0	1	0	1	0	1
3		J	max	2.313	3	-0.059	2	0	4	0	4	0	4	0	4
4			min	0.588	1	-0.216	3	0	1	0	1	0	1	0	1
5	M4	I	max	2.313	3	0.216	3	0	4	0	4	0	4	0	4
6			min	0.588	1	0.058	1	0	1	0	1	0	1	0	1
7		J	max	2.649	3	-0.059	2	0	4	0	4	0	4	0	4
8			min	0.679	1	-0.216	3	0	1	0	1	0	1	0	1
9	M5	I	max	-0.5	2	0.552	2	0	4	0	4	0	4	0	4
10			min	-1.959	3	0.192	1	0	1	0	1	0	1	0	1
11		J	max	-0.5	2	-0.192	3	0	4	0	4	0	4	0	4
12			min	-1.959	3	-0.552	2	0	1	0	1	0	1	0	1

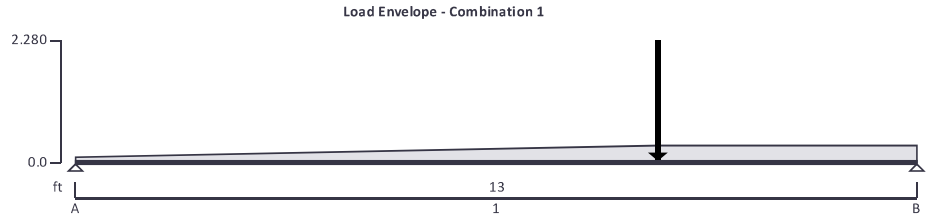
Envelope AWC NDS-18: ASD Member Wood Code Checks

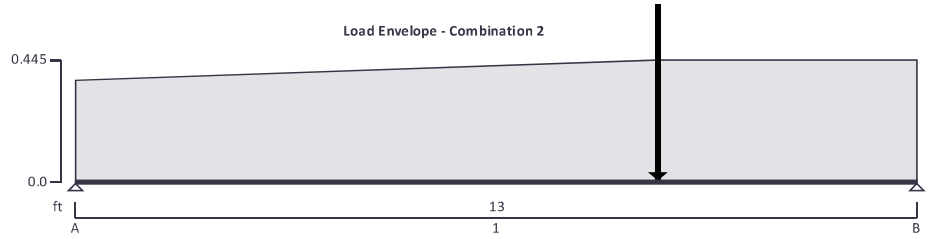
	Member	Shape	Code Check	Loc[ft]	LC	Shear Check	Loc[ft]	Dir	LC	Fc' [ksi]	Ft' [ksi]	Fb1' [ksi]	Fb2' [ksi]	Fv' [ksi]	RB	CL	CP	Eqn
1	M3	2X10	0.207	5.701	3	0.116	11.402	y	3	1.468	1.323	1.942	1.955	0.201	7.024	0.993	0.774	3.9-3
2	M4	2X10	0.207	5.701	3	0.116	11.402	y	3	1.468	1.323	1.942	1.955	0.201	7.024	0.993	0.774	3.9-3
3	M5	2X10	0.913	9	2	0.341	18	y	2	0.826	1.15	1.69	1.7	0.175	7.024	0.994	0.5	3.9-1

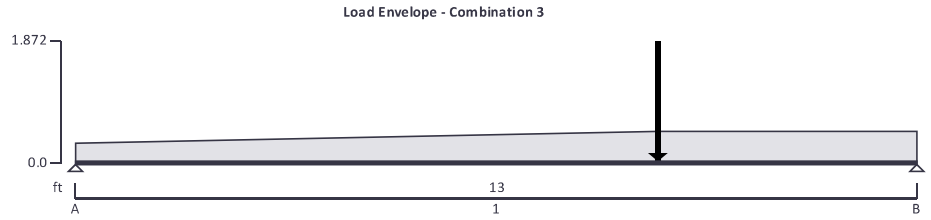
STRUCTURAL COMPOSITE LUMBER MEMBER ANALYSIS & DESIGN (NDS)

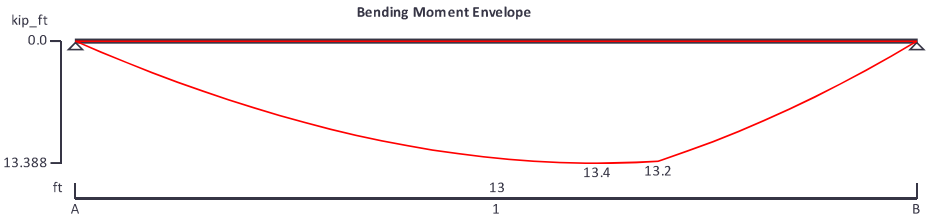
In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

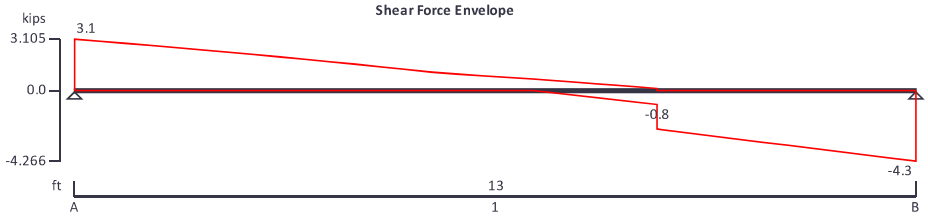
Tedds calculation version 1.7.09











Applied loading

Beam loads

	Dead self weight of beam × 1
P(D)	Dead point load 650 lb at 108.00 in
P(S)	Snow point load 1630 lb at 108.00 in
wDLt	Dead partial VDL 0 lb/ft at 0.00 in to 74 lb/ft at 108.00 in
WSLt	Snow partial VDL 0 lb/ft at 0.00 in to 144 lb/ft at 108.00 in
wDL	Dead partial UDL 74 lb/ft from 108.00 in to 156.00 in
WSL	Snow partial UDL 144 lb/ft from 108.00 in to 156.00 in
Attic DL	Dead full UDL 90 lb/ft
Attic LL	Live full UDL 270 lb/ft

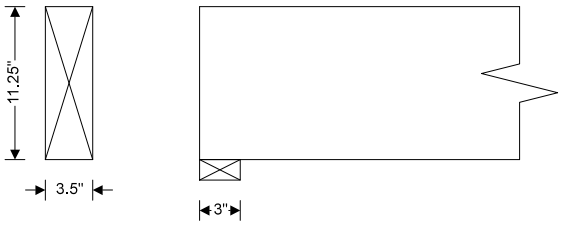
Load combinations

Load combination 1	Support A	Dead × 1.00
		Snow × 1.00
		Live × 0.00
	Span 1	Dead × 1.00
		Snow × 1.00
		Live × 0.00
	Support B	Dead × 1.00
		Snow × 1.00
		Live × 0.00
Load combination 2	Support A	Dead × 1.00
		Snow × 0.00
		Live × 1.00
	Span 1	Dead × 1.00
		Snow × 0.00
		Live × 1.00
	Support B	Dead × 1.00
		Snow × 0.00
		Live × 1.00
Load combination 3	Support A	Dead × 1.00
		Snow × 0.75
		Live × 0.75
	Span 1	Dead × 1.00

		Snow × 0.75
		Live × 0.75
	Support B	Dead × 1.00
		Snow × 0.75
		Live × 0.75

Analysis results

Maximum moment	M_{max} = **13388** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **13388** lb_ft	
Maximum shear	F_{max} = **3105** lb	F_{min} = **-4266** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **4266** lb	
Total load on member	W_{tot} = **7371** lb	
Reaction at support A	R_{A_max} = **3105** lb	R_{A_min} = **2024** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **1084** lb	
Unfactored snow load reaction at support A	R_{A_Snow} = **939** lb	
Unfactored live load reaction at support A	R_{A_Live} = **1755** lb	
Reaction at support B	R_{B_max} = **4266** lb	R_{B_min} = **3269** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **1514** lb	
Unfactored snow load reaction at support B	R_{B_Snow} = **1915** lb	
Unfactored live load reaction at support B	R_{B_Live} = **1755** lb	



Composite section details

Breadth of composite section	b = **3.5** in
Depth of composite section	d = **11.25** in
Number of composite sections in member	N = **1**
Overall breadth of composite member	b_b = N × b = **3.5** in
Composite type and grade	Microllam LVL, 2.0E-2600Fb grade
Bending parallel to grain	F_b = **2600** lb/in^2
Tension parallel to grain	F_t = **1555** lb/in^2
Compression parallel to grain	F_c = **2510** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **750** lb/in^2
Shear parallel to grain	F_v = **285** lb/in^2
Modulus of elasticity	E = **2000000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **1017000** lb/in^2
Mean shear modulus	G_{def} = E / 16 = **125000** lb/in^2
Average density	ρ = **42** lb/ft^3

Member details

Service condition	**Dry**

Length of span	L_{s1} = **13** ft
Length of bearing	L_b = **3** in
Load duration	**Ten years**

Section properties

Cross sectional area of member	$A = N \times b \times d$ = **39.38** in^2
Section modulus	$S_x = N \times b \times d^2 / 6$ = **73.83** in^3
	$S_y = d \times (N \times b)^2 / 6$ = **22.97** in^3
Second moment of area	$I_x = N \times b \times d^3 / 12$ = **415.28** in^4
	$I_y = d \times (N \times b)^3 / 12$ = **40.20** in^4

Adjustment factors

Load duration factor - Table 2.3.2	C_D = **1.00**
Temperature factor - Table 2.3.3	C_t = **1.00**
Volume factor	$C_V = (12 \text{ in} / \max(d, 3.5 \text{ in}))^{0.136}$ = **1.01**
Repetitive member factor - cl.8.3.7	C_r = **1.00**
Length factor	$C_{Len} = (4 \text{ ft} / L_{s1})^{0.085}$ = **0.90**
Bearing area factor - cl.3.10.4	C_b = **1.00**
Depth-to-breadth ratio	$d / (N \times b)$ = **3.21**
Effective laterally unsupported span length	l_e = **1.333** ft
Slenderness ratio for bending members - eq.3.3-5	$R_b = \sqrt{[l_e \times d / (N \times b)^2]}$ = **3.833**
Adjusted bending design value for bending	$F_b^* = F_b \times C_D \times C_M \times C_t \times C_r$ = **2600** lb/in^2
Adjusted modulus of elasticity for member stability	$E_{min}' = E_{min} \times C_M \times C_t$ = **1017000** lb/in^2
Critical buckling design value for bending	$F_{bE} = 1.2 \times E_{min}' / R_b^2$ = **83076** lb/in^2
Beam stability factor - eq.3.3-6	
	$C_L = [1 + (F_{bE} / F_b^*)] / 1.9 - \sqrt{[([1 + (F_{bE} / F_b^*)] / 1.9)^2 - (F_{bE} / F_b^*) / 0.95]}$ = **1.00**

Bearing perpendicular to grain - cl.3.10.2

Design compression perpendicular to grain	$F_{c\_perp}' = F_{c\_perp} \times C_t \times C_b$ = **750** lb/in^2
Applied compression stress perpendicular to grain	$f_{c\_perp} = R_{B\_max} / (N \times b \times L_b)$ = **406** lb/in^2
	f_{c_perp} / F_{c_perp}' = **0.542**

PASS - Design compressive stress exceeds applied compressive stress at bearing

Strength in bending - cl.3.3.1

Design bending stress	$F_b' = F_b \times C_D \times C_t \times C_L \times C_V \times C_r$ = **2619** lb/in^2
Actual bending stress	$f_b = M / S_x$ = **2176** lb/in^2
	f_b / F_b' = **0.831**

PASS - Design bending stress exceeds actual bending stress

Strength in shear parallel to grain - cl.3.4.1

Design shear stress	$F_v' = F_v \times C_D \times C_t$ = **285** lb/in^2
Actual shear stress - eq.3.4-2	$f_v = 3 \times F / (2 \times A)$ = **163** lb/in^2
	f_v / F_v' = **0.570**

PASS - Design shear stress exceeds actual shear stress

Deflection - cl.3.5.1

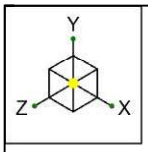
Modulus of elasticity for deflection	$E' = E \times C_M \times C_t$ = **2000000** lb/in^2
Design deflection	$\delta_{adm} = 0.004 \times L_{s1}$ = **0.624** in

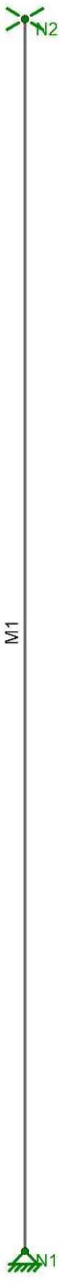
Total deflection

δ_{b_s1} = **0.581** in

δ_{b_s1} / δ_{adm} = **0.930**

PASS - Total deflection is less than design deflection





Albrecht Engineering	Post	SK-1
EB		Jul 27, 2021
2019-031.01		Post.r3d

Node Coordinates

	Label	X [ft]	Y [ft]	Z [ft]	Detach From Diaphragm
1	N1	0	0	0	
2	N2	0	10	0	

Member Primary Data

	Label	I Node	J Node	Section/Shape	Type	Design List	Material	Design Rule
1	M1	N1	N2	4X4	Column	Posts	SP	Typical

Node Loads and Enforced Displacements (BLC 1 : D)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	Y	-1.5
2	N2	L	MX	0.15

Node Loads and Enforced Displacements (BLC 2 : S)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	Y	-2.4
2	N2	L	MX	0.31

Load Combinations

	Description	Solve	P-Delta	BLC	Factor	BLC	Factor
1	IBC 16-8	Yes	Y	DL	1		
2	IBC 16-10 (b)	Yes	Y	DL	1	SL	1

Envelope Node Reactions

	Node Label		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N2	max	0	2	0	2	-0.015	1	0	2	0	2	0	2
2		min	0	1	0	1	-0.046	2	0	1	0	1	0	1
3	N1	max	0	2	3.93	2	0.046	2	0	2	LOCKED		0	2
4		min	0	1	1.53	1	0.015	1	0	1	LOCKED		0	1
5	Totals:	max	0	2	3.93	2	0	2						
6		min	0	1	1.53	1	0	1						

Envelope AWC NDS-18: ASD Member Wood Code Checks

	Member	Shape	Code Check	Loc[ft]	LC	Shear Check	Loc[ft]	Dir	LC	Fc' [ksi]	Ft' [ksi]	Fb1' [ksi]	Fb2' [ksi]	Fv' [ksi]	RB	CL	CP	Eqn
1	M1	4X4	0.91	10	2	0.028	10	z	2	0.74	1.15	1.725	1.725	0.201	5.855	1	0.39	3.9-3

Envelope Member Section Forces

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
1	M1	1	max	3.93	2	0	2	0.046	2	0	2	0	2	0	2
2			min	1.53	1	0	1	0.015	1	0	1	0	1	0	1
3		2	max	3.922	2	0	2	0.046	2	0	2	0.115	2	0	2
4			min	1.522	1	0	1	0.015	1	0	1	0.037	1	0	1
5		3	max	3.915	2	0	2	0.046	2	0	2	0.23	2	0	2
6			min	1.515	1	0	1	0.015	1	0	1	0.075	1	0	1
7		4	max	3.907	2	0	2	0.046	2	0	2	0.345	2	0	2
8			min	1.507	1	0	1	0.015	1	0	1	0.112	1	0	1
9		5	max	3.9	2	0	2	0.046	2	0	2	0.46	2	0	2
10			min	1.5	1	0	1	0.015	1	0	1	0.15	1	0	1

Envelope Member End Reactions

	Member	Member End		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
1	M1	I	max	3.93	2	0	2	0.046	2	0	2	0	2	0	2
2			min	1.53	1	0	1	0.015	1	0	1	0	1	0	1
3		J	max	3.9	2	0	2	0.046	2	0	2	0.46	2	0	2
4			min	1.5	1	0	1	0.015	1	0	1	0.15	1	0	1

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Registration Station				
Subject	Wind Load Calculations			Job No.	2019-031.01
	Components & Cladding - Walls			Sheet No.	of
Computed By	EB	Date	3/31/2021	Checked By	Date

Code Basis:
ASCE7-16

Analysis Procedure:
Procedure of Chapter 30, Part 1 C&C on buildings with h<60ft

Risk Category:
The building function is commercial, so Risk Category II is appropriate.

Basic Wind Speed:
Figure 26.5-1, Vult= 110 mph

Exposure:
The building is located in an area of open terrain and farmland so Exposure C is appropriate.

Exposure Coefficient:

Table 26.10-1	H	Kz
For Exposure C	15	0.85

Elevation:
Table 26.9-1, Ke = 1.0 for elevation < 1000ft

Topographic Effects:
Kzt = 1.0 for no abrupt changes in topography

Wind Directionality:
Table 26.6-1, Kd = 0.85 for buildings C&C

Velocity Pressure:
qz = 0.00256*Kz*Kzt*Kd*Ke*V^2
qz = **22.38** psf

Internal pressure coefficient:
Table 26.11-1, GCpi = 0.18 for enclosed buildings

Wind Pressure Coefficients:
Wall span = 10 ft
EWA = 33.3 ft^2 based on effective W = 1/3*span

Fig 30.3-1	EWA	GCp+	GCp-
Zone 4	33	0.9	-1
Zone 5	33	0.9	-1.1

Design Wind Pressure:

p = q*(GCp+Gcpi)	p+	p-
Zone 4	24.2	-26.4
Zone 5	24.2	-28.6

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Registration Station				
Subject	Wind Load Calculations MWFRS			Job No.	2019-031.01
	Enclosed, Simplified Method			Sheet No.	of
Computed By	EB	Date	3/26/2021	Checked By	Date

Code Basis:
ASCE7-16

Analysis Procedure:
Procedure of Chapter 28, Part 2 for MWFRS of enclosed, low rise, simple diapragm buildings

Risk Category:
The building function is commercial, so Risk Category II is appropriate.

Basic Wind Speed:
Figure 26.5-1B, Vult= 110 mph

Exposure:
The building is located in an area of open terrain and farmland so
Exposure C is appropriate.

Exposure Adjustment Factor:

Figure 28.5-1	h	λ
	15	1.21

Topographic Effects:
Kzt = 1.0 for no abrupt changes in topography

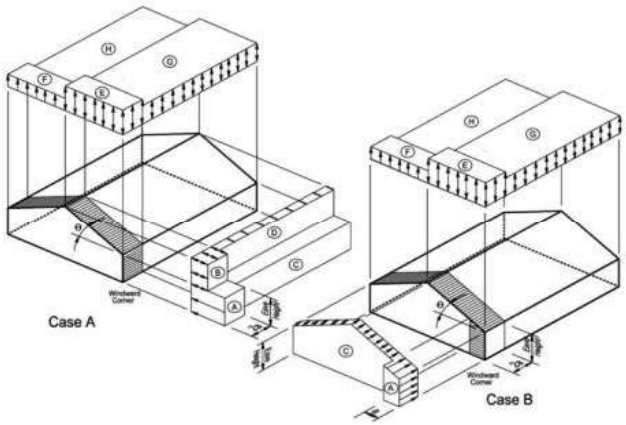
End Zone:

H =	15.0	ft	
B =	20.0	ft	
2*a =	2*(0.1B)	4.00	ft
	2*(0.4H)	12.00	ft
	2*3	6.00	ft
	USE 2a =	**6.00**	ft

Design Wind Load:

Figure 28.5-1: $p = \lambda * K_{zt} * p_{s30}$

	Load Case 1		Load Case 2	
	p_{s30}	p	p_{s30}	p
Zone A	21.6	**26.14**	21.6	**26.14**
Zone B	14.8	**17.91**	14.8	**17.91**
Zone C	17.2	**20.81**	17.2	**20.81**
Zone D	11.8	**14.28**	11.8	**14.28**
Zone E	1.7	**2.06**	8.3	**10.04**
Zone F	-13.1	**-15.85**	-6.5	**-7.87**
Zone G	0.6	**0.73**	7.2	**8.71**
Zone H	-11.3	**-13.67**	-4.6	**-5.57**
Zone E_{OH}	-7.6	**-9.20**	-7.6	**-9.20**
Zone G_{OH}	-8.7	**-10.53**	-8.7	**-10.53**



ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Registration Station				
Subject	Wind Load Calculations MWFRS			Job No.	2019-031.01
	Open Structure, Pitched Roof			Sheet No.	of
Computed By	EB	Date	3/26/2021	Checked By	Date

Code Basis:
ASCE7-16

Analysis Procedure:
Procedure of Chapter 27, Part 1 for MWFRS of buildings of any height

Risk Category:
The building function is commercial, so Risk Category II is appropriate.

Basic Wind Speed:
Figure 26.5-1B, Vult= 110 mph

Exposure:
The building is located in an area of open terrain and farmland so Exposure C is appropriate.

Exposure Adjustment Factor:

Table 26.10-1	H	Kz
	15	0.85

Ground Elevation Factor:

Table 26.9-1	Elev	Ke
	0	1

Topographic Effects:
Kzt = 1.0 for no abrupt changes in topography

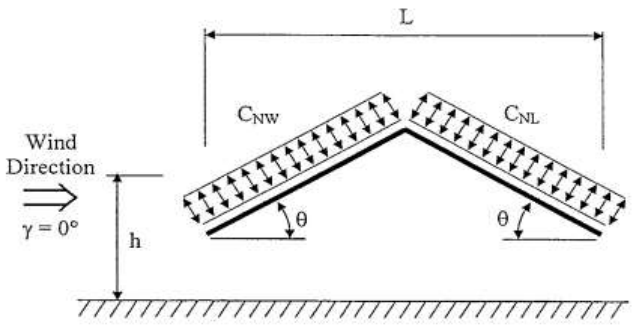
Wind Directionality:
Table 26.6-1 Kd= 0.85 for MWFRS

Velocity Pressure: qz = 0.00256*Kz*Kzt*Kd*Ke*V^2

H	qh	
15	**22.38**	psf

Gust Effect Factor: Section 26.11
For a rigid structure, G = 0.85

Open Buildings: Figure 27.3-5



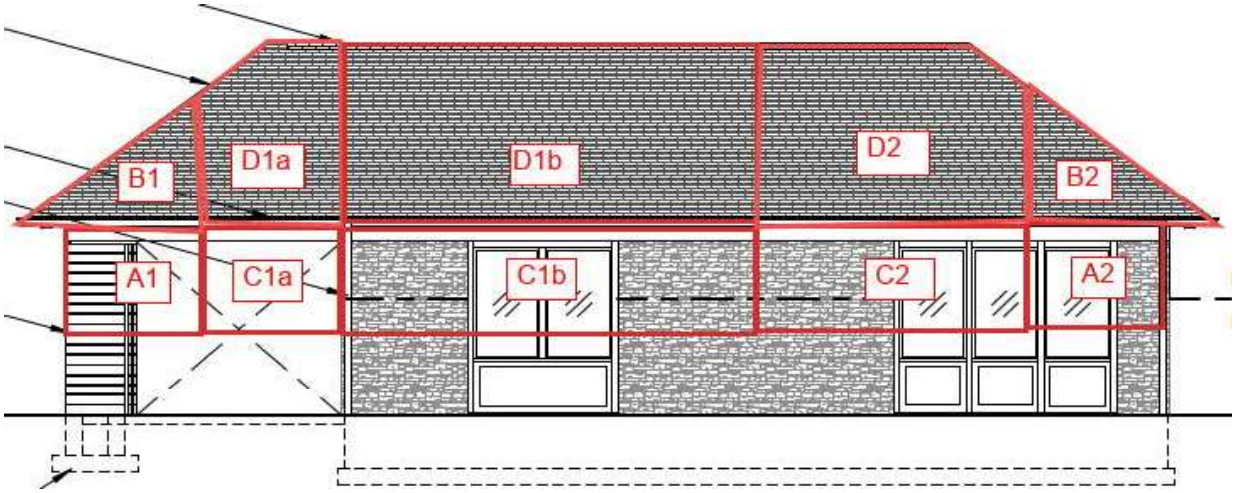
Roof Angle:	37	degrees			
Net Pressure Coefficient:	C_{NW}	C_{NL}			
Load Case A	1.3	0.6			
Load Case B	-0.2	-0.6			
Net Design Pressure:	p = qh*G*C_N			Rise	9
Load Case A	**24.73**	**11.41**	psf	Run	12
Load Case B	**-3.80**	**-11.41**	psf	SRSS	15

Vertical Component			Horizontal Component			Net Horiz
Load Case A	**19.75**	**9.12**	Load Case A	**14.88**	**6.87**	**8.01**
Load Case B	**-3.04**	**-9.12**	Load Case B	**-2.29**	**-6.87**	**4.58**

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Registration Station				
Subject	Wind Load Calculations MWFRS			Job No.	2019-031.01
	Shear Wall Loading			Sheet No.	of
Computed By	EB	Date	3/26/2021	Checked By	Date

X-direction Wind Load - Walls



Since the net horizontal component of wind load in the open structure is less than the wind load for enclosed, we will use the values for enclosed building

At Line 1:

	p	A1	F1	
Zone A1	26.1	30	0.78	
Zone B1	17.9	27	0.48	
Zone C1a	20.8	30	0.62	
Zone D1a	14.3	60	0.86	
Zone C1b	20.8	100	2.08	
Zone D1b	14.3	200	2.86	
Total L1:			7.69	k

At Line 2:

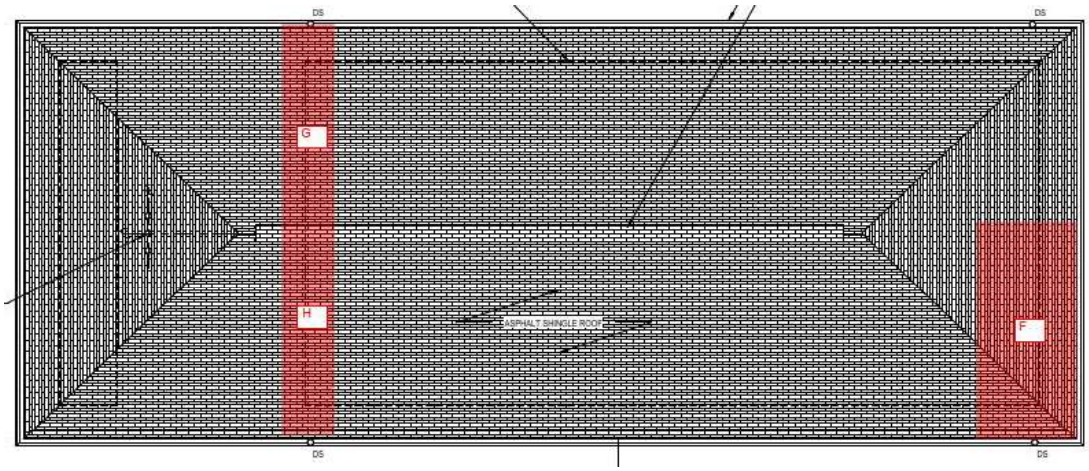
Zone C2	20.8	70	1.46	
Zone D2	14.3	140	2.00	
Zone A2	26.1	30	0.78	
Zone B2	17.9	27	0.48	
Total L2:			4.72	k

Total X:	12.41	k

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Registration Station				
Subject	Wind Load Calculations MWFRS			Job No.	2019-031.01
	Shear Wall Loading			Sheet No.	of
Computed By	EB	Date	3/26/2021	Checked By	Date

X-direction Wind Load - Roof



At Line 1:

	p	A1	F1		DL	A1	F1	
Zone G	0.6	13	8.00		10.0	13	133.30	
Zone H	-11.3	13	-150.63		10.0	13	133.30	
Zone G_{OH}	-8.7	3	-23.19		10.0	3	26.66	
Total:			-165.83				293.26	
Uniform Load:		20.00	**-8.29**	plf		20.00	**14.66**	plf

For load combination 0.6D-0.6W, 0.6D = 8.80 > 0.6W = -4.97 *so no net uplift*

At Line 2:

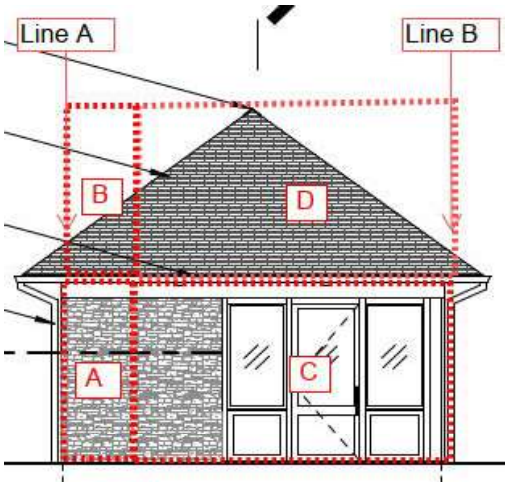
	p	A1	F1		DL	A1	F1	
Zone F	-13.1	72	-943.20		10.0	72	720.00	
Zone G_{OH}	-8.7	24	-208.80		10.0	24	240.00	
Total:			-1152.00				960.00	
Uniform Load:		10.00	**-115.20**	plf		10.00	**96.00**	plf

For load combination 0.6D-0.6W, 0.6D = 57.60 < 0.6W = -69.12 *so inlcude net uplift*

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Registration Station				
Subject	Wind Load Calculations MWFRS			Job No.	2019-031.01
	Shear Wall Loading			Sheet No.	of
Computed By	EB	Date	3/26/2021	Checked By	Date

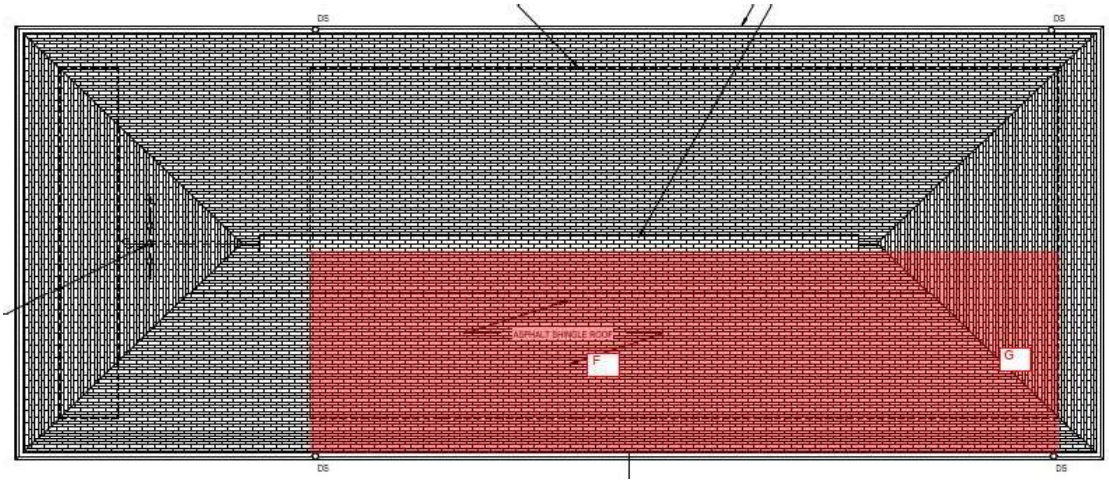
Y-direction Wind Load - Walls



	p	Aa	Fa	Ab	Fb			
Zone A	26.1	30	0.78	30	0.78	Total:		
Zone B	17.9	60	1.07	60	1.07	F =	5.69	k
Zone C	20.8	20	0.42	20	0.42	Use F =	7.70	k, seismic
Zone D	14.3	40	0.57	40	0.57	For 5.7' wall panel:		
Forces:			2.85		2.85	F =	1.15	k
						For 13.3' wall panel:		
						F =	2.70	k

For 5' wall panel:

Y-direction Wind Load - Roof



At Line A and B:

	p	A1	F1		DL	A1	F1	
Zone F	-11.3	340	-3842.00		10.0	340	3400.00	
Zone H	-13.1	60	-786.00		10.0	60	600.00	
Zone G_{OH}	-8.7	80	-696.00		10.0	80	800.00	
Total:			-5324.00				4800.00	
Uniform Load:		40.00	**-133.10**	plf		40.00	**120.00**	plf

For load combination 0.6D-0.6W, 0.6D = 72.00 < 0.6W = -79.86 *so inlcude net uplift*

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Registration Station				
Subject	Seismic Load Calculations			Job No.	2019-031.01
	Sesimic Weight			Sheet No.	of
Computed By	EB	Date	3/26/2021	Checked By	Date

Seismic Loads

Short Period Spectral Response Acceleration Parameter, S_S=	**0.134**
1-S Period Spectral Response Acceleration Parameter, S_1 =	**0.067**
Soil Classification	**D**
Risk category	**II**

Canopy Seismic Weight

Element		Unit Weight	No.	Area (sf)	Length (ft)	Weight (lb)
Roof		20	1	1080.0		21600.0
North Wall		90	1	200		18000.0
South Wall		90	1	240		21600.0
East Wall		90	1	200		18000.0
West Wall		90	1	80		7200.0

W = **86.4** kip

V = **7.7** kip *from TEDDS*

Since the design base shear for wind loading at is more than 1.5 times the design story shear for seismic, the design is controlled by wind loading.

SEISMIC FORCES (ASCE 7-16)

Tedds calculation version 3.1.00

Site parameters

Site class	D, Soil properties not known
Mapped acceleration parameters (Section 11.4.2)	
at short period	S_S = **0.126**
at 1 sec period	S_1 = **0.042**
Site coefficientat short period (Table 11.4-1)	F_a = **1.600**
at 1 sec period (Table 11.4-2)	F_v = **2.400**

Spectral response acceleration parameters

at short period (Eq. 11.4-1)	$S_{MS} = F_a \times S_S$ = **0.202**
at 1 sec period (Eq. 11.4-2)	$S_{M1} = F_v \times S_1$ = **0.101**

Design spectral acceleration parameters (Sect 11.4.4)

at short period (Eq. 11.4-3)	$S_{DS} = 2 / 3 \times S_{MS}$ = **0.134**
at 1 sec period (Eq. 11.4-4)	$S_{D1} = 2 / 3 \times S_{M1}$ = **0.067**

Seismic design category

Occupancy category (Table 1-1)	II
Seismic design category based on short period response acceleration (Table 11.6-1)	A
Seismic design category based on 1 sec period response acceleration (Table 11.6-2)	B
Seismic design category	B

Approximate fundamental period

Height above base to highest level of building	h_n = **15** ft
From Table 12.8-2:	
Structure type	All other systems
Building period parameter C_t	C_t = **0.02**
Building period parameter x	x = **0.75**
Approximate fundamental period (Eq 12.8-7)	$T_a = C_t \times (h_n)^x \times 1\text{sec} / (1\text{ft})^x$= **0.152** sec
Building fundamental period (Sect 12.8.2)	$T = T_a$ = **0.152** sec
Long-period transition period	T_L = **12** sec

Seismic response coefficient

Seismic force-resisting system (Table 12.2-1)	A. Bearing_Wall_Systems 11. Ordinary plain masonry shear walls
Response modification factor (Table 12.2-1)	R = **1.5**
Seismic importance factor (Table 1.5-2)	I_e = **1.000**
Seismic response coefficient (Sect 12.8.1.1)	
Calculated (Eq 12.8-3)	$C_{s\_calc} = S_{DS} / (R / I_e)$ = **0.0896**
Maximum (Eq 12.8-3)	$C_{s\_max} = S_{D1} / ((T / 1\text{ sec}) \times (R / I_e))$ = **0.2939**
Minimum (Eq 9.5.5.2.1-3)	$C_{s\_min} = \max(0.044 \times S_{DS} \times I_e, 0.01)$ = **0.0100**

Seismic response coefficient C_s = **0.0896**

Seismic base shear (Sect 12.8.1)

Effective seismic weight of the structure W = **86.4** kips

Seismic response coefficient C_s = **0.0896**

Seismic base shear (Eq 12.8-1) $V = C_s \times W$ = **7.7** kips

Vertical distribution of seismic forces (Sect 12.8.3)

Vertical distribution factor (Eq 12.8-12) $C_{vx} = w_x \times h_x^k / \Sigma(w_i \times h_i^k)$

Lateral force induced at level i (Eq 12.8-11) $F_x = C_{vx} \times V$

Vertical force distribution table

Level	Height from base to Level i (ft), h_x	Portion of effective seismic weight assigned to Level i (kips), w_x	Distribution exponent related to building period, k	Vertical distribution factor, C_{vx}	Lateral force induced at Level i (kips), F_x
1	15.0;	86.4;	1.00;	1.000;	7.7

MASONRY WALL PANEL DESIGN TO TMS 402/602-16

Using the allowable stress design method

Tedds calculation version 2.2.07

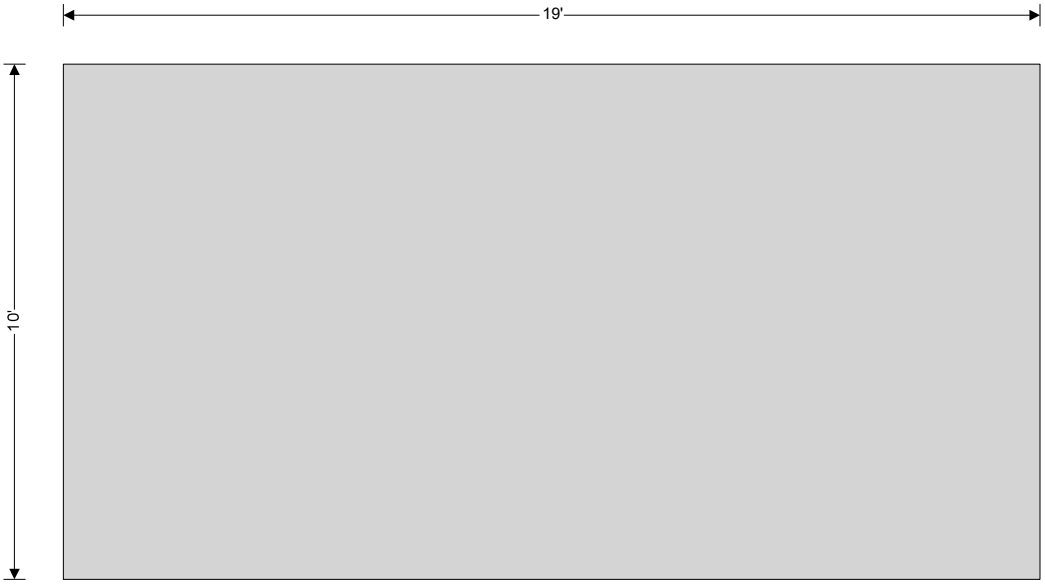
Masonry wall panel details

Shear Wall Line 1 - Unreinforced single-wythe wall, the wall is pinned at the top and at the bottom for out of plane loads

The wall is fixed at the bottom and free at the top for in plane loads

Panel length L = **19** ft

Panel height h = **10** ft



Seismic properties

Seismic design category B

Seismic importance factor (ASCE7 Table 1.5-2) I_e = **1**

Design spectral response acceleration parameter, short periods (ASCE7 11.4.4)

S_{DS} = **0.13**

Seismic wall classification Nonparticipating

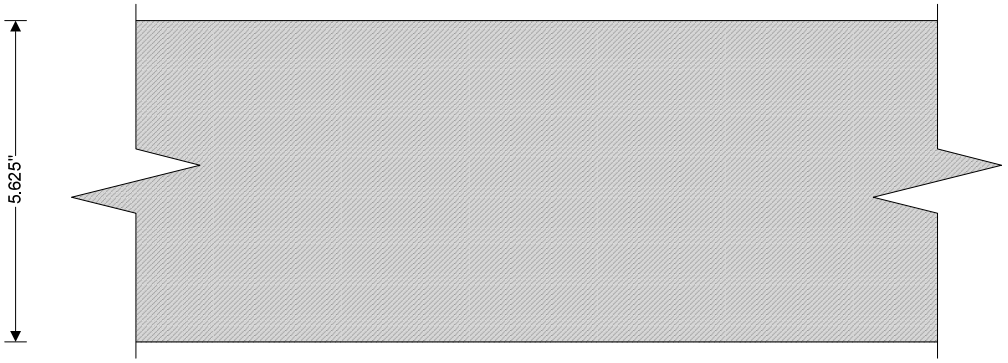
No prescriptive minimum seismic reinforcement

Redundancy factor, on out-of-plane load ρ_E = **1.0**

Construction details

Wall thickness t = **5.625** in

Walls are 6" hollow block filled with vermiculite with composite 5" stone veneer, assume properties similar to 6" solid block



Masonry details

Solid concrete units in running bond with Mortar cement class N mortar

Compressive strength of units	f'_{cu} = **1900** psi
Density of masonry	γ_{block} = **115** lb/ft^3
Height of masonry units	h_b = **7.625** in
Area of block	A_{block} = t = **67.5** in^2/ft
Self weight of wall	$w_{SW} = A_{block} \times \gamma_{block}$ = **53.91** psf

From TMS 602-16 Table 2 - Compressive strength of masonry

Net compressive strength of masonry	f'_m = **1700** psi
Modulus of elasticity for masonry	$E_m = 900 \times f'_m$ = **1530000** psi
Shear modulus of masonry	$G_v = 0.4 \times E_m$ = **612000** psi

From TMS 402 -16 Table 8.2.4.2 - Allowable flexural tensile stresses for clay and concrete masonry

Allowable flexural tensile stress normal to bed	F_{t_norm} = **40** psi
Allowable flexural tensile stress parallel to bed	F_{t_para} = **80** psi

Lateral out-of-plane loads

Wind load on panel	W = **28.6** psf
Wind load on parapet	W_p = **18** psf
Seismic load factor (ASCE7 12.11.1)	$F_p = 0.4 \times S_{DS} \times I_e$ = **0.052**
Seismic load from wall	$E_{wall} = \max(F_p, 0.1) \times w_{SW}$ = **5.4** psf
Additional seimic load	E_{add} = **0** psf
Seismic lateral load on panel	$E = E_{wall} + E_{add}$ = **5.4** psf

Lateral in-plane loads

Wind shear load on wall	V_W = **7690** lbs

Vertical loading details

Vertical seismic load factor applied to dead load	$F_{Ev} = 0.2 \times S_{DS}$ = **0.026**

From ASCE 7-16 cl.2.4 - Combining nominal loads using allowable stress design (Utilization)

Load combination no.1	DL (0.026)
Load combination no.5	DL + 0.6 × W (0.917)
Load combination no.9	0.6 × DL + 0.6 × W (0.957)

Properties of masonry section

Cross-sectional area	A = t = **67.5** in^2/ft

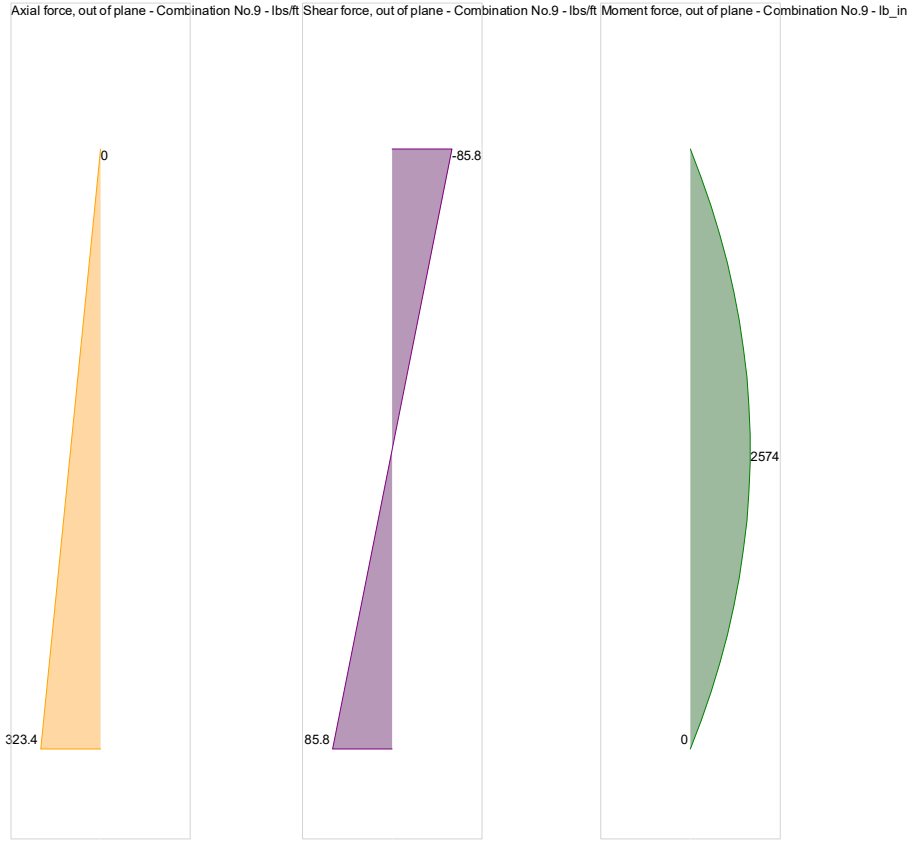
Properties for walls loaded out-of-plane:

Moment of inertia	$I = t^3 / 12 =$ **178** in^4/ft
Section modulus	$S = I / c =$ **63.3** in^3/ft
Radius of gyration	$r = \sqrt{[I / A]} =$ **1.624** in
Effective height factor	$K =$ **1**

Properties for walls loaded in-plane:

Gross moment of inertia	$I_{x\_gross} = t \times L^3 / 12 =$ **5555790** in^4
Gross section modulus	$S_{x\_gross} = I_{x\_gross} / (L / 2) =$ **48735** in^3

Consider wall at maximum moment location under load combination no.9



Maximum moment location	5 ft
Axial load at max moment loc. of panel	P = **162** lb/ft
Compressive stress due to axial load	$f_a = P / A =$ **2.4** psi
Slenderness ratio	$(K \times h) / r =$ **73.901** < 99
Allowable compressive stress due to axial load	$F_a = (1 / 4) \times f'_m \times [1 - ((K \times h) / (140 \times r))^2] =$ **306.6** psi
	$f_a / F_a =$ **0.008**

PASS - Allowable compressive stress exceeds compressive stress due to axial loads

Moment due to axial load	$M_a =$ **0** lb_in/ft
Eccentricity of axial load	e = **0** in
Euler buckling load	$P_e = \pi^2 \times E_m \times I \times [1 - 0.577 \times e / r]^3 / h^2 =$ **186636** lb/ft
	$P / (0.25 \times P_e) =$ **0.003**

PASS - Axial load is less than a quarter of the Euler buckling load

Bending moment at max. moment loc. of panel	M = **2574** lb_in/ft
Compressive stress due to flexural load	f_b = M / S = **40.7** psi
Allowable compressive stress due to flexural load	$F_b = (1 / 3) \times f'_m$ = **566.7** psi
	f_b / F_b = **0.072**

PASS - Allowable compressive stress exceeds compressive stress due to flexure

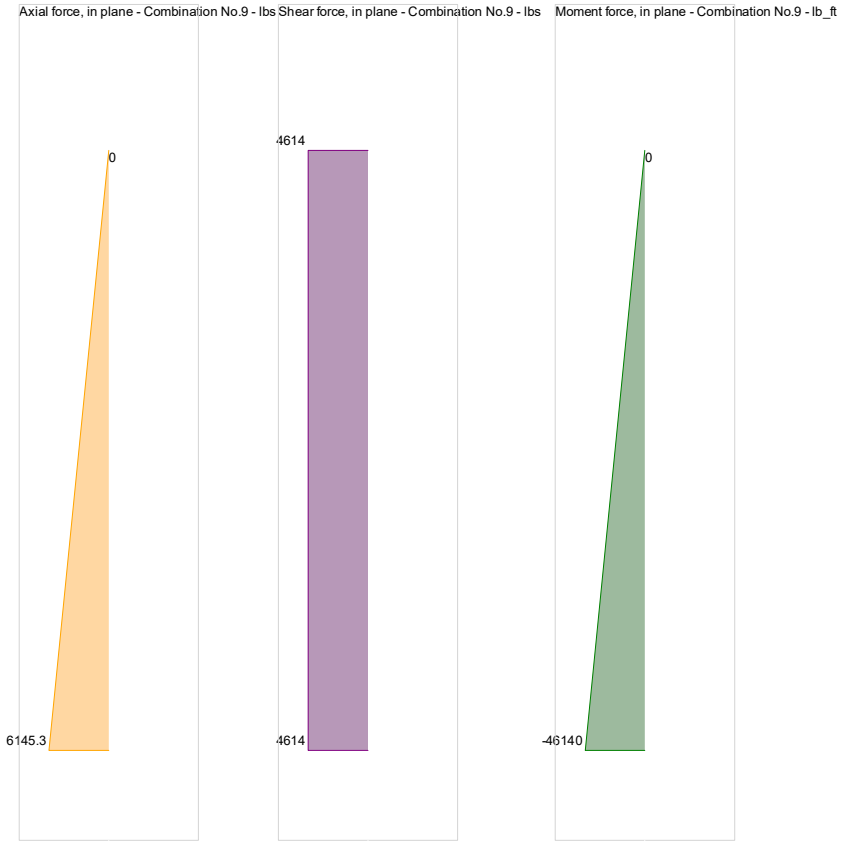
Axial compression and flexure	$f_a / F_a + f_b / F_b$ = **0.080**

PASS - Combined axial and flexural stresses are acceptable

Net flexural tension	f_t = M / S - P / A = **38.3** psi
Allowable tensile stress due to flexural load	$F_t = F_{t\_norm}$ = **40** psi
	f_t / F_t = **0.957**

PASS - Allowable tensile stress exceeds tensile stress due to flexure

Consider wall at bottom under load combination no.9



Shear force	V = **4614** lbs
Depth to reinforcement	$d_{in} = L - l_b / 4$ = **18.7** ft
Net shear area	$A_{nv} = L \times t$ = **1282.5** in^2
Shear stress	$f_v = (3 / 2) \times V / A_{nv}$ = **5.4** psi
Compressive force	$N_v = 0.6 \times P_{DL,b,in}$ = **6145.3** lbs
Allowable shear stress	$F_v = \min(1.5 \times \sqrt{(f'_m \times 1\ psi)}, 120\ psi, 60\ psi + 0.45 \times N_v / (A \times L))$ = **61.8** psi
Shear utilization	f_v / F_v = **0.087**

PASS - Allowable shear stress exceeds applied shear stress

Bending moment from shear load	M_v = **46140** lbs_ft
Net tension under shear load	f_{tv} = max(M_v / S_{x_gross} - N_v / (A × L), 0 psi) = **6.6** psi
Allowable tensile stress under shear load	F_{tv} = F_{t_norm} = **40** psi
	f_{tv} / F_{tv} = **0.164**

PASS - Allowable tensile stress exceeds tensile stress due to shear

Net compression under shear load	f_{bv} = M_v / S_{x_gross} + N_v / (A × L) = **16.2** psi
	f_{bv} / F_b = **0.029**

PASS - Allowable compressive stress exceeds compressive stress due to shear

MASONRY WALL PANEL DESIGN TO TMS 402/602-16

Using the allowable stress design method

Tedds calculation version 2.2.07

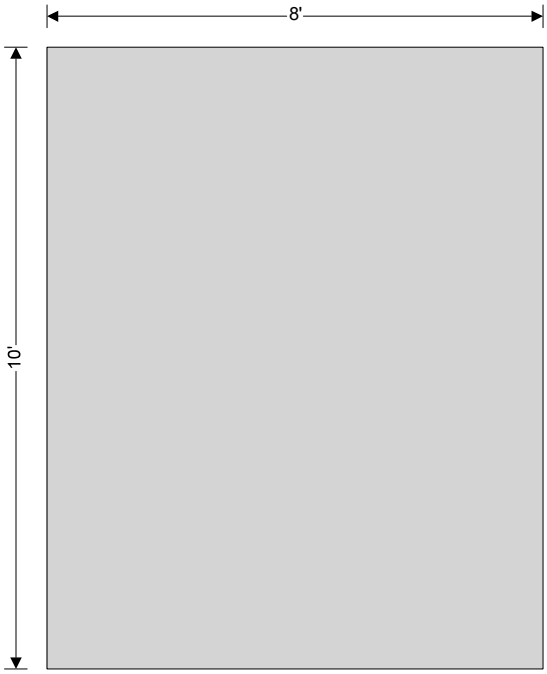
Masonry wall panel details

Shear Wall Line 2 - Unreinforced single-wythe wall, the wall is pinned at the top and at the bottom for out of plane loads

The wall is fixed at the bottom and free at the top for in plane loads

Panel length L = **8** ft

Panel height h = **10** ft



Seismic properties

Seismic design category B

Seismic importance factor (ASCE7 Table 1.5-2) I_e = **1**

Design spectral response acceleration parameter, short periods (ASCE7 11.4.4)

S_{DS} = **0.13**

Seismic wall classification Nonparticipating

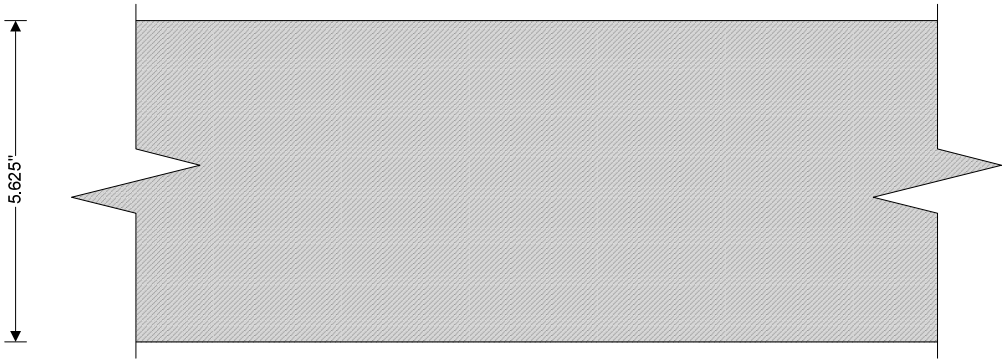
No prescriptive minimum seismic reinforcement

Redundancy factor, on out-of-plane load ρ_E = **1.0**

Construction details

Wall thickness t = **5.625** in

Walls are 6" hollow block filled with vermiculite with composite 5" stone veneer, assume properties similar to 6" solid block



Masonry details

Solid concrete units in running bond with Mortar cement class N mortar

Compressive strength of units	f'_{cu} = **1900** psi
Density of masonry	γ_{block} = **115** lb/ft^3
Height of masonry units	h_b = **7.625** in
Area of block	A_{block} = t = **67.5** in^2/ft
Self weight of wall	$w_{SW} = A_{block} \times \gamma_{block}$ = **53.91** psf

From TMS 602-16 Table 2 - Compressive strength of masonry

Net compressive strength of masonry	f'_m = **1700** psi
Modulus of elasticity for masonry	$E_m = 900 \times f'_m$ = **1530000** psi
Shear modulus of masonry	$G_v = 0.4 \times E_m$ = **612000** psi

From TMS 402 -16 Table 8.2.4.2 - Allowable flexural tensile stresses for clay and concrete masonry

Allowable flexural tensile stress normal to bed	F_{t_norm} = **40** psi
Allowable flexural tensile stress parallel to bed	F_{t_para} = **80** psi

Lateral out-of-plane loads

Wind load on panel	W = **28.6** psf
Wind load on parapet	W_p = **18** psf
Seismic load factor (ASCE7 12.11.1)	$F_p = 0.4 \times S_{DS} \times I_e$ = **0.052**
Seismic load from wall	$E_{wall} = \max(F_p, 0.1) \times w_{SW}$ = **5.4** psf
Additional seimic load	E_{add} = **0** psf
Seismic lateral load on panel	$E = E_{wall} + E_{add}$ = **5.4** psf

Lateral in-plane loads

Wind shear load on wall	V_W = **4720** lbs

Vertical loading details

Dead load from above	DL_{above} = **96** lb/ft
Wind load from above	WL_{above} = **-115** lb/ft
Vertical seismic load factor applied to dead load	$F_{Ev} = 0.2 \times S_{DS}$ = **0.026**

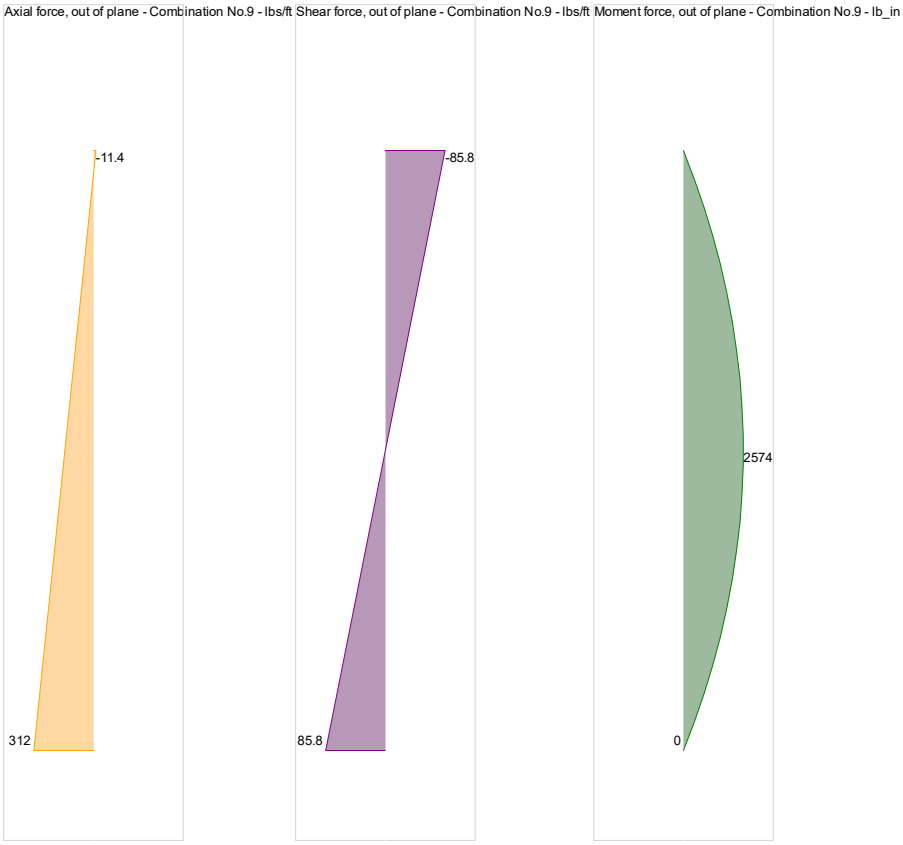
From ASCE 7-16 cl.2.4 - Combining nominal loads using allowable stress design (Utilization)

Load combination no.1	DL (0.031)
Load combination no.5	DL + 0.6 × W (0.907)
Load combination no.9	0.6 × DL + 0.6 × W (0.961)

Properties of masonry section

Cross-sectional area	A = t = **67.5** in^2/ft
Properties for walls loaded out-of-plane:	
Moment of inertia	$I = t^3 / 12$ = **178** in^4/ft
Section modulus	S = I / c = **63.3** in^3/ft
Radius of gyration	$r = \sqrt{[I / A]}$ = **1.624** in
Effective height factor	K = **1**
Properties for walls loaded in-plane:	
Gross moment of inertia	$I_{x\_gross} = t \times L^3 / 12$ = **414720** in^4
Gross section modulus	$S_{x\_gross} = I_{x\_gross} / (L / 2)$ = **8640** in^3

Consider wall at maximum moment location under load combination no.9



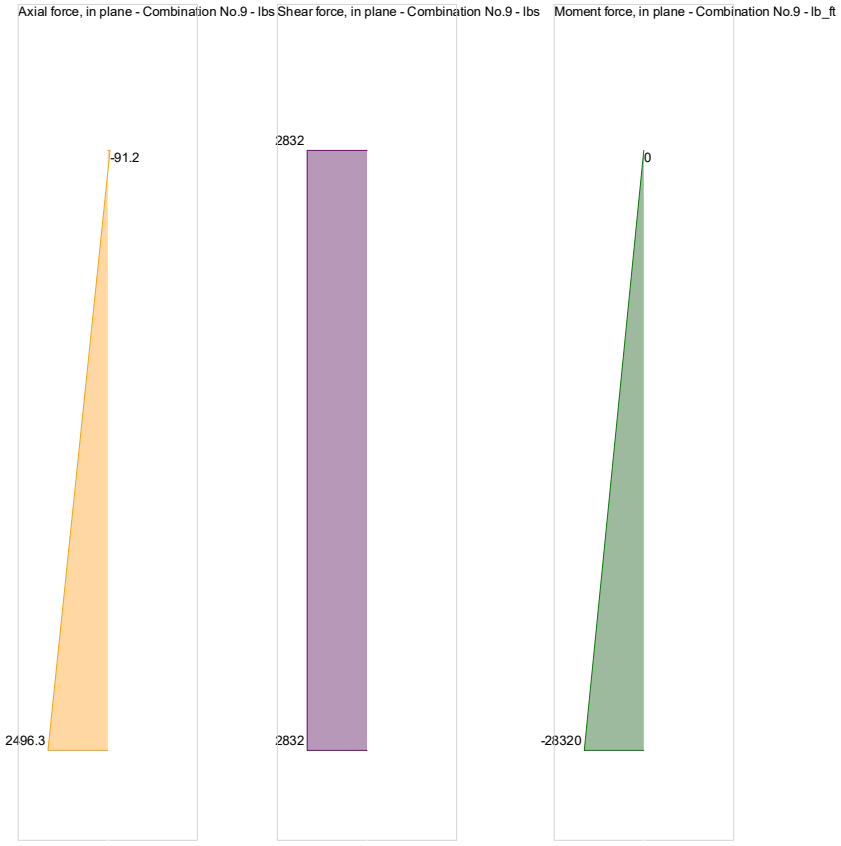
Maximum moment location	5 ft
Axial load at max moment loc. of panel	P = **150** lb/ft
Compressive stress due to axial load	$f_a = P / A$ = **2.2** psi
Slenderness ratio	$(K \times h) / r$ = **73.901** < 99
Allowable compressive stress due to axial load	$F_a = (1 / 4) \times f'_m \times [1 - ((K \times h) / (140 \times r))^2]$ = **306.6** psi
	f_a / F_a = **0.007**

PASS - Allowable compressive stress exceeds compressive stress due to axial loads

Moment due to axial load	M_a = **0** lb_in/ft
Eccentricity of axial load	e = **0** in

Euler buckling load	$P_e = \pi^2 \times E_m \times I \times [1 - 0.577 \times e / r]^3 / h^2 =$ **186636** lb/ft
	$P / (0.25 \times P_e) =$ **0.003**
	PASS - Axial load is less than a quarter of the Euler buckling load
Bending moment at max. moment loc. of panel	M = **2574** lb_in/ft
Compressive stress due to flexural load	$f_b = M / S =$ **40.7** psi
Allowable compressive stress due to flexural load	$F_b = (1 / 3) \times f'_m =$ **566.7** psi
	$f_b / F_b =$ **0.072**
	PASS - Allowable compressive stress exceeds compressive stress due to flexure
Axial compression and flexure	$f_a / F_a + f_b / F_b =$ **0.079**
	PASS - Combined axial and flexural stresses are acceptable
Net flexural tension	$f_t = M / S - P / A =$ **38.4** psi
Allowable tensile stress due to flexural load	$F_t = F_{t\_norm} =$ **40** psi
	$f_t / F_t =$ **0.961**
	PASS - Allowable tensile stress exceeds tensile stress due to flexure

Consider wall at bottom under load combination no.9



Shear force	V = **2832** lbs
Depth to reinforcement	$d_{in} = L - l_b / 4 =$ **7.7** ft
Net shear area	$A_{nv} = L \times t =$ **540** in^2
Shear stress	$f_v = (3 / 2) \times V / A_{nv} =$ **7.9** psi
Compressive force	$N_v = 0.6 \times P_{DL,b,in} =$ **3048.3** lbs

Allowable shear stress	$F_v = \min(1.5 \times \sqrt{f'_m \times 1\ psi}, 120\ psi, 60\ psi + 0.45 \times N_v / (A \times L)) =$ **61.8** psi
Shear utilization	$f_v / F_v =$ **0.127**
	PASS - Allowable shear stress exceeds applied shear stress
Bending moment from shear load	$M_v =$ **28320** lbs_ft
Net tension under shear load	$f_{tv} = \max(M_v / S_{x\_gross} - N_v / (A \times L), 0\ psi) =$ **33.7** psi
Allowable tensile stress under shear load	$F_{tv} = F_{t\_norm} =$ **40** psi
	$f_{tv} / F_{tv} =$ **0.842**
	PASS - Allowable tensile stress exceeds tensile stress due to shear
Net compression under shear load	$f_{bv} = M_v / S_{x\_gross} + N_v / (A \times L) =$ **45** psi
	$f_{bv} / F_b =$ **0.079**
	PASS - Allowable compressive stress exceeds compressive stress due to shear

MASONRY WALL PANEL DESIGN TO TMS 402/602-16

Using the allowable stress design method

Tedds calculation version 2.2.07

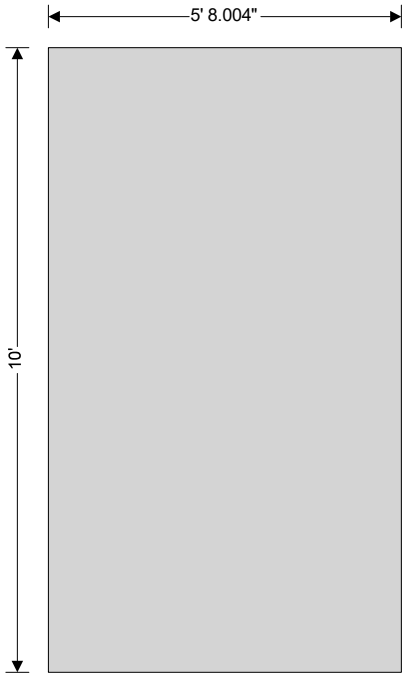
Masonry wall panel details

SHear Wall Line A, L = 5.67ft - Unreinforced single-wythe wall, the wall is pinned at the top and at the bottom for out of plane loads

The wall is fixed at the bottom and free at the top for in plane loads

Panel length L = **5.667** ft

Panel height h = **10** ft



Seismic properties

Seismic design category B

Seismic importance factor (ASCE7 Table 1.5-2) I_e = **1**

Design spectral response acceleration parameter, short periods (ASCE7 11.4.4)

S_{DS} = **0.13**

Seismic wall classification Nonparticipating

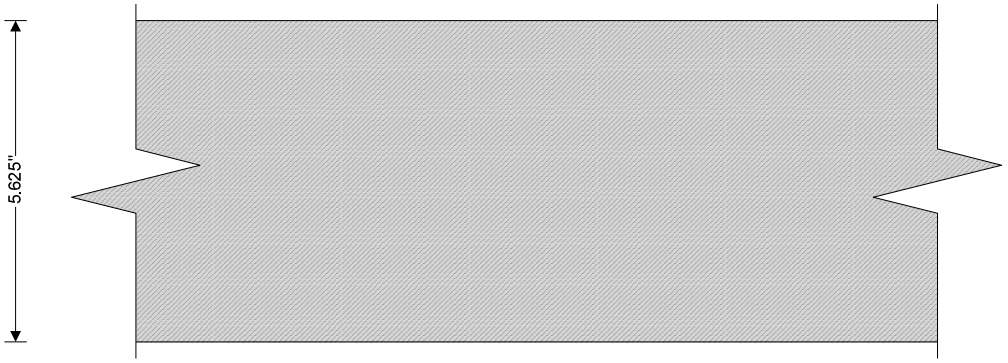
No prescriptive minimum seismic reinforcement

Redundancy factor, on out-of-plane load ρ_E = **1.0**

Construction details

Wall thickness t = **5.625** in

Walls are 6" hollow block filled with vermiculite with composite 5" stone veneer, assume properties similar to 6" solid block



Masonry details

Solid concrete units in running bond with Mortar cement class N mortar

Compressive strength of units	f'_{cu} = **1900** psi
Density of masonry	γ_{block} = **115** lb/ft^3
Height of masonry units	h_b = **7.625** in
Area of block	A_{block} = t = **67.5** in^2/ft
Self weight of wall	$w_{SW} = A_{block} \times \gamma_{block}$ = **53.91** psf

From TMS 602-16 Table 2 - Compressive strength of masonry

Net compressive strength of masonry	f'_m = **1700** psi
Modulus of elasticity for masonry	$E_m = 900 \times f'_m$ = **1530000** psi
Shear modulus of masonry	$G_v = 0.4 \times E_m$ = **612000** psi

From TMS 402 -16 Table 8.2.4.2 - Allowable flexural tensile stresses for clay and concrete masonry

Allowable flexural tensile stress normal to bed	F_{t_norm} = **40** psi
Allowable flexural tensile stress parallel to bed	F_{t_para} = **80** psi

Lateral out-of-plane loads

Wind load on panel	W = **28.6** psf
Wind load on parapet	W_p = **18** psf
Seismic load factor (ASCE7 12.11.1)	$F_p = 0.4 \times S_{DS} \times I_e$ = **0.052**
Seismic load from wall	$E_{wall} = \max(F_p, 0.1) \times w_{SW}$ = **5.4** psf
Additional seimic load	E_{add} = **0** psf
Seismic lateral load on panel	$E = E_{wall} + E_{add}$ = **5.4** psf

Lateral in-plane loads

Wind shear load on wall	V_W = **1250** lbs

Vertical loading details

Dead load from above	DL_{above} = **120** lb/ft
Wind load from above	WL_{above} = **-133** lb/ft
Vertical seismic load factor applied to dead load	$F_{Ev} = 0.2 \times S_{DS}$ = **0.026**

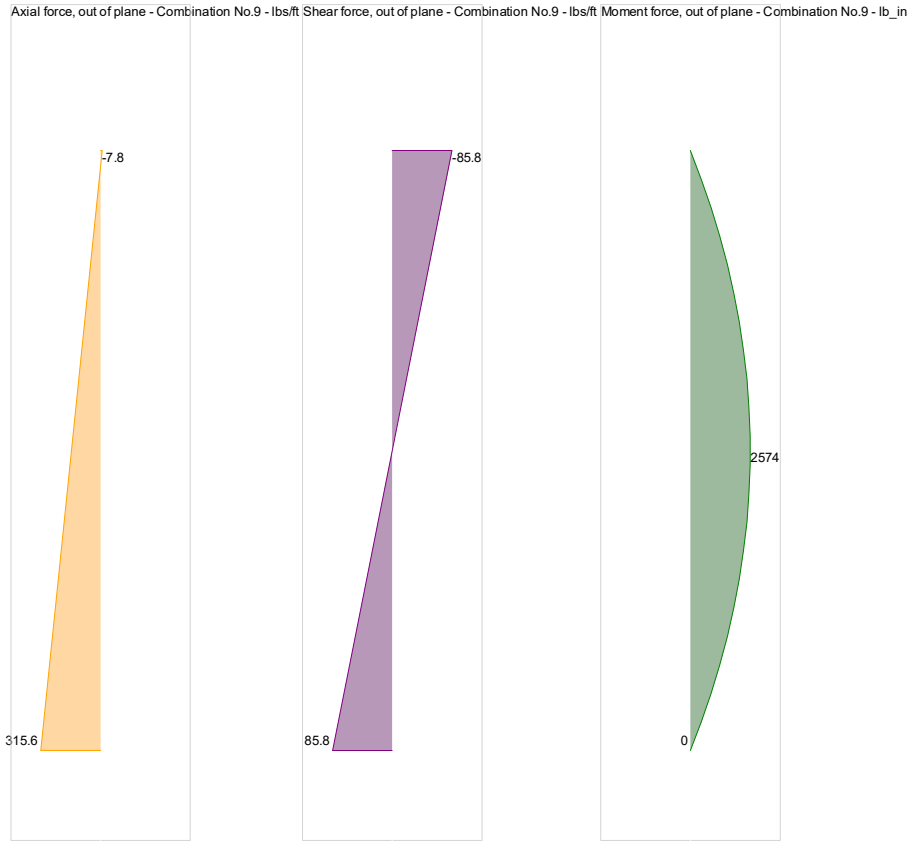
From ASCE 7-16 cl.2.4 - Combining nominal loads using allowable stress design (Utilization)

Load combination no.1	DL (0.032)
Load combination no.5	DL + 0.6 × W (0.902)
Load combination no.9	0.6 × DL + 0.6 × W (0.960)

Properties of masonry section

Cross-sectional area	$A = t =$ **67.5** in^2/ft
Properties for walls loaded out-of-plane:	
Moment of inertia	$I = t^3 / 12 =$ **178** in^4/ft
Section modulus	$S = I / c =$ **63.3** in^3/ft
Radius of gyration	$r = \sqrt{[I / A]} =$ **1.624** in
Effective height factor	$K =$ **1**
Properties for walls loaded in-plane:	
Gross moment of inertia	$I_{x\_gross} = t \times L^3 / 12 =$ **147416** in^4
Gross section modulus	$S_{x\_gross} = I_{x\_gross} / (L / 2) =$ **4336** in^3

Consider wall at maximum moment location under load combination no.9



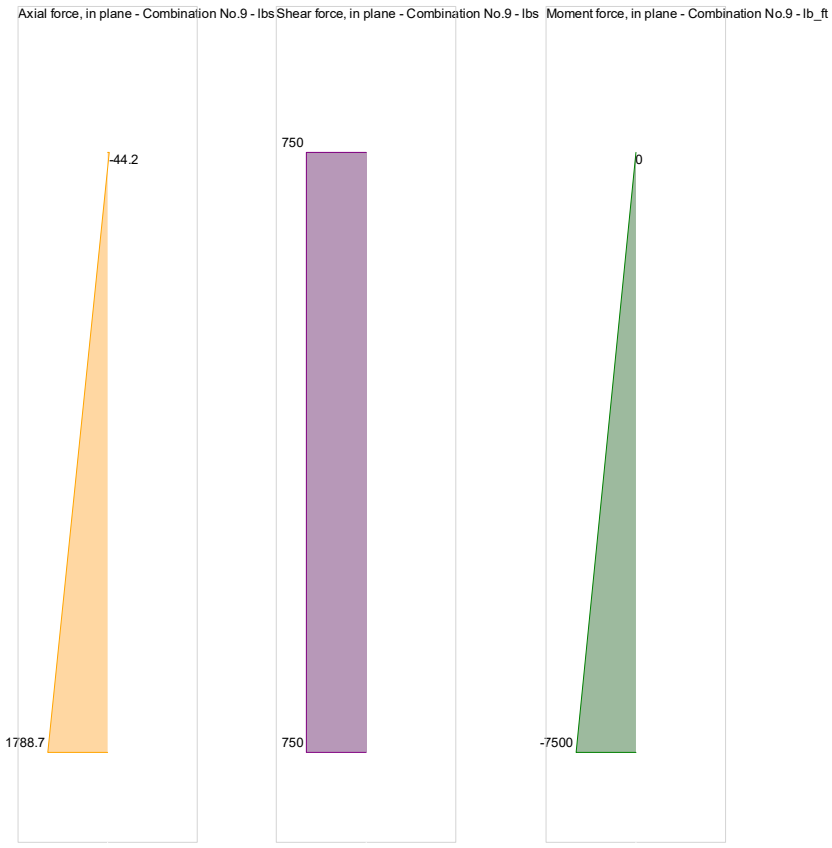
Maximum moment location	5 ft
Axial load at max moment loc. of panel	$P =$ **154** lb/ft
Compressive stress due to axial load	$f_a = P / A =$ **2.3** psi
Slenderness ratio	$(K \times h) / r =$ **73.901** < 99
Allowable compressive stress due to axial load	$F_a = (1 / 4) \times f'_m \times [1 - ((K \times h) / (140 \times r))^2] =$ **306.6** psi
	$f_a / F_a =$ **0.007**

PASS - Allowable compressive stress exceeds compressive stress due to axial loads

Moment due to axial load	$M_a =$ **0** lb_in/ft
Eccentricity of axial load	$e =$ **0** in

Euler buckling load	$P_e = \pi^2 \times E_m \times I \times [1 - 0.577 \times e / r]^3 / h^2 =$ **186636** lb/ft
	$P / (0.25 \times P_e) =$ **0.003**
	PASS - Axial load is less than a quarter of the Euler buckling load
Bending moment at max. moment loc. of panel	M = **2574** lb_in/ft
Compressive stress due to flexural load	$f_b = M / S =$ **40.7** psi
Allowable compressive stress due to flexural load	$F_b = (1 / 3) \times f'_m =$ **566.7** psi
	$f_b / F_b =$ **0.072**
	PASS - Allowable compressive stress exceeds compressive stress due to flexure
Axial compression and flexure	$f_a / F_a + f_b / F_b =$ **0.079**
	PASS - Combined axial and flexural stresses are acceptable
Net flexural tension	$f_t = M / S - P / A =$ **38.4** psi
Allowable tensile stress due to flexural load	$F_t = F_{t\_norm} =$ **40** psi
	$f_t / F_t =$ **0.960**
	PASS - Allowable tensile stress exceeds tensile stress due to flexure

Consider wall at bottom under load combination no.9



Shear force	V = **750** lbs
Depth to reinforcement	$d_{in} = L - l_b / 4 =$ **5.3** ft
Net shear area	$A_{nv} = L \times t =$ **382.5** in^2
Shear stress	$f_v = (3 / 2) \times V / A_{nv} =$ **2.9** psi
Compressive force	$N_v = 0.6 \times P_{DL,b,in} =$ **2240.9** lbs

Allowable shear stress	$F_v = \min(1.5 \times \sqrt{f'_m \times 1\ psi}, 120\ psi, 60\ psi + 0.45 \times N_v / (A \times L)) =$ **61.8** psi
Shear utilization	$f_v / F_v =$ **0.048**
	PASS - Allowable shear stress exceeds applied shear stress
Bending moment from shear load	$M_v =$ **7500** lbs_ft
Net tension under shear load	$f_{tv} = \max(M_v / S_{x\_gross} - N_v / (A \times L), 0\ psi) =$ **14.9** psi
Allowable tensile stress under shear load	$F_{tv} = F_{t\_norm} =$ **40** psi
	$f_{tv} / F_{tv} =$ **0.373**
	PASS - Allowable tensile stress exceeds tensile stress due to shear
Net compression under shear load	$f_{bv} = M_v / S_{x\_gross} + N_v / (A \times L) =$ **26.6** psi
	$f_{bv} / F_b =$ **0.047**
	PASS - Allowable compressive stress exceeds compressive stress due to shear

MASONRY WALL PANEL DESIGN TO TMS 402/602-16

Using the allowable stress design method

Tedds calculation version 2.2.07

Masonry wall panel details

Shear Wall Line A, L = 13.3ft - Unreinforced single-wythe wall, the wall is pinned at the top and at the bottom for out of plane loads

The wall is fixed at the bottom and free at the top for in plane loads

Panel length L = **13.333** ft

Panel height h = **10** ft

Seismic properties

Seismic design category B

Seismic importance factor (ASCE7 Table 1.5-2) I_e = **1**

Design spectral response acceleration parameter, short periods (ASCE7 11.4.4)

S_{DS} = **0.13**

Seismic wall classification Nonparticipating

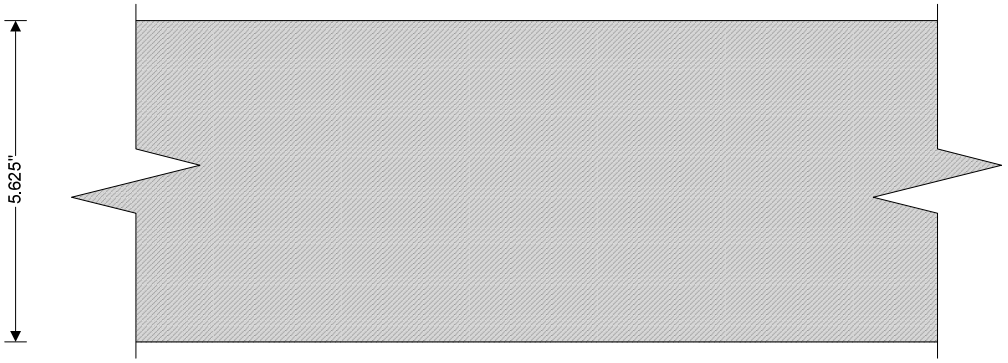
No prescriptive minimum seismic reinforcement

Redundancy factor, on out-of-plane load ρ_E = **1.0**

Construction details

Wall thickness t = **5.625** in

Walls are 6" hollow block filled with vermiculite with composite 5" stone veneer, assume properties similar to 6" solid block



Masonry details

Solid concrete units in running bond with Mortar cement class N mortar

Compressive strength of units	f'_{cu} = **1900** psi
Density of masonry	γ_{block} = **115** lb/ft^3
Height of masonry units	h_b = **7.625** in
Area of block	A_{block} = t = **67.5** in^2/ft
Self weight of wall	$w_{SW} = A_{block} \times \gamma_{block}$ = **53.91** psf

From TMS 602-16 Table 2 - Compressive strength of masonry

Net compressive strength of masonry	f'_m = **1700** psi
Modulus of elasticity for masonry	$E_m = 900 \times f'_m$ = **1530000** psi
Shear modulus of masonry	$G_v = 0.4 \times E_m$ = **612000** psi

From TMS 402 -16 Table 8.2.4.2 - Allowable flexural tensile stresses for clay and concrete masonry

Allowable flexural tensile stress normal to bed	F_{t_norm} = **40** psi
Allowable flexural tensile stress parallel to bed	F_{t_para} = **80** psi

Lateral out-of-plane loads

Wind load on panel	W = **28.6** psf
Wind load on parapet	W_p = **18** psf
Seismic load factor (ASCE7 12.11.1)	$F_p = 0.4 \times S_{DS} \times I_e$ = **0.052**
Seismic load from wall	$E_{wall} = \max(F_p, 0.1) \times w_{SW}$ = **5.4** psf
Additional seimic load	E_{add} = **0** psf
Seismic lateral load on panel	$E = E_{wall} + E_{add}$ = **5.4** psf

Lateral in-plane loads

Wind shear load on wall	V_W = **2700** lbs

Vertical loading details

Dead load from above	DL_{above} = **120** lb/ft
Wind load from above	WL_{above} = **-133** lb/ft
Vertical seismic load factor applied to dead load	$F_{Ev} = 0.2 \times S_{DS}$ = **0.026**

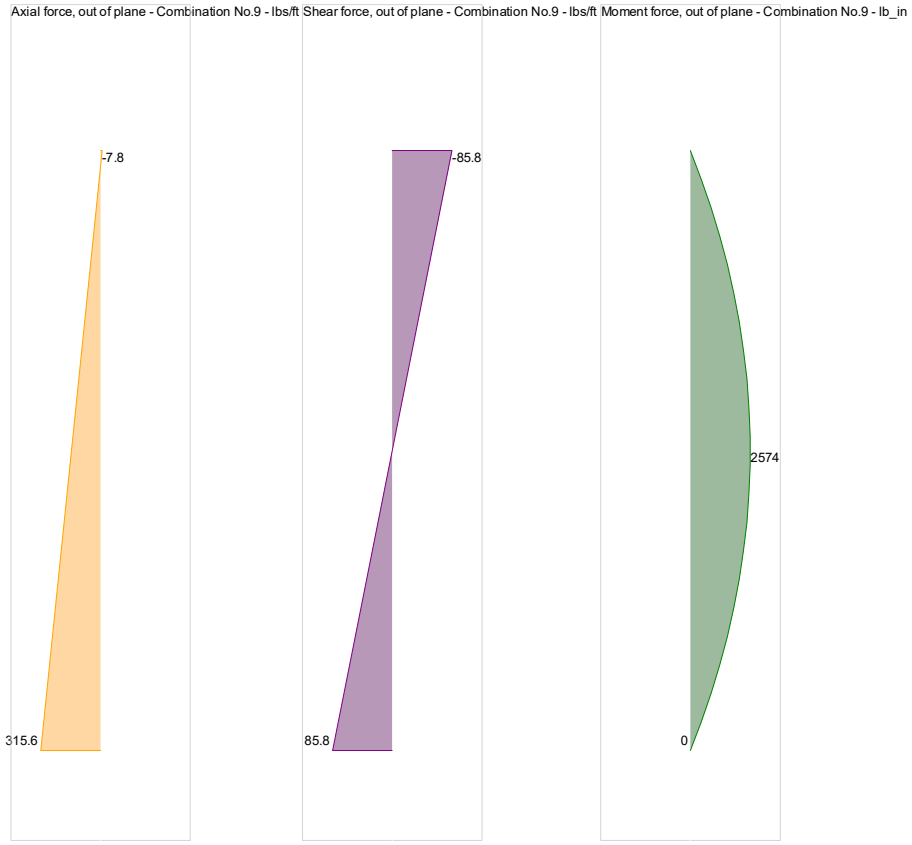
From ASCE 7-16 cl.2.4 - Combining nominal loads using allowable stress design (Utilization)

Load combination no.1	DL (0.032)
Load combination no.5	DL + 0.6 × W (0.902)
Load combination no.9	0.6 × DL + 0.6 × W (0.960)

Properties of masonry section

Cross-sectional area	A = t = **67.5** in^2/ft
Properties for walls loaded out-of-plane:	
Moment of inertia	$I = t^3 / 12$ = **178** in^4/ft
Section modulus	S = I / c = **63.3** in^3/ft
Radius of gyration	$r = \sqrt{[I / A]}$ = **1.624** in
Effective height factor	K = **1**
Properties for walls loaded in-plane:	
Gross moment of inertia	$I_{x\_gross} = t \times L^3 / 12$ = **1919856** in^4
Gross section modulus	$S_{x\_gross} = I_{x\_gross} / (L / 2)$ = **23999** in^3

Consider wall at maximum moment location under load combination no.9



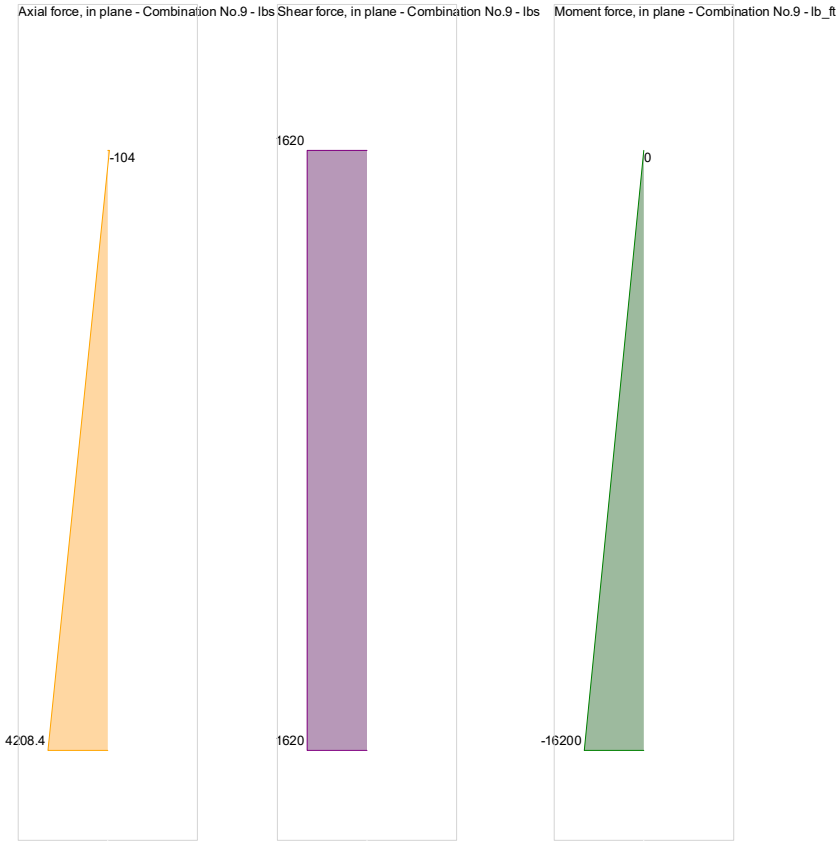
Maximum moment location	5 ft
Axial load at max moment loc. of panel	P = **154** lb/ft
Compressive stress due to axial load	$f_a = P / A$ = **2.3** psi
Slenderness ratio	$(K \times h) / r$ = **73.901** < 99
Allowable compressive stress due to axial load	$F_a = (1 / 4) \times f'_m \times [1 - ((K \times h) / (140 \times r))^2]$ = **306.6** psi
	f_a / F_a = **0.007**

PASS - Allowable compressive stress exceeds compressive stress due to axial loads

Moment due to axial load	M_a = **0** lb_in/ft
Eccentricity of axial load	e = **0** in

Euler buckling load	$P_e = \pi^2 \times E_m \times I \times [1 - 0.577 \times e / r]^3 / h^2 =$ **186636** lb/ft
	$P / (0.25 \times P_e) =$ **0.003**
	PASS - Axial load is less than a quarter of the Euler buckling load
Bending moment at max. moment loc. of panel	M = **2574** lb_in/ft
Compressive stress due to flexural load	$f_b = M / S =$ **40.7** psi
Allowable compressive stress due to flexural load	$F_b = (1 / 3) \times f'_m =$ **566.7** psi
	$f_b / F_b =$ **0.072**
	PASS - Allowable compressive stress exceeds compressive stress due to flexure
Axial compression and flexure	$f_a / F_a + f_b / F_b =$ **0.079**
	PASS - Combined axial and flexural stresses are acceptable
Net flexural tension	$f_t = M / S - P / A =$ **38.4** psi
Allowable tensile stress due to flexural load	$F_t = F_{t\_norm} =$ **40** psi
	$f_t / F_t =$ **0.960**
	PASS - Allowable tensile stress exceeds tensile stress due to flexure

Consider wall at bottom under load combination no.9



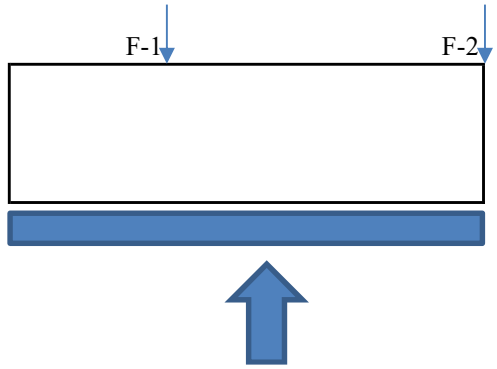
Shear force	V = **1620** lbs
Depth to reinforcement	$d_{in} = L - l_b / 4 =$ **13** ft
Net shear area	$A_{nv} = L \times t =$ **900** in^2
Shear stress	$f_v = (3 / 2) \times V / A_{nv} =$ **2.7** psi
Compressive force	$N_v = 0.6 \times P_{DL,b,in} =$ **5272.4** lbs

Allowable shear stress	$F_v = \min(1.5 \times \sqrt{f'_m \times 1\ psi}, 120\ psi, 60\ psi + 0.45 \times N_v / (A \times L)) =$ **61.8** psi
Shear utilization	$f_v / F_v =$ **0.044**
	PASS - Allowable shear stress exceeds applied shear stress
Bending moment from shear load	$M_v =$ **16200** lbs_ft
Net tension under shear load	$f_{tv} = \max(M_v / S_{x\_gross} - N_v / (A \times L), 0\ psi) =$ **2.2** psi
Allowable tensile stress under shear load	$F_{tv} = F_{t\_norm} =$ **40** psi
	$f_{tv} / F_{tv} =$ **0.056**
	PASS - Allowable tensile stress exceeds tensile stress due to shear
Net compression under shear load	$f_{bv} = M_v / S_{x\_gross} + N_v / (A \times L) =$ **14** psi
	$f_{bv} / F_b =$ **0.025**
	PASS - Allowable compressive stress exceeds compressive stress due to shear

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Registration Station				
Subject	Wind Load Calculations MWFRS			Job No.	2019-031.01
	Diaphragm Analysis			Sheet No.	of
Computed By	EB	Date	3/26/2021	Checked By	Date

DIAPHRAGM ANALYSIS (X-Direction)



Roof diaphragm loading:

	F		L		v = F/L	
F-1 (left)	2.75	k	20.00	ft	137	plf
F-1 (right)	4.94	k	20.00	ft	247	plf
F-2	4.72	k	20.00	ft	236	plf

The shear capacity of unblocked wood diaphragm with 1/2" APA rated sheathing and 8d common nails at 6" OC with 2x framing from NDS Table 4.2C: v_w = 505.00 plf

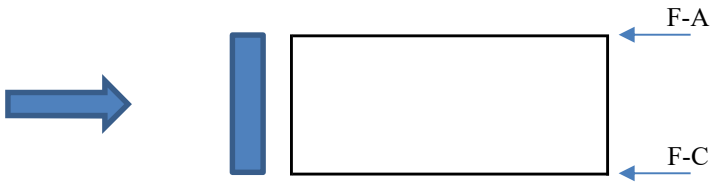
Adjustment factor for species = [1-(0.5-G)] where G = 0.42 for HF = 0.92

ϕr_n = 0.80 * v_w * factor = 372 plf **OK**

Collector Forces:

	v		L		Fcoll		
F-2	236.00	plf	10.00	ft	2360	lb	continuous 2x6 top plate

DIAPHRAGM ANALYSIS (Y-Direction)



Roof diaphragm loading:

	F		L		v = F/L	
F-A	2.85	k	54.00	ft	53	plf
F-B	2.85	k	54.00	ft	53	plf

The shear capacity of unblocked wood diaphragm with 1/2" APA rated sheathing and 8d common nails at 6" OC with 2x framing from NDS Table 4.2C: v_w = 505.00 plf

Adjustment factor for species = [1-(0.5-G)] where G = 0.42 for HF = 0.92

ϕr_n = 0.80 * v_w * factor = 372 plf **OK**

Collector Forces:

	v		L		Fcoll		
F-A	53.00	plf	12.00	ft	636	lb	continuous 2x6 top plate
F-B	53.00	plf	12.00	ft	636	lb	continuous 2x6 top plate

ALBRECHT ENGINEERING INC

Project	Greenbrier State Park - Registration Station				
Subject	Foundation Loads			Job No.	2019-031.01
				Sheet No.	of
Computed By	EB	Date	3/26/2021	Checked By	Date

Foundation Loads

	p	trib W	w	
Roof DL	10.00	12	120	plf
Ceiling DL	10.00	10	100	plf
Roof LL	30.00	12	360	plf
Ceiling LL	30.00	10	300	plf
Snow	33.50	12	402	plf
Wall DL	34.50	10	345	plf

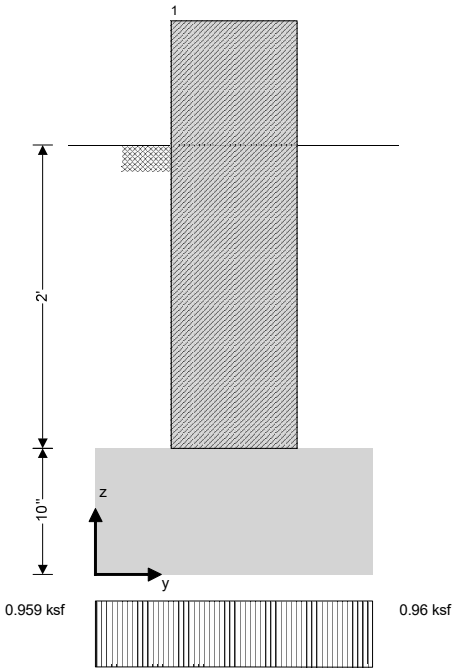
DL =	565	plf
LL =	300	plf
RLL =	360	plf
SL =	402	plf

SEE TEDDS output

Tedds calculation version 3.2.09

FOOTING ANALYSIS

Length of foundation	L_x = **1** ft
Width of foundation	L_y = **1.833** ft
Foundation area	$A = L_x \times L_y$ = **1.833** ft^2
Depth of foundation	h = **10** in
Depth of soil over foundation	h_{soil} = **24** in
Density of concrete	γ_{conc} = **150.0** lb/ft^3



Wall no.1 details

Width of wall	l_{y1} = **10** in
position in y-axis	y_1 = **11** in

Soil properties

Net allowable bearing pressure	q_{allow_Net} = **3** ksf
Density of soil	γ_{soil} = **120.0** lb/ft^3
Angle of internal friction	ϕ_b = **30.0** deg
Design base friction angle	δ_{bb} = **30.0** deg
Coefficient of base friction	$\tan(\delta_{bb})$ = **0.577**

Foundation loads

Self weight	$F_{swt} = h \times \gamma_{conc}$ = **125** psf
Soil weight	$F_{soil} = h_{soil} \times \gamma_{soil}$ = **240** psf

Wall no.1 loads per linear foot

Dead load in z — F_{Dz1} = **0.6** kips

Live load in z — F_{Lz1} = **0.3** kips

Live roof load in z — F_{Lrz1} = **0.4** kips

Snow load in z — F_{Sz1} = **0.4** kips

Footing analysis for soil and stability

Load combinations per ASCE 7-10

1.0D (0.202)

1.0D + 1.0L (0.251)

1.0D + 1.0Lr (0.260)

1.0D + 1.0S (0.267)

1.0D + 0.75L + 0.75Lr (0.283)

1.0D + 0.75L + 0.75S (0.287)

1.0D + 0.75L + 0.75R (0.238)

Combination 7 results: 1.0D + 0.75L + 0.75S

Forces on foundation per linear foot

Force in z-axis — $F_{dz} = \gamma_D \times A \times (F_{swt} + F_{soil}) + \gamma_D \times F_{Dz1} + \gamma_L \times F_{Lz1} + \gamma_S \times F_{Sz1}$ = **1.8** kips

Moments on foundation per linear foot

Moment in y-axis, about y is 0 — $M_{dy} = \gamma_D \times (A \times (F_{swt} + F_{soil}) \times L_y / 2) + \gamma_D \times (F_{Dz1} \times y_1) + \gamma_L \times (F_{Lz1} \times y_1) + \gamma_S \times (F_{Sz1} \times y_1)$ = **1.6** kip_ft

Uplift verification

Vertical force — F_{dz} = **1.759** kips

PASS - Foundation is not subject to uplift

Stability against sliding

Resistance due to base friction — $F_{RFriction} = \max(F_{dz}, 0\ kN) \times \tan(\delta_{bb})$ = **1.016** kips

Bearing resistance

Eccentricity of base reaction

Eccentricity of base reaction in y-axis — $e_{dy} = M_{dy} / F_{dz} - L_y / 2$ = **0.001** in

Strip base pressures

$q_1 = F_{dz} \times (1 - 6 \times e_{dy} / L_y) / (L_y \times 1\ ft)$ = **0.959** ksf

$q_2 = F_{dz} \times (1 + 6 \times e_{dy} / L_y) / (L_y \times 1\ ft)$ = **0.96** ksf

Minimum base pressure — $q_{min} = \min(q_1, q_2)$ = **0.959** ksf

Maximum base pressure — $q_{max} = \max(q_1, q_2)$ = **0.96** ksf

Allowable bearing capacity

Allowable bearing capacity — $q_{allow} = q_{allow\_Net} + (h + h_{soil}) \times \gamma_{soil}$ = **3.34** ksf

q_{max} / q_{allow} = **0.287**

PASS - Allowable bearing capacity exceeds design base pressure

APPENDIX D: GEOTECHNICAL ENGINEERING REPORT

Entry Gate Fee Station Improvements
Greenbrier State Park
Washington County, Maryland
DGS Project No: P-052-200-002

Prepared for Ziger | Snead Architects

Schnabel Reference 20C14026
November 20, 2020

Schnabel ENGINEERING
T 410.944.6170 / F 410.944.1162
1504 Woodlawn Drive / Baltimore, MD 21207 schnabel-eng.com

November 20, 2020

Mr. Jeremy Chinnis, AIA, LEED AP
Ziger | Snead Architects
1006 Morton Street
Baltimore, Maryland 21201

Subject: **Geotechnical Engineering Report, Entry Gate Fee Station Improvements, Greenbrier State Park, Washington County, Maryland**
DGS Project No: P-052-200-002 (Schnabel Reference 20C14026)

Dear Mr. Chinnis:

SCHNABEL ENGINEERING, LLC (Schnabel) is pleased to submit our geotechnical engineering report for this project. This study was performed in accordance with our proposal dated June 8, 2020, as authorized on October 12, 2020.

1.0 SCOPE OF SERVICES

Our proposal dated June 8, 2020 defines the scope of services for this project. We developed this scope based on the Project RFP and conversations with your office and the design team. The scope of services includes the following:

- Planning and site reconnaissance
- A subsurface exploration program including four test borings to depths of 10 to 20 ft
- Laboratory testing on soil samples collected during the subsurface exploration
- Geotechnical engineering analysis and this report

2.0 PROJECT DESCRIPTION

2.1 Site Description

The site for this project is the existing entry gate and charge station for Greenbrier State Park in Washington County Maryland. A Site Vicinity Map is included as Figure 1.

The park is a popular attraction for day use, especially during the summer, where entry lines for the park can cause congestion on the nearby National Pike (US 40). The park is also a popular destination for large recreational vehicles due to its 165 campsites. There is currently one lane of traffic in each direction at the project site, with one toll/charge station serving entry to the park. The project site also contains passenger vehicle parking and a small camp office building.

The site is located within the Appalachian Mountains, and appears to have been locally graded out of the existing mountain slope, which generally grades downward from south to north. The existing roadway at the project site has surface elevations of approximately EL 1061 to EL 1066. The asphalt pavement at the site was recently paved and is in good condition.

Schnabel obtained the site information from the project RFP, the topographic site plans provided to us, and through our site visits and correspondence with the project team.

2.2 Proposed Construction

The existing charge station will be removed and replaced with two new staggered, 8 by 12 ft, automated charge stations. A new entrance lane and a widening of the existing roadway will allow for two lanes of traffic to enter the park. The camp office building will be expanded and renovated to include a new covered porch, and will have an approximate proposed footprint of 54 by 20 ft. The proposed charge stations are expected to have total foundation loads of approximately 500 psf each, while the new construction for the office building will have approximate wall loads of 750 psf and column loads of about 4,000 pounds.

Additional planned site features include a low stone wall/fence between the entrance roadway and parking area, two new bioretention stormwater management facilities, and new recreational vehicle parking. The roadway widening, RV parking, and stormwater management facilities will require cuts and fills. Based on topographic site plans provided to us, we estimate maximum fill depths will be approximately 7 ft and maximum cut depths will be approximately 2 ft. Ziger | Snead provided the project details, AMT provided the site grading plans, and Albrecht Engineering provided the structural load information.

3.0 SUBSURFACE EXPLORATION AND LABORATORY TESTING PROGRAM

We performed a subsurface exploration and field testing program to identify the subsurface stratigraphy underlying the site and to evaluate the geotechnical properties of the materials encountered. This program included test borings and infiltration testing. Exploration methods used are discussed below. The appendices contain the results of our exploration.

3.1 Subsurface Exploration Methods

3.1.1 Test Borings

Schnabel's subcontractor, Connelly & Associates, drilled four test borings under our observation on October 22, 2020. The Standard Penetration Test (SPT) was performed at selected depths in the borings. Appendix A includes specific observations, remarks, and logs for the borings; classification criteria; drilling methods; and sampling protocols. Figure 2 included at the end of this report indicates the approximate test boring locations. We will retain soil samples up to 90 days beyond the issuance of this report, unless you request other disposition.

The SPT samples were obtained using a hydraulically driven automatic trip hammer (ATH). Most correlations with SPT data are based on N-values collected with a safety hammer. The energy applied to the split-spoon sampler using the ATH is about 33 percent greater than that applied using the safety hammer, resulting in lower N-values. The hammer blows shown on the boring logs are uncorrected for

the higher energy. However, we correct SPT N-values for the higher energy when using N-values in our analyses.

3.1.2 In Situ Infiltration Testing

We performed two field infiltration test in accordance with the *Maryland Stormwater Design Manual Appendix D.1*. Tests were performed in holes offset from two test borings to determine the in-situ infiltration rates. Field Infiltration rates and stormwater design are discussed in Section 6.0 of this report.

3.2 Soil Laboratory Testing

Our laboratory performed tests on selected samples collected during the subsurface exploration. The testing aided in the classification of materials encountered in the subsurface exploration and provided data for use in the development of recommendations for design of foundations, earthwork, below-grade walls, and pavements. The results of the laboratory tests are included in Appendix B and are summarized (for each stratum) in Section 4.0 of this report. Selected test results are also shown on the test boring logs in Appendix A.

3.2.1 Index Testing

We performed index testing on samples collected as part of the exploration to provide soil classifications and to provide parameters for use with published correlations with soil properties. Index testing included performing natural moisture content, Atterberg Limit, and gradation tests on nine split spoon samples and one bulk sample of soil representing Strata A and B. USDA soil textural classifications were also performed to aid in stormwater management design.

3.2.2 Compaction Testing

We performed Modified Proctor compaction testing to evaluate compaction characteristics. Testing was performed on one sample representing Stratum A.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

We reviewed existing geologic data and information in our files. Based on this review, the geologic stratigraphy consists of residual materials derived from the weathering of the parent bedrock of the Harper's Formation. We obtained this information from the Geologic Map the Myersville Quadrangle, Maryland, published in 1981 by John L. Fauth.

4.2 Ground Cover

Two test borings were performed in the existing roadway and encountered 7 and 4 inches of asphalt over 3 and 8 inches of aggregate base, respectively. Two stormwater management borings were performed in the grass covered areas of the site and encountered 3 inches of topsoil. Approximate ground cover depths are noted on the test boring logs in Appendix A.

4.3 Stratum A - Existing Fill

Existing fill was present in one of the test borings, SWM-1, from below the ground cover to a depth of 7.5 ft below the ground surface. Fills are man-placed materials. Based on the topographic site plan provided to us, we believe Stratum A fill soils were placed in the northwestern corner of the site to provide a level

surface for parking and vehicle access. Fill soils were classified in the field through our observations of the soil composition, sample color and moisture, and/or presence of unexpected materials, such as root fragments.

The existing fills encountered during our investigation consisted of medium stiff to hard Sandy Lean Clay (CL) and Silt with Sand (ML) and contained rock fragments, root fragments and a probable boulder. Laboratory tests on the soil samples within this stratum resulted in the following properties:

- SPT N-Value: 6 to 30 blows per foot (bpf)
- Moisture Content: 15.8 %
- Liquid Limit: 40
- Plasticity Index: 24
- % Passing #200 Sieve 58.1 %

We performed a Modified Proctor Compaction test on a bulk sample representing this stratum. The compaction test resulted in a maximum dry density of 122.3 pcf at an optimum moisture content of 11.9 percent. A natural moisture content value of Stratum A soils tested in our laboratory was 15.8 percent, or 3.9 percent above the optimum value.

4.4 Stratum B - Residual Soils

Residual soils are derived from the chemical and physical weathering of the underlying parent rock. At this site, residual soils were present in all of the test borings below the ground cover or existing fill to depths of up to 16.8 ft below the ground surface, or to the termination depths of the test borings. These soils were generally brown in color with shades of yellow, orange, and gray, and showed some of the remaining structure of the parent bedrock. Rock fragments encountered within the soil typically had rough or angular edges.

The residual soils encountered during our investigation consisted loose to medium dense Silty Sand (SM) and stiff to very hard Silt (ML) with varying amounts of sand and rock fragments. The soil samples tested within this stratum have the following properties:

- SPT N-Value: 7 to 40 blows per foot (bpf)
- Moisture Content: 7.5 to 18 %
- Liquid Limit: 34
- Plasticity Index: 5
- % Passing #200 Sieve 48.1 to 71.2 %

4.5 Stratum C – Disintegrated Rock

Disintegrated Rock material was encountered in two test borings, B-1 and B-2, below and intermittently throughout the Stratum B soils, to the termination depths of the borings. Disintegrated Rock is defined as residual earth material with a Standard Penetration Resistance between 60 blows per ft and auger refusal (50 blows over 1 inch). At this site, the disintegrated rock was sampled as Silty Sand and Silt with Sand. This material may exhibit certain rock-like qualities, and some denser portions of this material could possess characteristics of soft rock.

Test boring B-1, refused at a 12.5 ft depth, believed to be at the bedrock surface.

4.6 Groundwater

We did not encounter groundwater in the test borings performed at this site. The bore holes caved dry at a depths of 5.5 to 12 ft. The test boring logs in Appendix A include groundwater observations obtained during our subsurface exploration. These data include measurements taken during drilling, upon drilling completion, and following completion of the boring. We did not obtain 24-hour water level readings since the borings were backfilled at the end of the workday for safety.

The groundwater levels on the logs indicate our estimate of the hydrostatic water table at the time of our subsurface exploration. The final design should anticipate the fluctuation of the hydrostatic water table depending on variations in precipitation, surface runoff, pumping, evaporation, leaking utilities, and similar factors.

4.7 Seismic Site Classification

We evaluated the Seismic Site Class and Seismic Site Coefficients for this project in accordance with ASCE 7-10. Our analysis indicates Site Class C for this location. This Site Class was evaluated based on corrected SPT N-values from the test borings. This Site Class was evaluated based on corrected SPT values from the test borings and extrapolation of the soil parameters to a depth of 100 ft.

The project was mapped using the ASCE 7 Hazard tool. Based on the recommended site class and the project location, the following seismic design parameters were calculated:

Table 4.7: Seismic Parameters

Period	Mapped Maximum Considered Spectral Response Acceleration		Design Spectral Response Acceleration
	For Site Class C	Site Adjusted	
Short (0.2 sec)	S_s = 0.126g	S_{ms} = 0.164g	S_{DS} = 0.109g
1 second	S_1 = 0.042g	S_{m1} = 0.063g	S_{D1} = 0.042g

5.0 GEOTECHNICAL ENGINEERING RECOMMENDATIONS

We based our geotechnical engineering analysis on the information developed from our subsurface exploration and soil laboratory testing, along with the project development plans, site plans, and structural loading furnished to our office. The following sections of the report provide our detailed recommendations.

5.1 Site Grading and Earthwork

Proposed site grades will require placement of up to 7 ft depth of compacted structural fill at the new proposed RV parking area, with smaller amounts of fill need for the proposed lane expansions and stormwater management facilities. Cuts of up to about 2 ft are also anticipated for the new stormwater management features. Recommendations for compacted fill, subgrade preparation, fill soil requirements, placement and compaction criteria, are presented in subsequent sections.

5.1.1 Compacted Fill Subgrades

Subgrades to receive compacted structural fill for building or pavement support should be stripped of vegetation, topsoil, and organic matter. Schnabel's subsurface exploration indicated topsoil to depths of 3 inches below the ground surface. However, stripping of wooded areas, such as the area of the

proposed RV parking, typically results in some deeper disturbance and deeper organics and roots from stump removal. Therefore, we recommend a stripping depth of 1 ft be considered for the site during the project planning.

Compacted structural fill subgrades should consist of suitable firm soils of Strata A, B, and C. These soils are expected to be encountered at shallow depths beneath the topsoil and root mat. Existing fill soils of Stratum A encountered during our investigation were variable in consistency, and therefore have a greater risk of being found to be unsuitable after stripping.

The Geotechnical Engineer should evaluate the suitability of the fill subgrades by observing proofrolling with a loaded dump truck, or equivalent equipment. Areas that exhibit excessive pumping, weaving, or rutting should be scarified, dried and recompacted, or undercut and replaced with compacted structural fill as recommended by the Geotechnical Engineer. Subgrade evaluation techniques complementary to proofrolling could include a combination of probing with a penetrometer, drilling hand augers, or observing test pits.

When removal of unsuitable materials is required, the excavation should be performed in a manner to limit disturbance of the underlying suitable material. To evaluate required excavation depths, the excavation should be performed under the observation of the Geotechnical Engineer.

If stripping and earthwork operations are performed during an extended period of warm, dry weather, the non-organic portions of the undercut materials may be reused as compacted structural fill. The use of these materials as compacted structural fill will depend on the soil moisture content, and the Contractor's ability during stripping and undercutting to limit contamination of these materials with organic matter, roots, and rock.

Compacted structural fill subgrades should be kept free of ponded water. If springs or other flowing water is present at the compacted structural fill subgrade level, the Contractor should direct water to discharge beyond the fill limits. Recommendations for discharging springs should be provided by the Geotechnical Engineer.

Compacted structural fill subgrades should be free of snow, ice, and frozen soils. If snow, ice, or frozen soils are present at subgrade levels, these materials should be removed as recommended by the Geotechnical Engineer.

Existing shed structures present on site near the proposed RV parking area will need to be removed before earthwork construction. Therefore, buried foundations and other associated debris may be encountered during grading activities. Existing foundations should be completely removed from the proposed new building areas. Existing foundations and walls in the proposed pavement areas should be removed to at least 2 ft below the design pavement subgrade level. Abandoned utilities and drainage structures within the new building areas should be removed and replaced with compacted structural fill.

Compacted structural fill subgrades should not be steeper than about 5H:1V. If steeper slopes are present, the subgrades should be benched to permit placement of horizontal lifts of fill. The benches should be wide enough for the compaction equipment to operate and should not exceed 4 ft.

5.1.2 Compacted Fill

Compacted structural fill and backfill should consist of non-organic on-site soils. If off-site borrow materials are needed, these soils should classify as CL, ML, SC, SM, SP, SW, GC, GM, GP, or GW according to ASTM D2487. Fill materials should be free of deleterious materials and not contain particles larger than 3 inches.

Compacted structural fill should be placed in maximum 8 inch thick horizontal, loose lifts. Fill should be compacted to at least 92 percent of the maximum dry density per ASTM D1157 (Modified Proctor), with the exception of fill 1 ft below pavement subgrades, which should be compacted to 97 percent of maximum dry density for the same standard.

Backfill in excavations, trenches, and other areas that large compaction equipment cannot access should be placed in maximum 6 inch thick lifts. Backfill should meet the material, placement, and compaction requirements outlined above.

Successful re-use of the excavated, on-site soils as compacted structural fill will depend on their natural moisture contents during excavation. Laboratory test results indicate soils encountered in proposed borrow areas are wet of the optimum moisture content. Scarifying and drying of these soils should be anticipated to achieve the recommended compaction. Drying of these soils will likely result in some delays, and may not be possible during cooler, wetter weather. We recommend that the earthwork be performed during the warmer, drier times of the year.

5.1.3 Slopes

Cut slopes and compacted structural fill slopes on the site may be constructed at 2H:1V or flatter. Control of surface and groundwater is critical to the slope performance and stability. All surface water from runoff, drainage pipes, etc., should be carried to the base of the slopes to minimize water infiltration into the slopes. Placement of water lines, storm drains, culverts, etc. in the slopes should be avoided. Underground utilities above the slopes should be placed on firm bedding and installation carefully performed to minimize water leakage due to pipe settlement or cracks. Periodic maintenance and inspection of all water-bearing utilities should be performed to check for and repair leaks.

Site grading should provide positive drainage away from the slope crests and prevent ponding on top of the slopes. Ponding of water on or above the slopes should not be allowed. It is critical that excess water not be allowed to enter into the slope soils, as this is a primary cause of slope failures and surface erosion.

The slope vegetation must be properly maintained. Slopes must be covered with grass vegetation to minimize erosion. Trees should not be planted on the slope faces. Loss of vegetation from foot or other traffic, erosion, etc. should be prevented. Temporary erosion protection is critical until the vegetation is established.

5.2 Spread Footings

We consider spread footings suitable for support of the proposed charge stations and office building additions. We also expect that the stone wall will be constructed on spread footings. Spread footings should be founded on suitable firm soils of Strata A, B, and C or on new compacted structural fill. Compacted structural fill should meet the requirements outlined in the Site Grading and Earthwork

(Section 5.1) of this report. We recommend footings supported on these materials be designed for a net allowable soil bearing pressure of 2,000 psf. This bearing pressure provides a factor of safety against general bearing capacity failure of at least 3.0.

All footing subgrades should be observed and approved by the Geotechnical Engineer prior to placement of concrete to evaluate if subgrade materials are as anticipated. The Geotechnical Engineer should evaluate their suitability using a probe rod, hand auger, dynamic cone penetrometer, or similar methods to verify the subgrade conditions are similar to those described herein. Footing subgrades should be free of ponded water, snow ice frozen soils, organics, rubble, or debris.

If unsuitable soils are encountered at the design bearing grade, these soils should be compacted or removed and replaced as recommended by the Geotechnical Engineer. Unsuitable soils should be replaced with compacted fill, flowable fill, lean concrete, or concrete.

The above allowable soil bearing pressure may be increased by 33 percent for wind and seismic loads when used in conjunction with load combinations defined in IBC 2009 Section 1605.3.2, *Alternative Basic Load Combinations* for use with allowable stress design. This increase is not applicable for other allowable stress load combinations, strength design, or load and resistance factor design.

Settlements of shallow foundations supported on suitable natural soils and on properly placed compacted structural fill are not expected to exceed about ½ inch. Differential settlements between similarly loaded new footings are not expected to exceed about half this value. However, differential settlements between new and existing footings may approach ½ inch.

Column and wall footings should be at least 18 and 12 inches wide, respectively, for shear considerations. Exterior footings, including those for the proposed stone wall, should be founded at least 3 ft below final exterior grades for frost protection. Interior footings in heated areas may be founded at nominal depths below the floor slabs. Interior footings subject to freezing should be founded at least 3 ft below slab grade. Where bearing grades between adjacent footings vary, the slope between the bottom edges of adjacent footings should not be steeper than 45 degrees (1H:1V).

5.3 Floor Slabs

We expect the proposed buildings will have slab on grade construction. Floor slabs should be supported on suitable firm soils of Strata A, B, and C or new compacted structural fill. A modulus of subgrade reaction, k, of 125 pci should be used in the design of floor slabs. The recommended modulus value is for a 1-ft-square plate. Some slab design software may consider different definitions of k for input. The Structural Engineer should contact our office if their software considers a different definition of k.

A four inch crushed stone or washed gravel capillary moisture barrier should underlie floor slabs on grade. Moisture barrier material should consist of AASHTO No. 57 crushed stone. The Contractor should compact the stone in place with at least two passes of suitable vibratory compaction equipment.

The Contractor should compact floor slab subgrades to repair any disturbance that may occur due to construction operations before placing the capillary moisture barrier materials. Because floors will be slab-on-grade, footing and utility excavations should be backfilled with compacted structural fill as defined in Section 5.1 of this report.

5.4 Pavements

New asphalt pavements are planned for the roadway widening at the northern edge of the site, the new parking areas, and leading up to the new charge stations. We expect that the existing pavements will be milled and overlaid.

The Contractor should prepare pavement subgrades and place compacted structural fill for pavement support as described in the Site Grading and Earthwork (Section 5.1) of this report. Final pavement subgrades should be proofrolled under the observation of the Geotechnical Engineer immediately prior to placing subbase or base course aggregate to evaluate their suitability to support the pavement. Dense-graded aggregate placed as pavement base course should be compacted to at least 97 percent of maximum dry density according to AASHTO T-180, Modified Proctor. Dense-graded aggregate should be placed in maximum 8 inch thick loose lifts.

We developed the recommended pavement sections according to the AASHTO 1993 design method for flexible pavements based on a design CBR value of 3. We assumed a design life for the pavements of 25 years.

We estimated the two way traffic volumes for our analysis to be 2,500 vehicles per day with 2.5% truck traffic (including recreational vehicles). We should be notified if the expected traffic volumes are expected to exceed these values so we can reassess our recommendations.

Our analysis considers that proper grading will be maintained to provide runoff from the pavement surface and beyond the limits of paved areas. We recommend the following pavement sections:

Table 5.4: Recommend Pavement Section

Type Section	Thickness (inch)
HMA Superpave 12.5 mm, Surface	2
HMA Superpave 19 mm, Base	4
Graded Aggregate Base Course	8

In areas where vehicles will be frequently stopping and starting, such as in front of the fee gates, we recommend that a concrete pavement section be considered. Due to the RV traffic at the site, we recommend that concrete pavement conform to the MDSHA standard for Bus Stop Pads, MD 580.07. We have included a copy of this standard in Appendix D for Reference.

Adequate control of surface drainage will be a very important consideration for the overall performance of this pavement design. The area surrounding pavements should be graded to direct surface water away from paved areas. Utility excavations within pavement areas should be backfilled with compacted structural fill.

We recommend providing pavement subdrains or drainage ditches in cut areas where grades slope toward the pavement. The invert grade of ditches or drains should be at least 1 ft below the pavement subgrade level. Pavement subdrains should discharge into a ditch or into a storm drain.

6.0 STORMWATER MANAGEMENT

Stormwater management structures at the site will consist of two bioretention facilities. The Maryland Department of the Environment (MDE) has set particular standards and specifications for the design and construction of stormwater management (SWM) devices with infiltration. These regulations include parameters on soil textures, depth of limiting zones, topographic conditions, and other considerations. We performed two test borings near the proposed bioretention facility locations.

6.1 Depth to Limiting Zone

The 2000 MDE Maryland Stormwater Design Manual (revised 2009) recommends that a 2 to 4 ft distance be provided between the bottom of the infiltration system and any limiting zone. Limiting zones are defined as a seasonably high water table or bedrock. Neither bedrock nor groundwater were encountered within the depths explored in the stormwater management borings, and thus, are not considered limiting factors.

Fill materials are also considered a limiting zone, as MDE does not allow SWM structures founded in existing fills to be designed for infiltration. We believe that fill (Stratum A) was encountered at SWM-1 to approximately 6 ft below the planned basin elevation. Table 6.1 summarizes the fill, rock, and water limiting zones for the BMP structures at this site:

Table 6.1: Limiting Zones

SWM Device / Boring ID	SWM Bottom Elevation (ft)	Highest Water Depth/ Elevation (ft)	Highest Bedrock Depth/ Elevation (ft)	Bottom of Fill Depth/ Elevation (ft)	Limiting Zone (yes/no)
SWM-1	1023	None observed	None observed	7.5 / 1017	Yes
SWM-2	1022	None observed	None observed	None observed	No

6.2 Soil Textures

The 2000 MDE Maryland Stormwater Design Manual requires United States Department of Agriculture (USDA) Soil Textural Classifications for each type of soil at the infiltration device. These classifications are used to correlate the material with typical minimum infiltration rates.

Soil samples were collected at or below the infiltration test depth and were classified based on our laboratory testing program, the results of which are included in Appendix B. The 2000 MDE Maryland Stormwater Design Manual recommends the minimum infiltration rates be assigned to the tested soils as shown in Table 6.2.

Table 6.2: USDA Minimum Infiltration Rates

Boring ID	Sample Depth / Elevation (ft)	USDA Textural Classification	USDA Hydrologic Soil Group	Minimum Infiltration Rate (inches/hour)
SWM-1	8.5 / EL. 1016.0	Loam	B	0.52
SWM-1	8.5 / EL. 1016.5	Silt Loam	B	0.27

6.3 In-Situ Infiltration Rates

In order to confirm the infiltration rates from the soil textural classification, in-situ infiltration tests are required. The tests were performed in general accordance with Appendix D.1 of the 2000 MDE Stormwater Design Manual guidelines. The test procedure is described in Appendix C. The results of the infiltration tests are summarized in Table 6.3. The results of the tests are also included in Appendix C.

Table 6.3: Field Infiltration Rates

Boring ID	Test Depth and Elevation (feet)	USDA Textural Classification	Infiltration Rate (inches/hour)
SWM-1	6 ft / EL 1018.5	Existing Fill*	0.38**
SWM-2	6 ft / EL 1019.0	Silt Loam	0.50

* Existing Fill is considered a limiting zone for infiltration

** Selected rate based on last test interval- see results in Appendix C

It should be noted that the recorded infiltration rates from the field infiltration testing are only an approximation of the in-situ soil permeability at the locations tested, and variations of the actual permeability of the facility should be expected. SWM facility subgrades should be observed by the Geotechnical Engineer during construction to visually evaluate their suitability for infiltration.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Site Grading and Earthwork

The on-site soils are susceptible to moisture changes, will be easily disturbed, and will be difficult to compact under wet weather conditions. Drying and reworking of the soils are likely to be difficult during periods of wet months. We recommend that the earthwork phases of this project be performed during the warmer, drier times of the year to limit the potential for disturbance of on-site soils. If not, allowances should be established for additional costs due to earthwork difficulties.

Traffic on stripped or undercut subgrades should be limited to reduce disturbance of underlying soils. Also, using lightweight, track-mounted dozer equipment for stripping will limit the disturbance of underlying soils, and may reduce the undercut volume needed. The Contractor should construct temporary site slopes to maintain subgrades free of water and to avoid saturation and disturbance of the subgrade soils before placing compacted structural fill, pavement base course, or footings. This site drainage will be important during all phases of the construction work. The Contractor should be responsible for reworking of subgrades and compacted structural fill that were initially considered suitable but were later disturbed by equipment and/or weather.

7.2 Slope Maintenance and Inspection

Slopes should be inspected at least annually to check for signs of slope failure including wet spots, slumps, cracks, etc. on the surface of the slopes. Areas without vegetation should be reseeded. The root matter from trees that have died must be removed to prevent the decaying roots from providing a conduit for water to enter the slopes. Gullies should also be filled and reseeded or sodded. If wet spots, slumps, or cracks are observed, an engineer should be contacted to assess the problem and determine corrective measures, if needed.

7.3 Spread Footings

The Contractor should exercise care during excavation for spread footings so that as little disturbance as possible occurs at the foundation level. The Contractor should carefully clean loose or soft soils from the bottom of the excavation before placing concrete. The Geotechnical Engineer should observe footing subgrades prior to concrete placement to evaluate whether subgrade soils are as anticipated in this report.

Footing subgrades needing undercut may be concreted at the elevation of undercut or backfilled as described in Section 5.1 of this report. Placement of concrete should take place the same day as excavation of footings to minimize exposure.

7.4 Stormwater Management

Traffic on stormwater management facility subgrades should be limited to reduce the compaction of underlying soils during construction. Lightweight, track-mounted equipment should be used when grading activities cannot be performed outside of the excavation.

Site drainage should be provided to direct water away from the stormwater management facilities before the facility is stabilized. The Contractor should be responsible for reworking of subgrades and compacted fill that were initially considered suitable but were later disturbed by equipment and/or weather.

7.5 Engineering Services During Construction

The engineering recommendations provided in this report are based on the information obtained from the subsurface exploration and laboratory testing. However, conditions on the site may vary between the discrete locations observed at the time of our subsurface exploration. The nature and extent of variations between borings may not become evident until during construction.

To account for this variability, Schnabel should provide professional observation and testing of subsurface conditions revealed during construction as an extension of our engineering services. These services will also help in evaluating the Contractor's conformance with the plans and specifications in accordance with building code requirements. Because of our unique position to understand the intent of the geotechnical engineering recommendations, retaining Schnabel for these services will allow the owner to receive consistent service throughout the project construction.

7.6 General Specification Recommendations

An allowance should be established to account for possible additional costs that may be required to construct earthwork and foundations as recommended in this report. Additional costs may be incurred for a variety of reasons including variation of soil between borings, greater than anticipated unsuitable soils,

tree stumps, organic matter, need for borrow fill material, wet on-site soils, obstructions, rock excavation, etc.

The project specifications should indicate the Contractor's responsibility for providing adequate site drainage during construction. Inadequate drainage will most likely lead to disturbance of soils by construction traffic and increased volume of undercut.

This report may be made available to prospective bidders for informational purposes. We recommend that the project specifications contain the following statement:

> *Schnabel Engineering, LLC has prepared this geotechnical engineering report for this project. This report is for informational purposes only and is not part of the contract documents. The opinions expressed represent the Geotechnical Engineer's interpretation of the subsurface conditions, tests, and the results of analyses performed. Should the data contained in this report not be adequate for the Contractor's purposes, the Contractor may make, before bidding, independent exploration, tests, and analyses. This report may be examined by bidders at the office of the Owner, or copies may be obtained from the Owner at nominal charge.*

Additional data and reports prepared by others that could have an impact upon the Contractor's bid should also be made available to prospective bidders for informational purposes.

8.0 LIMITATIONS

We based the analyses and recommendations submitted in this report on the information revealed by our exploration. We attempted to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during construction.

This report has been prepared to aid in the evaluation of this site and to assist in the design of the project. It is intended for use concerning this specific project. We based our recommendations on information on the site and proposed construction as described in this report. Substantial changes in loads, locations, or grades should be brought to our attention so we can modify our recommendations as needed. We would appreciate an opportunity to review the plans and specifications as they pertain to the recommendations contained in this report, and to submit our comments to you based on this review.

We have endeavored to complete the services identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this report or other instrument of service.

We appreciate the opportunity to be of service for this project. Please call us if you have any questions regarding this report.

Sincerely,

SCHNABEL ENGINEERING, LLC

David MacGregor
Staff Engineer

Kenneth E. Derrenbacher, PE
Principal
DM:KD:kdn

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland.
License No. 16495, Expiration Date: 5/18/2021

Distribution:
Matt Ernest, PE (AMT) Rachel Albrecht, PE (Albrecht Engineering)

Figures

Subsurface Exploration Data
Soil Laboratory Test Data
Infiltration Test Results
MDSHA Standard Detail for Bus Stop Pads

FIGURES

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the

NOT TO SCALE

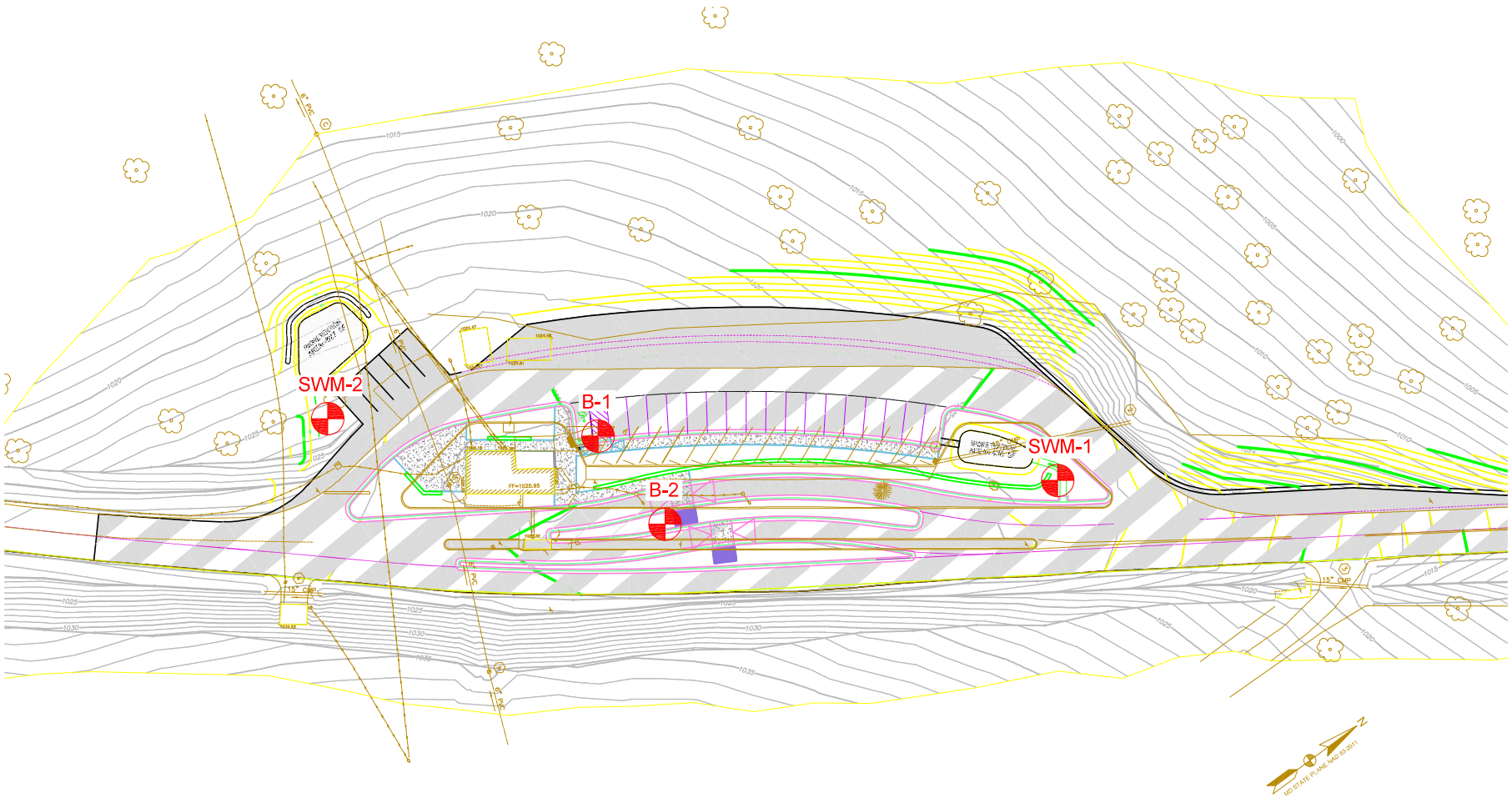
Schnabel ENGINEERING

ENTRY GATE FEE STATION IMPROVEMENTS
GREENBRIER STATE PARK
WASHINGTON COUNTY, MARYLAND
PROJECT NO. 20C14026.00

SITE VICINITY MAP

FIGURE 1

10/15/2020 This Map was Created In Schnabel Engineerings Site Vicinity Map Application arcgis



LEGEND

- Approximate Test Boring Location

SCALE

0ft 20ft 40ft 80ft

REFERENCE: AMT BASE PLAN DATE 10/30/20

Schnabel ENGINEERING

ENTRY GATE FEE STATION IMPROVEMENTS
GREENBRIER STATE PARK
WASHINGTON COUNTY, MARYLAND

PROJECT NO. 20C14026.00

BORING LOCATION PLAN

FIGURE 2

SUBSURFACE EXPLORATION DATA

Subsurface Exploration Procedures
General Notes for Subsurface Exploration Logs
Identification of Soil
Boring Logs, B-1, B-2, SWM-1, and SWM-2

SUBSURFACE EXPLORATION PROCEDURES

Test Borings – Hollow Stem Augers

The borings are advanced by turning a continuous flight auger with a center opening of 3¼ inches. Cuttings are brought to the surface by the auger flights. Sampling is performed through the center opening in the hollow stem auger, by standard methods. Usually, no water is introduced into the boring using this procedure.

Standard Penetration Test Results

The numbers in the Sampling Data column of the boring logs represent Standard Penetration Test (SPT) results. Each number represents the blows needed to drive a 2-inch O.D., 1⅜-inch I.D. split-spoon sampler 6 inches, using a 140-pound hammer falling 30 inches. The sampler is typically driven a total of 18 or 24 inches. The first 6 inches are considered a seating interval. The total of the number of blows for the second and third 6-inch intervals is the SPT "N-value." The SPT is performed according to ASTM D1586.

The SPT samples were obtained using a hydraulically driven automatic trip hammer (ATH). Most correlations with SPT data are based on N-values collected with a safety hammer. The energy applied to the split-spoon sampler using the ATH is about 33 percent greater than that applied using the safety hammer, resulting in lower N-values. The hammer blows shown on the boring logs are uncorrected for the higher energy. However, we correct SPT N-values for the higher energy when using N-values in our analyses.

Soil Classification Criteria

The group symbols on the logs represent the Unified Soil Classification System Group Symbols (ASTM D2487) based on visual observation and limited laboratory testing of the samples. Criteria for visual identification of soil samples are included in this appendix. Some variation can be expected between samples visually classified and samples classified in the laboratory.

Residual soils are derived through the in-place physical and chemical weathering of the underlying rock. Disintegrated rock is defined as residual material with SPT N-values between 60 blows per foot and refusal. Refusal is defined as an N-value of 50 blows for a penetration of one inch or less.

Pocket Penetrometer Results

The values following "PP=" in the sampling data column of the logs represent pocket penetrometer readings. Pocket penetrometer readings provide an estimate of the unconfined compressive strength of fine-grained soils.

Boring Locations and Elevations

Boring locations were staked by us in the field based on existing site features. Approximate boring locations are shown on Figure 2. Ground surface elevations at the boring locations were obtained from the site topographic plan and are indicated on the boring logs. Locations and elevations should be considered no more accurate than the methods used to determine them.

GENERAL NOTES FOR SUBSURFACE EXPLORATION LOGS

1. Numbers in sampling data column next to Standard Penetration Test (SPT) symbols indicate blows required to drive a 2-inch O.D., 1⅜-inch I.D. sampling spoon 6 inches using a 140 pound hammer falling 30 inches. The Standard Penetration Test (SPT) N-value is the number of blows required to drive the sampler 12 inches, after a 6-inch seating interval. The Standard Penetration Test is performed in general accordance with ASTM D1586.
2. Visual classification of soil is in accordance with terminology set forth in “Identification of Soil.” The ASTM D2487 group symbols (e.g., CL) shown in the classification column are based on visual observations.
3. Estimated water levels indicated on the logs are only estimates from available data and may vary with precipitation, porosity of the soil, site topography, and other factors.
4. Refusal at the surface of rock, boulder, or other obstruction is defined as an SPT resistance of 50 blows for 1 inch or less of penetration.
5. The logs and related information depict subsurface conditions only at the specific locations and at the particular time when drilled or excavated. Soil conditions at other locations may differ from conditions occurring at these locations. Also, the passage of time may result in a change in the subsurface soil and water level conditions at the subsurface exploration location.
6. The stratification lines represent the approximate boundary between soil and rock types as obtained from the subsurface exploration. Some variation may also be expected vertically between samples taken. The soil profile, water level observations and penetration resistances presented on these logs have been made with reasonable care and accuracy and must be considered only an approximate representation of subsurface conditions to be encountered at the particular location.
7. Key to symbols and abbreviations:

S-1, SPT	Sample No., Standard Penetration Test
5+10+1	Number of blows in each 6-inch increment

LL	Liquid Limit
MC	Moisture Content (percent)
PL	Plastic Limit
PP	Pocket Penetrometer Reading (tsf)
%Passing#200	Percent by weight passing a No. 200 Sieve

IDENTIFICATION OF SOIL

I. DEFINITION OF SOIL GROUP NAMES (ASTM D2487)

			SYMBOL	GROUP NAME
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels – More than 50% of coarse fraction retained on No. 4 sieve Coarse, ¾" to 3" Fine, No. 4 to ¾"	Clean Gravels Less than 5% fines	GW	WELL GRADED GRAVEL
			GP	POORLY GRADED GRAVEL
		Gravels with fines More than 12% fines	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	Sands – 50% or more of coarse Fraction passes No. 4 sieve Coarse, No. 10 to No. 4 Medium, No. 40 to No. 10 Fine, No. 200 to No. 40	Clean Sands Less than 5% fines	SW	WELL GRADED SAND
			SP	POORLY GRADED SAND
		Sands with fines More than 12% fines	SM	SILTY SAND
			SC	CLAYEY SAND
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays – Liquid Limit less than 50 Low to medium plasticity	Inorganic	CL	LEAN CLAY
			ML	SILT
		Organic	OL	ORGANIC CLAY
				ORGANIC SILT
	Silts and Clays – Liquid Limit 50 or more Medium to high plasticity	Inorganic	CH	FAT CLAY
			MH	ELASTIC SILT
		Organic	OH	ORGANIC CLAY
				ORGANIC SILT
Highly Organic Soils	Primarily organic matter, dark in color and organic odor		PT	PEAT

II. DEFINITION OF SOIL COMPONENT PROPORTIONS (ASTM D2487)

			Examples
Adjective Form	GRAVELLY SANDY	>30% to <50% coarse grained component in a fine-grained soil	GRAVELLY LEAN CLAY
	CLAYEY SILTY	>12% to <50% fine grained component in a coarse-grained soil	SILTY SAND
"With"	WITH GRAVEL WITH SAND	>15% to <30% coarse grained component in a fine-grained soil	FAT CLAY WITH GRAVEL
	WITH GRAVEL WITH SAND	>15% to <50% coarse grained component in a coarse-grained soil	POORLY GRADED GRAVEL WITH SAND
	WITH SILT WITH CLAY	>5% to <12% fine grained component in a coarse-grained soil	POORLY GRADED SAND WITH SILT

III. GLOSSARY OF MISCELLANEOUS TERMS

SYMBOLS ..... Unified Soil Classification Symbols are shown above as group symbols. A dual symbol "-" indicates the soil belongs to two groups. A borderline symbol "/" indicates the soil belongs to two possible groups.

FILL ..... Man-made deposit containing soil, rock and often foreign matter.

DISINTEGRATED ROCK (DR) ..... Residual materials with a standard penetration resistance (SPT) between 60 blows per foot and refusal. Refusal is defined as an SPT of 100 blows for 2" or less penetration.

ROCK FRAGMENTS BOULDERS & COBBLES..... Gravel sized particles (No. 4 to 3") that are angular, and origin is from the parent bedrock Boulders are considered rounded pieces of rock larger than 12 inches, while cobbles range from 3 to 12-inch size.

LENSES..... 0 to ½-inch seam within a material in a test pit.

LAYERS ..... ½ to 12-inch seam within a material in a test pit.

POCKET..... Discontinuous body within a material in a test pit.

Schnabel ENGINEERING **TEST BORING LOG**

Project: Entry Gate Fee Station Improvements
Greenbrier State Park
Boonsboro, Maryland

Boring Number: **B-1**
Contract Number: 20C14026.00
Sheet: 1 of 1

Contractor: Connelly and Associates, Inc.
Frederick, Maryland
Contractor Foreman: B. Mullendore
Schnabel Representative: S. Henry
Equipment: CME-55LC (Track)
Method: 3-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)
Dates Started: 10/22/20 **Finished:** 10/22/20
Location: See Location Plan

Ground Surface Elevation: 1025± (ft) **Total Depth:** 12.5 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	10/22	---	---	---	---
Completion ▼	10/22	10:43 AM	Dry	12.5'	---
Casing Pulled ▼	10/22	10:46 AM	Dry	---	8.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.6	Asphalt; 7 inches		1024.4					Surface
0.8	AGGREGATE BASE; 3 inches		1024.2					Residual
2.3	SILT WITH SAND; moist, orangish brown with mottles of light brown	ML	1022.7			S-1, SPT 3+5+6 REC=18", 100%	MC = 17.9% PP = 2.50 tsf	
	SILT WITH ROCK FRAGMENTS; moist, tan	ML				S-2, SPT 6+6+7 REC=12", 67%	MC = 9.7% PP = 2.00 tsf	
4.5	SANDY SILT WITH ROCK FRAGMENTS; moist, light brown with streaks of light gray	ML	1020.5	B	5	S-3, SPT 3+5+9 REC=13", 72%	PP = 2.00 tsf	
7.5	DISINTEGRATED ROCK, sampled as silty sand, fine to medium grained sand; moist, reddish brown	DR	1017.5	C	10	S-4, SPT 50/3"" REC=3", 100%		Disintegrated Rock
12.5			1012.5			S-5, SPT 50/0"" REC=0"		

Bottom of Boring at 12.5 ft.
Auger refusal at 12.5 ft.
Boring backfilled with cuttings upon completion.

Schnabel ENGINEERING **TEST BORING LOG**

Project: Entry Gate Fee Station Improvements
Greenbrier State Park
Boonsboro, Maryland

Boring Number: **B-2**
Contract Number: 20C14026.00
Sheet: 1 of 1

Contractor: Connelly and Associates, Inc.
Frederick, Maryland
Contractor Foreman: B. Mullendore
Schnabel Representative: S. Henry
Equipment: CME-55LC (Track)
Method: 3-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)
Dates Started: 10/22/20 **Finished:** 10/22/20
Location: See Location Plan

Ground Surface Elevation: 1026± (ft) **Total Depth:** 20.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	10/22	---	---	---	---
Completion ▼	10/22	11:50 AM	Dry	18.5'	---
Casing Pulled ▼	10/22	11:55 AM	Dry	---	12.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.3	Asphalt; 4 inches		1025.2					Surface
1.0	AGGREGATE BASE; 8 inches		1024.5					
	SILT; moist, light brown	ML				S-1, SPT 2+3+4 REC=13", 72%	MC = 18.0%	Residual
2.5	SANDY SILT; moist, orangish brown		1023.0			S-2, SPT 5+6+5 REC=10", 56%	LL = 34 PI = 5 MC = 14.7% % Passing #200 = 57.8	
	Change: light yellowish brown	ML		B	5	S-3, SPT 5+8+9 REC=15", 83%	PP = 2.75 tsf MC = 12.9% PP = 4.00 tsf	
9.0	DISINTEGRATED ROCK, sampled as silty sand, fine to medium grained sand; moist, light reddish brown with speckles of white	DR	1016.5	C	10	S-4, SPT 33+50/4"" REC=10", 100%		Disintegrated Rock
14.1	SILT; moist, light brown with streaks of light gray	ML	1011.4	B	15	S-5, SPT 12+16+24 REC=18", 100%	PP = 4.25 tsf	Residual
16.8	DISINTEGRATED ROCK, sampled as silt with sand; moist, light brown, contains rock fragments	DR	1008.8	C				Disintegrated Rock
20.0			1005.5		20	S-6, SPT 50/3"" REC=3", 100%		

Bottom of Boring at 20.0 ft.
Boring backfilled with cuttings upon completion.

Schnabel ENGINEERING **TEST BORING LOG**

Project: Entry Gate Fee Station Improvements
Greenbrier State Park
Boonsboro, Maryland

Boring Number: **SWM-1**
Contract Number: 20C14026.00
Sheet: 1 of 1

Contractor: Connelly and Associates, Inc.
Frederick, Maryland
Contractor Foreman: B. Mullendore
Schnabel Representative: S. Henry
Equipment: CME-55LC (Track)
Method: 3-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)
Dates Started: 10/22/20 **Finished:** 10/22/20
Location: See Location Plan

Ground Surface Elevation: 1025± (ft) **Total Depth:** 10.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	10/22	---	---	---	---
Completion ▽	10/22	8:40 AM	Dry	8.5'	---
Casing Pulled ▽	10/22	8:45 AM	Dry	---	6.0'
End of Day ▽	10/22	12:00 PM	Dry	---	5.8'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.3	Topsoil; 3 inches		1024.3					Surface
	FILL, sampled as sandy lean clay with gravel sized rock fragments; moist, brown	FILL		A		S-1, SPT 3+3+3 REC=16", 89%	MC = 15.8% LL = 40 PI = 24 % Passing #200 = 58.1	Fill
						S-2, SPT 3+20+10 REC=15", 83%		Spoon glancing off probable boulder
5.2	FILL, sampled as silt with sand; moist, light orangish brown, contains rock fragments, contains root fragments	FILL	1019.3		5	S-3, SPT 2+2+15 REC=9", 50%	PP = 1.75 tsf	
7.5	SILTY SAND WITH ROCK FRAGMENTS; moist, light orangish brown, LOAM (USDA)	SM	1017.0	B				Residual
					10	S-4, SPT 7+5+3 REC=18", 100%	MC = 17.2% % Passing #200 = 48.1 PP = 1.50 tsf	
10.0			1014.5					

Bottom of Boring at 10.0 ft.
Boring backfilled with cuttings after last groundwater measurement.
Bulk sample collected from 0-5 feet

Schnabel ENGINEERING **TEST BORING LOG**

Project: Entry Gate Fee Station Improvements
Greenbrier State Park
Boonsboro, Maryland

Boring Number: SWM-2
Contract Number: 20C14026.00
Sheet: 1 of 1

Contractor: Connelly and Associates, Inc.
Frederick, Maryland
Contractor Foreman: B. Mullendore
Schnabel Representative: S. Henry
Equipment: CME-55LC (Track)
Method: 3-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)
Dates Started: 10/22/20 **Finished:** 10/22/20
Location: See Location Plan

Ground Surface Elevation: 1025± (ft) **Total Depth:** 10.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	10/22	---	---	---	---
Completion ▼	10/22	9:55 AM	Dry	8.5'	---
Casing Pulled ▼	10/22	9:58 AM	Dry	---	5.5'
End of Day ▼	10/22	12:10 PM	Dry	---	5.5'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.3	Topsoil; 3 inches		1024.8					Surface
	SILTY SAND, fine grained sand; moist, light brown	SM				S-1, SPT 3+4+6 REC=16", 89%		Residual
						S-2, SPT 5+8+7 REC=18", 100%		
4.5	SILT WITH SAND; moist, light brown, SILT LOAM (USDA)	ML	1020.5	B	5	S-3, SPT 8+9+11 REC=18", 100%	MC = 7.5% % Passing #200 = 71.2 PP = 2.50 tsf	
7.5	SANDY SILT WITH ROCK FRAGMENTS; moist, light brown	ML	1017.5					
					10	S-4, SPT 8+16+33 REC=11", 61%		
10.0			1015.0					

Bottom of Boring at 10.0 ft.
Boring backfilled with cuttings after last groundwater measurement.

SOIL LABORATORY TEST DATA

Summary of Laboratory Tests
Gradation Curves
USDA Textural Classification Chart

Summary of Laboratory Tests

Project Number: 20C14026.00

Boring No.	Sample Depth ft / Elevation ft	Sample Type	Description of Soil Specimen	Stratum	Natural Moisture (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	% Retained No. 4 Sieve	Proctor Test Method	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
B-1	1.0 - 2.5 / 1024.0 - 1022.5	Jar	SILT WITH SAND (ML); moist, organish brown with mottles of light brown (Visual)	B	17.9	--	--	--	--	--	--	--	--
B-1	2.5 - 4.0 / 1022.5 - 1021.0	Jar	SILT WITH ROCK FRAGMENTS (ML); moist, tan (Visual)	B	9.7	--	--	--	--	--	--	--	--
B-2	1.0 - 2.5 / 1024.5 - 1023.0	Jar	SILT (ML); moist, light brown (Visual)	B	18.0	--	--	--	--	--	--	--	--
B-2	2.5 - 4.0 / 1023.0 - 1021.5	Jar	SANDY SILT (ML); moist, orangish brown	B	14.7	34	29	5	57.8	0.0	--	--	--
B-2	5.0 - 6.5 / 1020.5 - 1019.0	Jar	SANDY SILT (ML); moist, light yellowish brown (Visual)	B	12.9	--	--	--	--	--	--	--	--
SWM-1	0.0 - 1.5 / 1024.5 - 1023.0	Jar	FILL, sampled as sandy lean clay with gravel sized rock fragments; moist, brown (Visual)	A	15.8	--	--	--	--	--	--	--	--
SWM-1	0.3 - 5.0 / 1024.3 - 1019.5	Bulk	FILL, sampled as sandy lean clay with gravel sized rock fragments; moist, brown	A	--	40	16	24	58.1	15.1	1557B	122.3	11.9

Notes:
1. Soil tests in general accordance with ASTM, ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487, USDA(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; ND=Not Detected; ; P=Present; T=Trace; -- indicates no test performed

Schnabel ENGINEERING

Project: Entry Gate Fee Station Improvements
Greenbrier State Park
Boonsboro, MD

Summary of Laboratory Tests

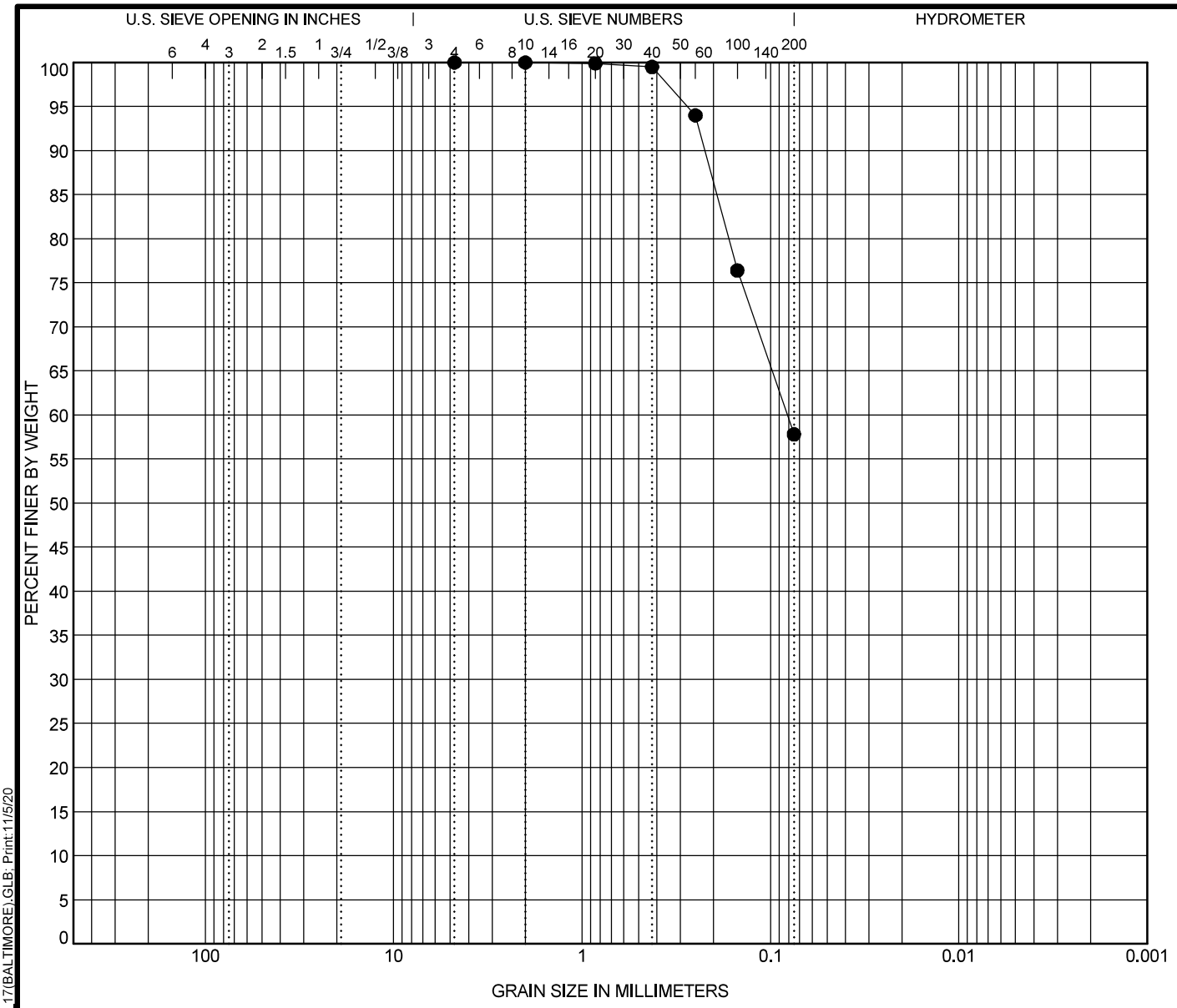
Project Number: 20C14026.00

Boring No.	Sample Depth ft / Elevation ft	Sample Type	Description of Soil Specimen	Stratum	Natural Moisture (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	% Retained No. 4 Sieve	Proctor Test Method	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
SWM-1	8.5 - 10.0 / 1016.0 - 1014.5	Jar	LOAM, light orangish brown (USDA)	B	17.2	--	--	--	48.1	15.0	--	--	--
SWM-2	5.0 - 6.5 / 1020.0 - 1018.5	Jar	SILT LOAM, light brown (USDA)	B	7.5	--	--	--	71.2	0.9	--	--	--

Notes:
1. Soil tests in general accordance with ASTM, ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487, USDA(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; ND=Not Detected; ; P=Present; T=Trace; -- indicates no test performed

Schnabel ENGINEERING

Project: Entry Gate Fee Station Improvements
Greenbrier State Park
Boonsboro, MD



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● B-2	2.5 ft	**SANDY SILT (ML), orangish brown**	**34**	**29**	**5**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D6913	**4.75**	**0.081**			**0.0**	**42.2**	**57.8**	

Percent Finer

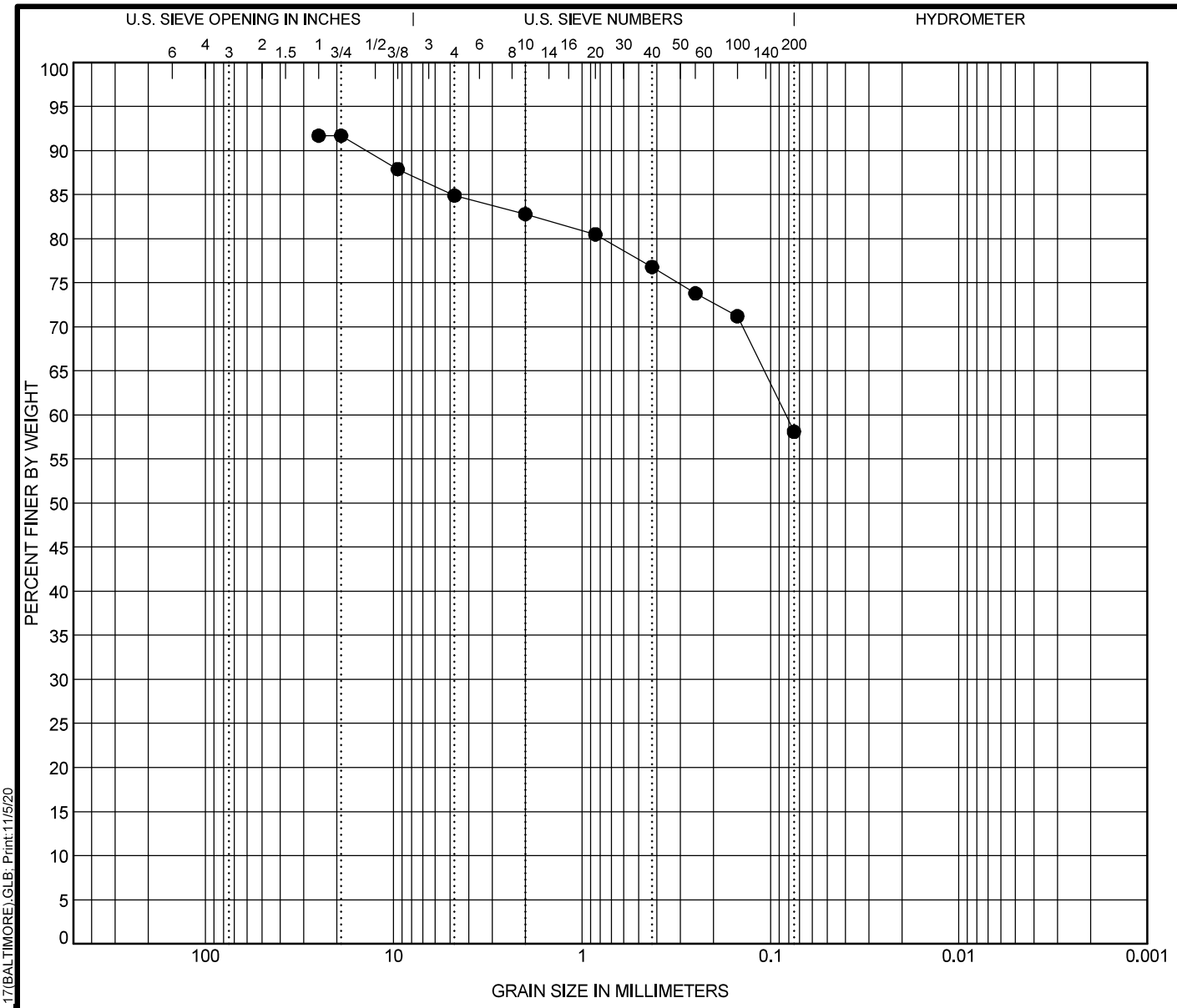
Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4
% Finer	57.8	76.4	94.0	99.5	99.9	100.0	100.0

Schnabel ENGINEERING

GRADATION CURVE

Project: Entry Gate Fee Station Improvements
Greenbrier State Park
Boonsboro, MD

Contract: 20C14026.00



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● SWM-1	0.3 ft	**SANDY LEAN CLAY WITH GRAVEL SIZED ROCK FRAGMENTS (CL), brown**	**40**	**16**	**24**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D6913	**25**	**0.083**			**15.1**	**26.8**	**58.1**	

Percent Finer

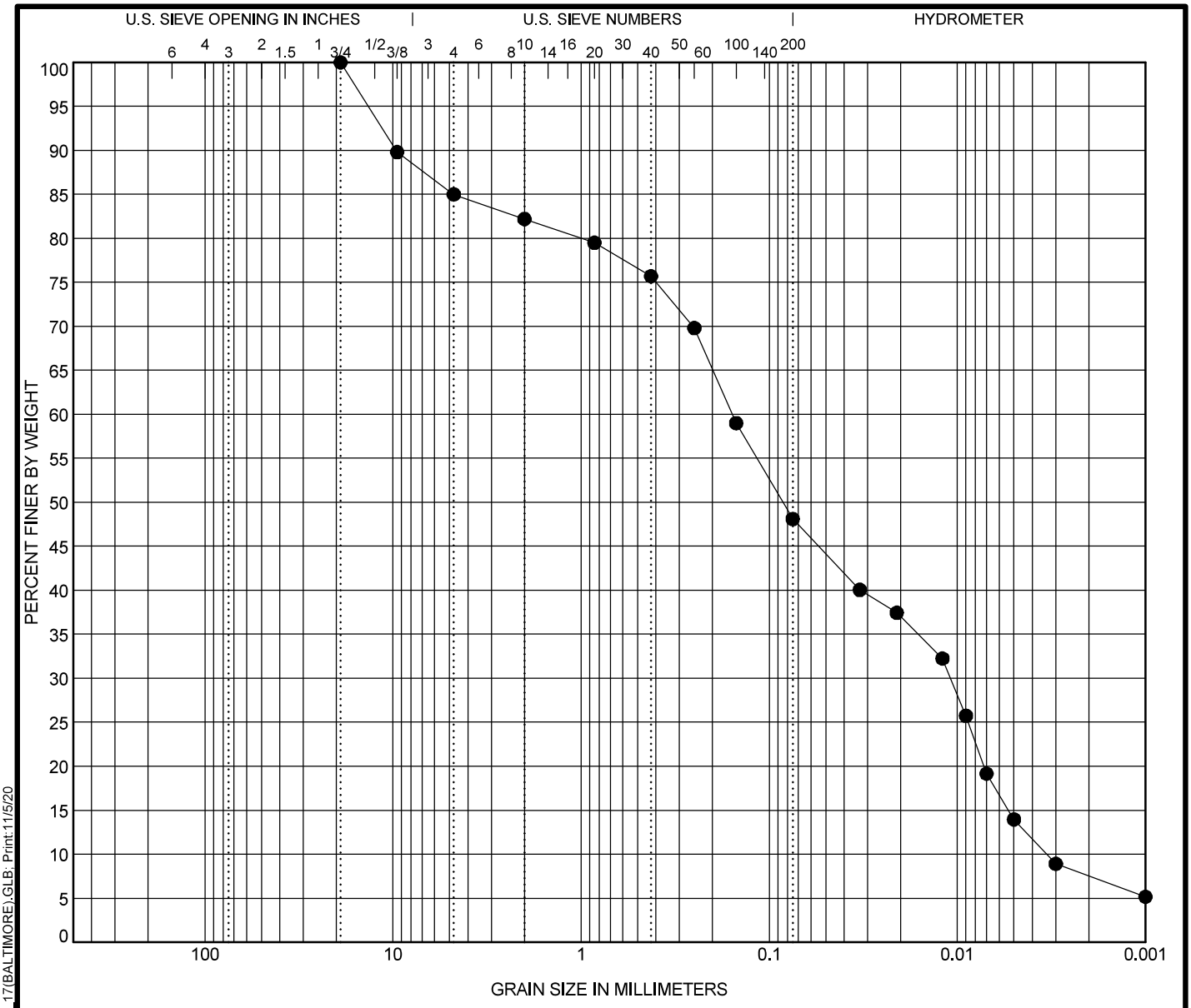
Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4	3/8 in.	3/4 in.	1 in.
% Finer	58.1	71.2	73.8	76.8	80.5	82.8	84.9	87.9	91.7	91.7

Schnabel ENGINEERING

GRADATION CURVE

Project: Entry Gate Fee Station Improvements
Greenbrier State Park
Boonsboro, MD

Contract: 20C14026.00



Specimen	Sample Description	LL	PL	PI
● SWM-1 8.5 ft	**LOAM** (USDA)	--	--	--

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D7928	**19**	**0.157**	**0.011**	**0.003**	**17.8**	**38.1**	**36.6**	**7.5**
Used in Classification						**46.4**	**44.5**	**9.1**

Percent Finer

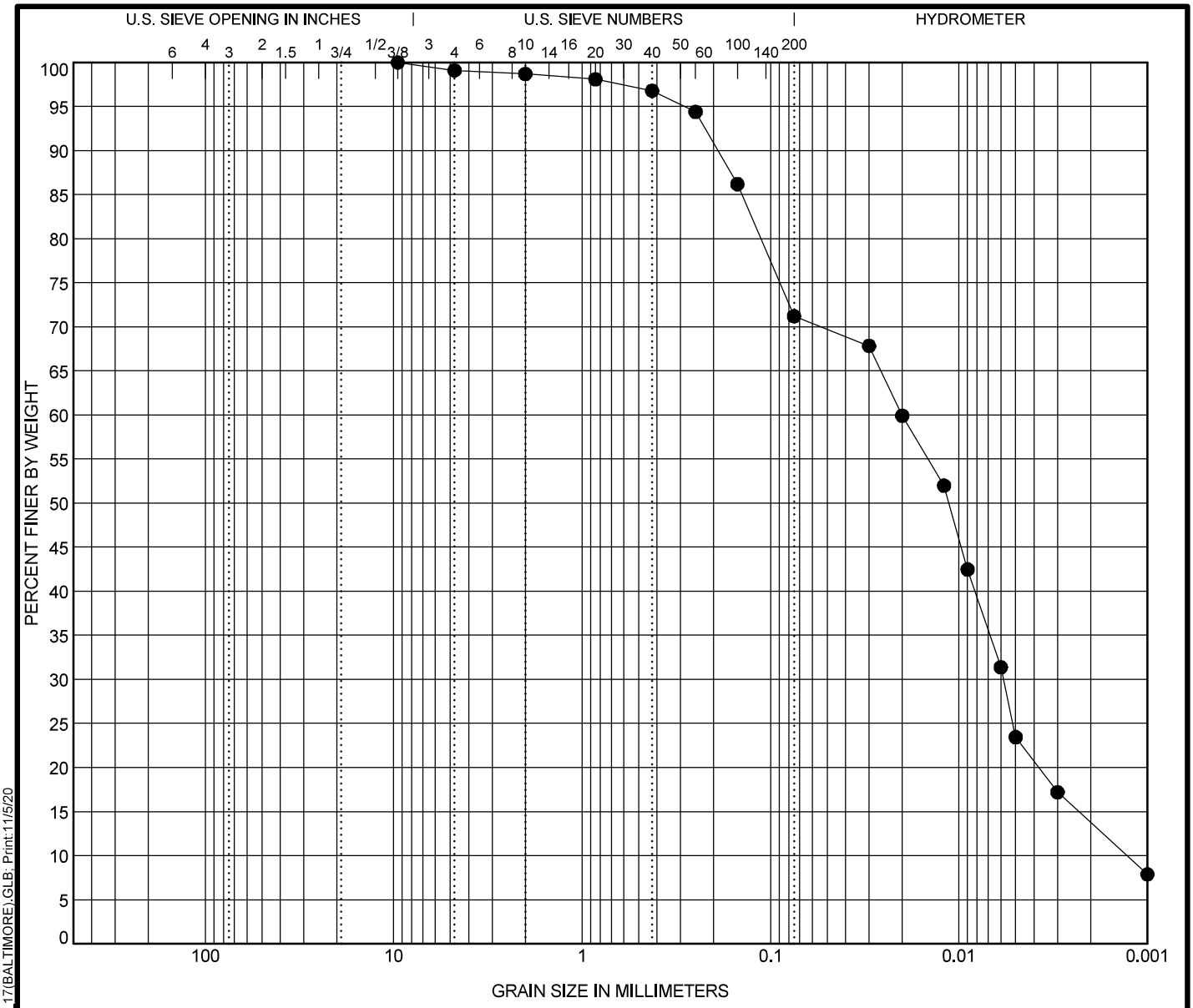
Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4	3/8 in.	3/4 in.
% Finer	48.1	59.0	69.8	75.7	79.5	82.2	85.0	89.8	100.0

Schnabel ENGINEERING

GRADATION CURVE

Project: Entry Gate Fee Station Improvements
Greenbrier State Park
Boonsboro, MD

Contract: 20C14026.00



Specimen	Sample Description	LL	PL	PI
● SWM-2 5.0 ft	**SILT LOAM** (USDA)	--	--	--

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D7928	**9.5**	**0.02**	**0.006**	**0.001**	**1.3**	**29.0**	**56.0**	**13.7**
					Used in Classification	**29.4**	**56.7**	**13.9**

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4	3/8 in.
% Finer	71.2	86.2	94.4	96.8	98.1	98.7	99.1	100.0

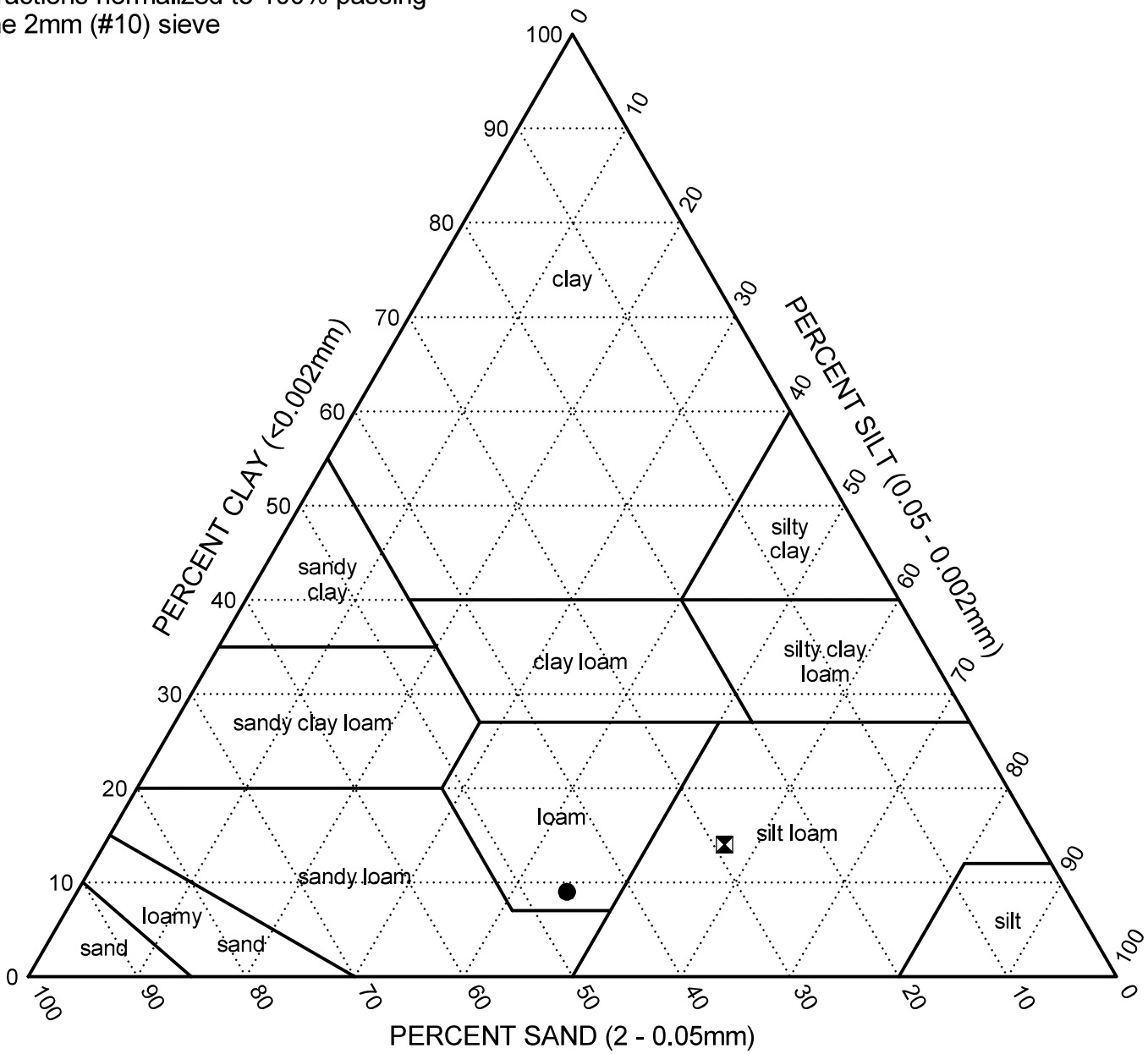
Schnabel ENGINEERING

GRADATION CURVE

Project: Entry Gate Fee Station Improvements
Greenbrier State Park
Boonsboro, MD

Contract: 20C14026.00

Fractions normalized to 100% passing the 2mm (#10) sieve



	Borehole	Depth (ft)	USDA Classification	Sand (%)	Silt (%)	Clay (%)
●	**SWM-1**	**8.5**	**LOAM**	**46.4**	**44.5**	**9.1**
⧓	**SWM-2**	**5.0**	**SILT LOAM**	**29.4**	**56.7**	**13.9**

Schnabel ENGINEERING

USDA Textural Classification Chart

Project: Entry Gate Fee Station Improvements
Greenbrier State Park
Boonsboro, MD

Contract: 20C14026.00

USDA TEXTURAL CLASSIFICATION: P:\BORING LOGS_GREENBRIER ENTRY GATE.GPJ; D:\USDA TEXTURAL CLASS.GDT L:\GINT LIBRARY_2020_01_17\(BALTIMORE).GLB; Print:11/4/20

INFILTRATION TEST RESULTS

Infiltration Test Data Sheets: SWM-1 and SWM-2

INFILTRATION TEST PROCEDURES

We performed in-situ infiltration testing in general accordance with the 2000 Maryland Department of the Environment (MDE) Maryland Stormwater Design Manual (revised 2009). The infiltration tests were performed at an offset location (within about 5 ft) of the SWM boring locations. Infiltration testing was performed by augering a hole to the depth indicated. Infiltration tests adjacent to test borings were augered using a drill rig. The auger was removed and a 5 inch diameter, Polyvinyl Chloride (PVC) pipe was installed. The pipes were seated using the drill rig. Approximately 24 inches (depth) of water was poured into the pipe and the water was allowed to pre-soak the soils for about 24 hours. After the pre-soak, if no water infiltrated into the subgrade the test was ended. If any water infiltrated into the subgrade during the pre-soak period, additional water was added until the depth of water in the pipe was 24 inches and the water level was measured at the beginning and end of a one hour period. This process was repeated three times.

INFILTRATION TEST DATA SHEET

Schnabel ENGINEERING

Project:	Greenbrier Entrance	Project No:	20C14026.00
Boring No:	SWM-1	Date:	10/22/2020
Location:	Boonsboro, MD	Schnabel Rep.	B. Glass
Pipe length:	10.0 ft.	Ground Elevation:	1024.5
Pipe Height above ground:	4.0 ft.	SWM Basin Elevation:	1023
Pipe Depth below ground:	6.0 ft.	Bottom of Pipe Elevation:	1018.5
Depth of the borehole	10.0 ft.		

PRESOAK:	Start	24-Hour Reading
Date	10/22/20	10/23/20
Time	2:15:00 PM	12:20:00 PM
Water Depth below top of pipe:	8'	7' 2.5"
Water Depth below ground:	4'	3' 2.5"
Water Depth in pipe:	24"	14.5"

Visual Soil Description: Silt with Sand (Existing Fill)

USDA Textural Class: LOAM (from soil sample collected from 8.5 to 10 ft)

Hydrologic Group: Group B (according to USDA Textural class)

TEST:

Run	Date	Begin			End			Infiltration Rate (in/hr)
		Time	Water depth below top of pipe (feet or in)*	Depth of Water in pipe (in)**	Time	Water depth below top of pipe (feet or in)*	Depth of Water in pipe (in)**	
1	10/23/20	12:25 PM	7.958'	24.5	1:25 PM	8.479'	18.25	6.25
2	10/23/20	1:25 PM	8.000'	24	2:25 PM	8.094'	22.875	1.13
3	10/23/20	2:25 PM	8.000'	24	3:25 PM	8.063'	23.25	0.75
4	10/23/20	3:25 PM	7.990'	24.125	4:25 PM	8.020'	23.75	0.38
						Infiltration Rate (in/hr) ***		0.38

* depth includes pipe stickup above ground

** (pipe depth below ground)+(pipe stickup above ground)-(Water depth below top of pipe)

*** Infiltration rate determined from final field rate per MDE Design Manual Appendix D.1

INFILTRATION TEST DATA SHEET

Schnabel ENGINEERING

Project:	Greenbrier Entrance	Project No:	20C14026.00
Boring No:	SWM-2	Date:	10/22/2020
Location:	Boonsboro, MD	Schnabel Rep.	B. Glass
Pipe length:	10.0 ft.	Ground Elevation:	1025.0
Pipe Height above ground:	4.0 ft.	SWM Basin Elevation:	1022
Pipe Depth below ground:	6.0 ft.	Bottom of Pipe Elevation:	1019.0
Depth of the borehole	10.0 ft.		

PRESOAK:	Start	24-Hour Reading
Date	10/22/20	10/23/20
Time	2:15:00 PM	12:28:00 PM
Water Depth below top of pipe:	8'	6' 6"
Water Depth below ground:	4'	2' 6"
Water Depth in pipe:	24"	6"

Visual Soil Description:	Silt with Sand
USDA Textural Class:	SILT LOAM
Hydrologic Group:	Group B (according to USDA Textural class)

TEST:

Run	Date	Begin			End			Infiltration Rate (in/hr)
		Time	Water depth below top of pipe (feet or in)*	Depth of Water in pipe (in)**	Time	Water depth below top of pipe (feet or in)*	Depth of Water in pipe (in)**	
1	10/23/20	12:30 PM	7.771'	26.75	1:30 PM	7.813'	26.25	0.50
2	10/23/20	1:30 PM	7.813'	26.25	2:30 PM	7.854'	25.75	0.50
3	10/23/20	2:30 PM	7.854'	25.75	3:30 PM	7.896'	25.25	0.50
4	10/23/20	3:30 PM	7.896'	25.25	4:30 PM	7.938'	24.75	0.50
						Infiltration Rate (in/hr)***		0.50

* depth includes pipe stickup above ground

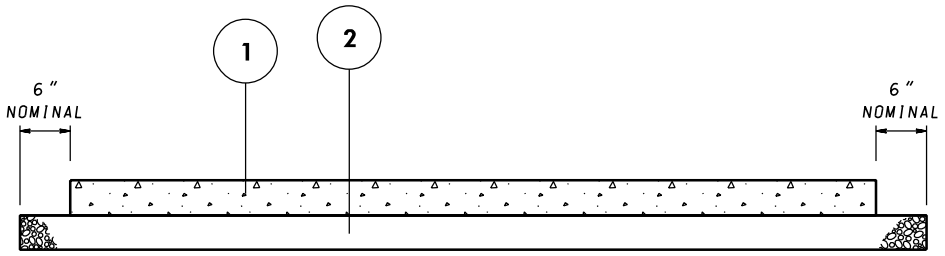
** (pipe depth below ground)+(pipe stickup above ground)-(Water depth below top of pipe)

*** Infiltration rate determined from final field rate per MDE Design Manual Appendix D.1

MDSHA STANDARD DETAIL FOR BUS STOP PADS

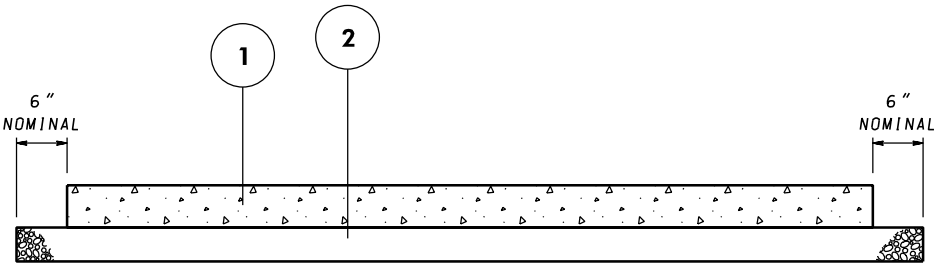
Detail: MD 580.07.

Schnabel Engineering, LLC



① 5″ JOINTED PLAIN CONCRETE - MIX #7. MAXIMUM JOINT SPACING SHALL BE 6′. NO LOAD TRANSFER DEVICES ARE NEEDED. REFER TO STD. NO. MD 577.07.
② 6″ GRADED AGGREGATE BASE

PARK & RIDE – RIGID PAVEMENT SECTION – PASSENGER VEHICLES



① 9″ JOINTED PLAIN CONCRETE - MIX #7. REFER TO STD. NOS. MD 572.21, MD 572.61 AND MD 572.91
② 6″ GRADED AGGREGATE BASE

PARK & RIDE – RIGID PAVEMENT SECTION – BUS LANE AND BUS STOP PAD

SPECIFICATION	CATEGORY CODE ITEMS
APPROVED	DIRECTOR – OFFICE OF HIGHWAY DEVELOPMENT

APPROVAL • SHA REVISIONS	APPROVAL • FEDERAL HIGHWAY ADMINISTRATION
APPROVAL 2-25-16	APPROVAL 2-23-16
REVISED	REVISED
REVISED	REVISED
REVISED	REVISED

SHA State Highway Administration

Maryland Department of Transportation
STATE HIGHWAY ADMINISTRATION
STANDARDS FOR HIGHWAYS AND INCIDENTAL STRUCTURES

PARK & RIDE PAVEMENT SECTIONS
RIGID PAVEMENT

STANDARD NO. MD 580.07

APPENDIX E: ENTRY GATE FEE STATION IMPROVEMENTS AT GREENBRIER STATE PRAK

Project No. P-052-200-002

STORMWATER MANAGEMENT CONCEPT REPORT

MDE Permit No. 21-SF-0104

OWNER / APPLICANT

State of Maryland
Department of General Services
301 West Preston Street
Baltimore, MD 21201

SUBMITTED TO

Maryland Department of the Environment
Water and Science Administration
1800 Washington Boulevard, 4th Floor
Baltimore, MD 21201

PREPARED BY

A. Morton Thomas and Associates, Inc.
800 King Farm Boulevard, 4th Floor
Rockville, MD 20850
301.881.2545
AMT No. 20-0424.001
amtengineering.com

February 19, 2021

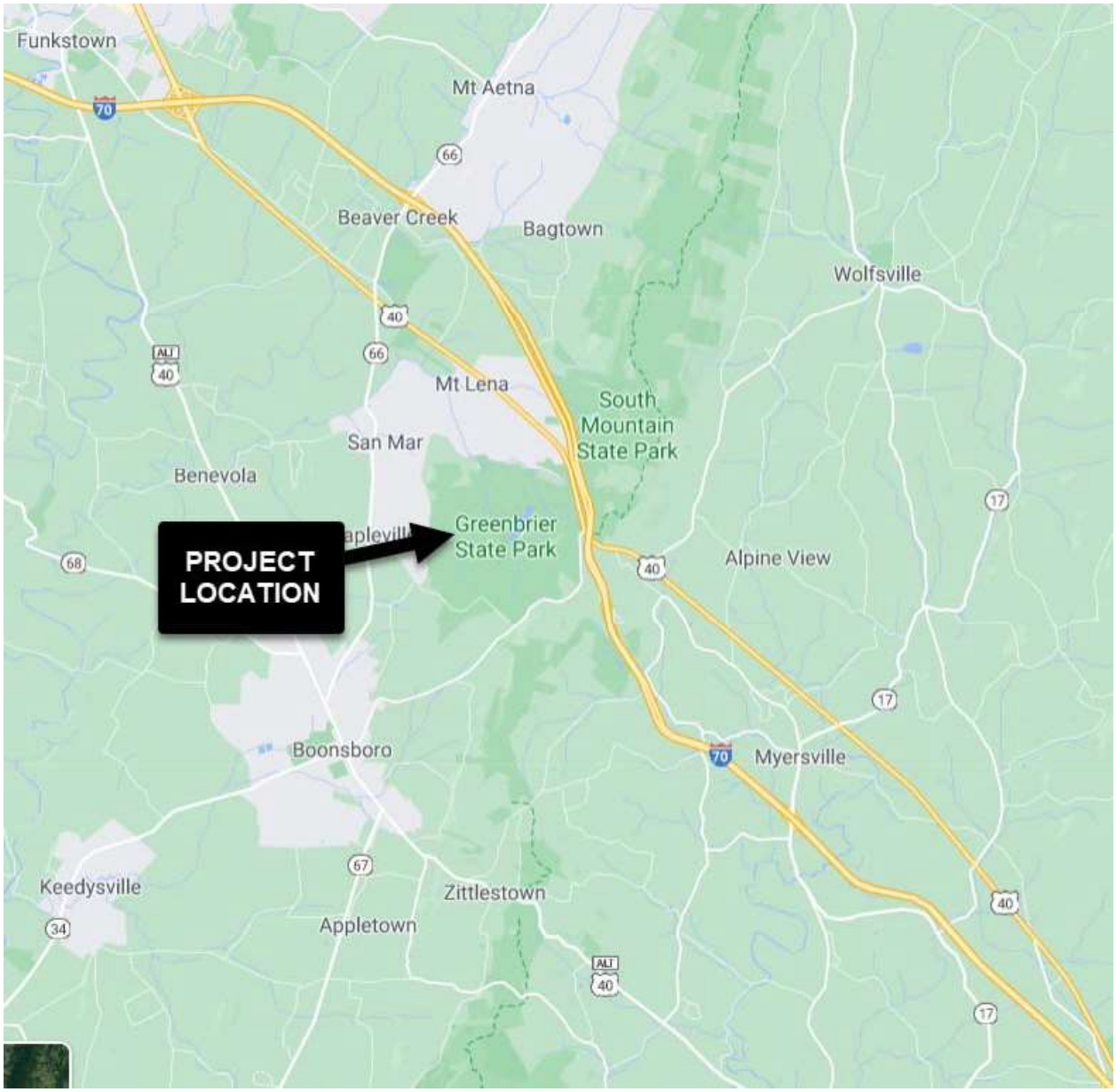
PROFESSIONAL CERTIFICATION

"Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the state of Maryland, License No. 32151 Expiration Date: 07/18/2021"

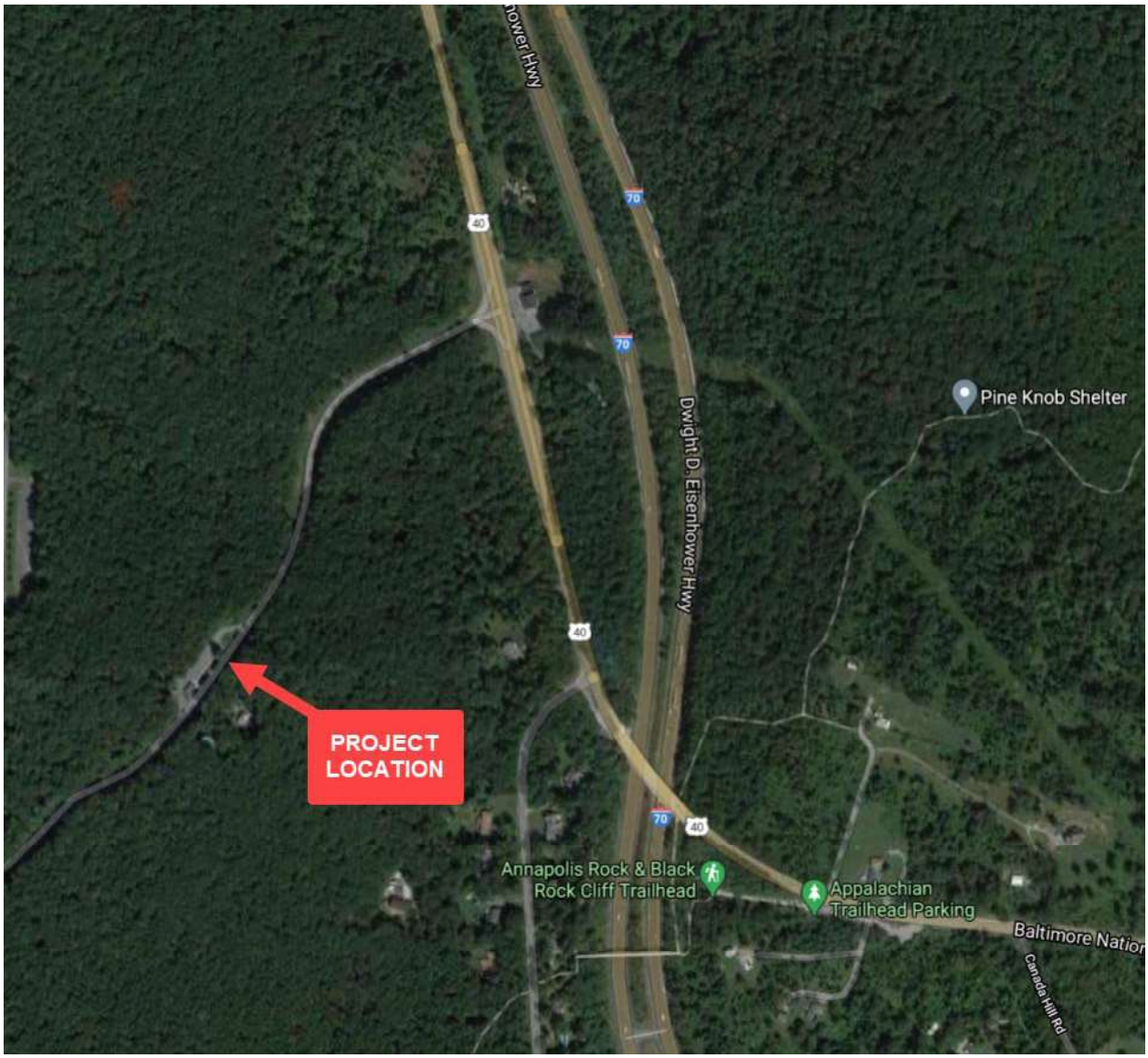
Seal / Signature

TABLE OF CONTENTS

LOCATION MAP



VICINITY MAP



1. INTRODUCTION

The project is located at the Greenbrier State Park in Washington County, Maryland. The project will consist of reconfiguring the entry/exit lanes to include two entry lanes and one exit lane, reconfiguring the parking lot to include a new pull-off parking area for cars pulling campers, new staff parking area and renovating the existing camper registration building. The pavement reconstruction will consist of new full depth paving for all new paved areas and a mill/overlay pavement section for area of new pavement over existing pavement.

2. PURPOSE

This report quantifies both qualitative and quantitative stormwater runoff generated by all proposed site improvements and provides stormwater management treatment of the improvements.

3. CRITERIA

All work was performed in accordance with the Maryland Stormwater Management Guidelines for State and Federal Projects, dated February 2015; and the 2000 Maryland Stormwater Management Design Manual, Volumes I and II.

- The term **Guidelines** here is in reference to the Maryland Stormwater Management Guidelines for State and Federal Projects (February 2015).
- The term **SWM Manual** here is in reference to the Maryland Stormwater Design Manual Volumes I and II (October 2000, Revised May 2009, and Supplements).
- MDE Technical Memorandum #11 is used in conjunction with MDE standard spreadsheets for stormwater management and summary calculations.
- MDE Table 2 – Minimum County Flood Control Requirements

County	$Q_{2\text{-yr}}$	$Q_{10\text{-yr}}$	$Q_{100\text{-yr}}$
Washington	No	Yes	N/A

- The below NOAA Rainfall values will be utilized for the hydrologic and hydraulic analyses. The 24-hour rainfall values are listed below to comply with the National Engineering Field Handbook, Part 650, Change Notice No. 6., Subject: NEH Part 650 Chapter 2, dated July 11, 2016 prepared by the Natural Resources Conservation Service.

County	Type	1-year	2-year	10-year	100-year
Washington	NOAA-B	2.38	2.86	4.15	6.56

[REMAINDER OF THIS PAGE INTENTIONALLY LEFT BLANK]

4. ANALYSIS AND RESULTS

4.1.Stormwater Management Narrative

4.1.1. Natural Resource Protection and Enhancement

There are no floodplains, major waterways, or wetlands within the project boundary.

4.1.2. Maintenance of Natural Flow Patterns

All major flow patterns are maintained as shown on the Existing Conditions and Proposed Conditions Drainage Area Maps to the maximum extents practical.

4.1.3. Reduction of Impervious Area through Better Site Design, Alternative Surfaces, and Non-Structural Practices

The impervious area generated by the project will be kept the minimum necessary to meet the program of requirements required by the Maryland Department of General Services.

4.1.4. Integration of Erosion and Sediment Controls into the Stormwater Strategy

Erosion and sediment control measures for the project will include perimeter control that will consist of stabilized construction entrances, super silt, diversion fence, inlet protection and daily stabilization. Erosion control measures will be located to minimize disturbance beyond the proposed construction limits to the maximum extent practical.

4.1.5. Implementation of ESD Planning Techniques and Practices to the MEP.

Since the existing impervious area is greater than 40%, the project will be considered “Redevelopment” and will provide all required SWM ESD treatment to the MEP on-site through new facilities.

4.1.6. Impacts to Existing Stormwater Management

No existing stormwater management facilities are located within the project area. No stormwater management facilities are located downstream of the proposed improvements.

4.2. Stormwater Management Point of Study Requirements Summary

As discussed with MDE officials, an all-encompassing SWM Study Area will be utilized with respect to the project classification. The Environmental Site Design (ESD) requirements are then based on the individual POS characteristics. Based on the project limits and topography the project has been broken into four (4) separate Point of Study (POS) areas.

Under existing conditions, the SWM Study Area of 1.63-acres that consists of 0.86-acres of impervious area that consists of roadways, parking, and an existing building. Since the SWM study area contains 52.8% impervious area which is greater than 40% impervious, the project will be classified as “Redevelopment”.

[REMAINDER OF THIS PAGE INTENTIONALLY LEFT BLANK]

4.2.1. Point of Study 1

4.2.1.1. POS-1 ESD Requirements

Table 1: POS-1 ESD Stormwater Management Summary	
Stormwater Management Area	1.63 acres
Existing Impervious Area	0.86 acres
Existing % Impervious	52.8%
Development Classification	Redevelopment
Existing Impervious Area (A)	0.16 acres
Proposed Impervious Area (B)	0.11 acres
Net Increase in Impervious Area (B-A)	-0.05 acres
Area for Which WQv is not Required	0.11 acres
IART Redevelopment	**0.03 acres**
IART New Development	**-0.05 acres**
IART TOTAL	**-0.02 acres**
Total ESDv Required	**0 cf**
Total Recharge Volume Required	**0 cf**

The MDE SWM Calculator worksheets are located in Appendix H.

No stormwater management facilities are needed for POS-1 and none have been provided in POS-1.

Table 2: POS-1 ESD Treatment Summary Table					
ESD Facility	**Facility Type**	**Drainage Area (acres)**	**PE Treated (inches)**	**Impervious Area Treated (IART) (acres)**	**ESD Provided (cubic feet)**
N/A	N/A	N/A	N/A	0.00	0
			TOTAL PROVIDED	0.00	0
			TOTAL REQUIRED	0.00	0
			ESD TO THE MEP ACHIEVED	YES	YES

The MDE Treatment Provided Summary Worksheet is located in Appendix J. The MDE ESD Summary Sheet is located in Appendix K. MDE Water Quality Summary Sheet (WQSS) is located in Appendix L.

While the project is classified as Redevelopment, the project does create a net increase in impervious area, therefore the project will require 10-year quantity control as outlined in MDE Table 2. Reference Existing and Proposed Drainage Area Maps in Appendix E and Appendix F, respectively.

4.2.1.2. POS-1 Quantity Control Requirements

Under existing conditions, POS-1 has a drainage area of 4.47 acres consisting of 0.27-acres of impervious area with the remaining area consisting of a combination of woods and meadow areas. This point of study is a point in an existing roadside ditch located on the north side of the roadway. The ditch captures run-off from the existing roadway to the west of the ditch and the forested area to the right of the ditch. The

existing time of concentration (Tc) is 17 minutes. The travel path is shown on the drainage area map. The hydrologic summary for the existing conditions is shown below. Detailed hydraulic/hydrologic calculations are provided in Appendix M.

Under proposed conditions, POS-1 has a drainage area decreases to 4.45 acres consisting of 0.22 acres of impervious area with the remaining area consisting of a combination of woods and meadow area. The Tc path remains unchanged at 30 minutes. No new stormwater management facilities will be constructed within this drainage area.

Table 3: POS-1 Hydrologic Summary

	Total Area (acres)	CN	Impervious Area (acres)	Tc (min)	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
Existing	4.47	58	0.27	30	0.44	2.61	9.13
Proposed	4.52	58	0.22	30	0.44	2.60	9.10
				% Change	0%	0%	0%

Since the drainage area experiences a decrease or no change in peak run-off from existing to proposed conditions, quantity control is not required for this study point.

4.2.2. Point of Study 2

4.2.2.1. POS-2 ESD Requirements

Table 4: POS-2 ESD Stormwater Management Summary	
Stormwater Management Area	1.63 acres
Existing Impervious Area	0.86 acres
Existing % Impervious	52.8%
Development Classification	Redevelopment
Existing Impervious Area (A)	0.27 acres
Proposed Impervious Area (B)	0.46 acres
Net Increase in Impervious Area (B-A)	0.19 acres
Area for Which WQv is not Required	0.24 acres
IART Redevelopment	**0.02 acres**
IART New Development	**0.19 acres**
IART TOTAL	**0.21 acres**
Total ESDv Required	**1,704 cf**
Total Recharge Volume Required	**170 cf**

The MDE SWM Calculator worksheets are located in Appendix H.

One micro-bioretention (MB) facility will be used to provide ESDv and IART treatment as shown on the stormwater management plans. Due to site constraints including grading, topography, and the program manual additional SWM facilities are not practical to be located in this POS. SWM-2 located in POS-3 will be oversized to compensate for required treatment and a waiver will be requested for any treatment deficits in final design. Detailed micro-bioretention sizing calculations are located in Appendix I.

Table 5: POS-2 ESD Treatment Summary Table					
ESD Facility	**Facility Type**	**Drainage Area (acres)**	**PE Treated (inches)**	**Impervious Area Treated (IART) (acres)**	**ESD Provided (cubic feet)**
SWM-1	Micro-Bioretention	0.27	2.17	0.17	1,311
			TOTAL PROVIDED	0.17	1,311
			TOTAL REQUIRED	0.21	1,704
			ESD TO THE MEP ACHIEVED	NO	NO

The MDE Treatment Provided Summary Worksheet is located in Appendix J. The MDE ESD Summary Sheet is located in Appendix K. MDE Water Quality Summary Sheet (WQSS) is located in Appendix L.

While the project is classified as Redevelopment, the project does create a net increase in impervious area, therefore the project will require 10-year quantity control as outlined in MDE Table 2. Reference Existing and Proposed Drainage Area Maps in Appendix E and Appendix F, respectively.

4.2.2.2. POS-2 Quantity Control Requirements

Under existing conditions, POS-2 is a line of study along the northwestern portion the project area and has a drainage area of 1.13 acres consisting of 0.27-acres of impervious area with the remaining area consisting of a combination of woods and meadow areas. The existing time of concentration (Tc) is 5 minutes. The travel path is shown on the drainage area map. The hydrologic summary for the existing conditions is shown below. Detailed hydraulic/hydrologic calculations are provided in Appendix M.

Under proposed conditions, POS-2 has a drainage area increases to 1.18 acres consisting of 0.46 acres of impervious area with the remaining area consisting of a combination of woods and meadow area. The Tc path remains unchanged at 5 minutes. A new micro-bioretention facility will be constructed within this drainage area.

Table 6: POS-2 Hydrologic Summary							
	Total Area (acres)	CN	Impervious Area (acres)	Tc (min)	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
Existing	1.13	67	0.27	5	0.74	2.01	4.96
Proposed	1.18	74	0.46	5	1.39	2.99	6.40
				% Change	+88%	+49%	+29%
Proposed With SWM	1.18	66	---	5	N/A	1.99	N/A
						-1%	

Since this drainage area experiences an increase in the peak flow for the 10-year storm event, 10-year Quantity Management will be required. Accounting for the stormwater storage within the micro-bioretention facility and utilizing the "Change in Runoff Curve Number Method", the 10-year peak discharge will decrease to 1.99 cfs. Since the 10-year proposed release rate with stormwater

management is less than the 10-year existing release rate, additional 10-year quantity control (Qp) is not required. Reduced Curve Number calculations are located in Appendix I.

4.2.3. Point of Study 3

4.2.3.1. POS-3 ESD Requirements

Table 7: POS-3 ESD Stormwater Management Summary	
Stormwater Management Area	1.63 acres
Existing Impervious Area	0.86 acres
Existing % Impervious	52.8%
Development Classification	Redevelopment
Existing Impervious Area (A)	0.02 acres
Proposed Impervious Area (B)	0.17 acres
Net Increase in Impervious Area (B-A)	0.15 acres
Area for Which WQv is not Required	0.11 acres
IART Redevelopment	**-0.05 acres**
IART New Development	**0.15 acres**
IART TOTAL	**0.10 acres**
Total ESDv Required	**1,345 cf**
Total Recharge Volume Required	**134 cf**

The MDE SWM Calculator worksheets are located in Appendix H.

One micro-bioretention (MB) facility will be used to provide the required ESDv and IART treatment as shown on the stormwater management plans. Detailed micro-bioretention sizing calculations are located in Appendix I.

Table 8: POS-3 ESD Treatment Summary Table					
ESD Facility	**Facility Type**	**Drainage Area (acres)**	**PE Treated (inches)**	**Impervious Area Treated (IART) (acres)**	**ESD Provided (cubic feet)**
SWM-2	Micro-Bioretention	0.24	2.41	0.16	1,364
			TOTAL PROVIDED	0.16	1,364
			TOTAL REQUIRED	0.10	1,345
			ESD TO THE MEP ACHIEVED	YES	YES

The MDE Treatment Provided Summary Worksheet is located in Appendix J. The MDE ESD Summary Sheet is located in Appendix K. MDE Water Quality Summary Sheet (WQSS) is located in Appendix L.

While the project is classified as Redevelopment, the project does create a net increase in impervious area, therefore the project will require 10-year quantity control as outlined in MDE Table 2. Reference Existing and Proposed Drainage Area Maps in Appendix E and Appendix F, respectively.

4.2.3.2. POS-3 Quantity Control Requirements

Under existing conditions, POS-3 is a line of study along the southwestern portion the project area and has a drainage area of 0.52 acres consisting of 0.01-acres of impervious area with the remaining area consisting of a combination of woods and meadow areas. The existing time of concentration (Tc) is 5 minutes. The travel path is shown on the drainage area map. The hydrologic summary for the existing conditions is shown below. Detailed hydraulic/hydrologic calculations are provided in Appendix M.

Under proposed conditions, POS-3 has a drainage area increase to 0.67 acres consisting of 0.17 acres of impervious area with the remaining area consisting of a combination of woods and meadow area. The Tc path remains unchanged at 5 minutes. A new micro-bioretention facility will be constructed within this drainage area.

Table 9: POS-3 Hydrologic Summary

	Total Area (acres)	CN	Impervious Area (acres)	Tc (min)	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
Existing	0.52	58	0.02	5	0.07	0.48	1.59
Proposed	0.67	68	0.17	5	0.49	1.26	3.05
				% Change	+600%	+163%	+92%
Proposed With SWM	0.67	49	---	5	N/A	0.15	N/A
						-69%	

Since this drainage area experiences an increase in the peak flow for the 10-year storm event, 10-year Quantity Management will be required. Accounting for the stormwater storage within the micro-bioretention facility and utilizing the "Change in Runoff Curve Number Method", the 10-year peak discharge will decrease to 0.15 cfs. Since the 10-year proposed release rate with stormwater management is less than the 10-year existing release rate, additional 10-year quantity control (Qp) is not required. Reduced Curve Number calculations are located in Appendix I.

4.2.4. Point of Study 4

4.2.4.1. POS-4 ESD Requirements

Table 10: POS-4 ESD Stormwater Management Summary	
Stormwater Management Area	1.63 acres
Existing Impervious Area	0.86 acres
Existing % Impervious	52.8%
Development Classification	Redevelopment
Existing Impervious Area (A)	0.41 acres
Proposed Impervious Area (B)	0.25 acres

Net Increase in Impervious Area (B-A)	-0.16 acres
Area for Which WQv is not Required	0.19 acres
IART Redevelopment	**0.11 acres**
IART New Development	**-0.16 acres**
IART TOTAL	**-0.05 acres**
Total ESDv Required	**0 cf**
Total Recharge Volume Required	**0 cf**

The MDE SWM Calculator worksheets are located in Appendix H.

No stormwater management facilities are needed for POS-4 and none have been provided in POS-4.

Table 11: POS-4 ESD Treatment Summary Table

ESD Facility	Facility Type	Drainage Area (acres)	PE Treated (inches)	Impervious Area Treated (IART) (acres)	ESD Provided (cubic feet)
N/A	N/A	N/A	N/A	0.00	0
			TOTAL PROVIDED	0.00	0
			TOTAL REQUIRED	0.00	0
			ESD TO THE MEP ACHIEVED	YES	YES

The MDE Treatment Provided Summary Worksheet is located in Appendix J. The MDE ESD Summary Sheet is located in Appendix K. MDE Water Quality Summary Sheet (WQSS) is located in Appendix L.

While the project is classified as Redevelopment, the project does create a net increase in impervious area, therefore the project will require 10-year quantity control as outlined in MDE Table 2. Reference Existing and Proposed Drainage Area Maps in Appendix E and Appendix F, respectively.

4.2.4.2. POS-4 Quantity Control Requirements

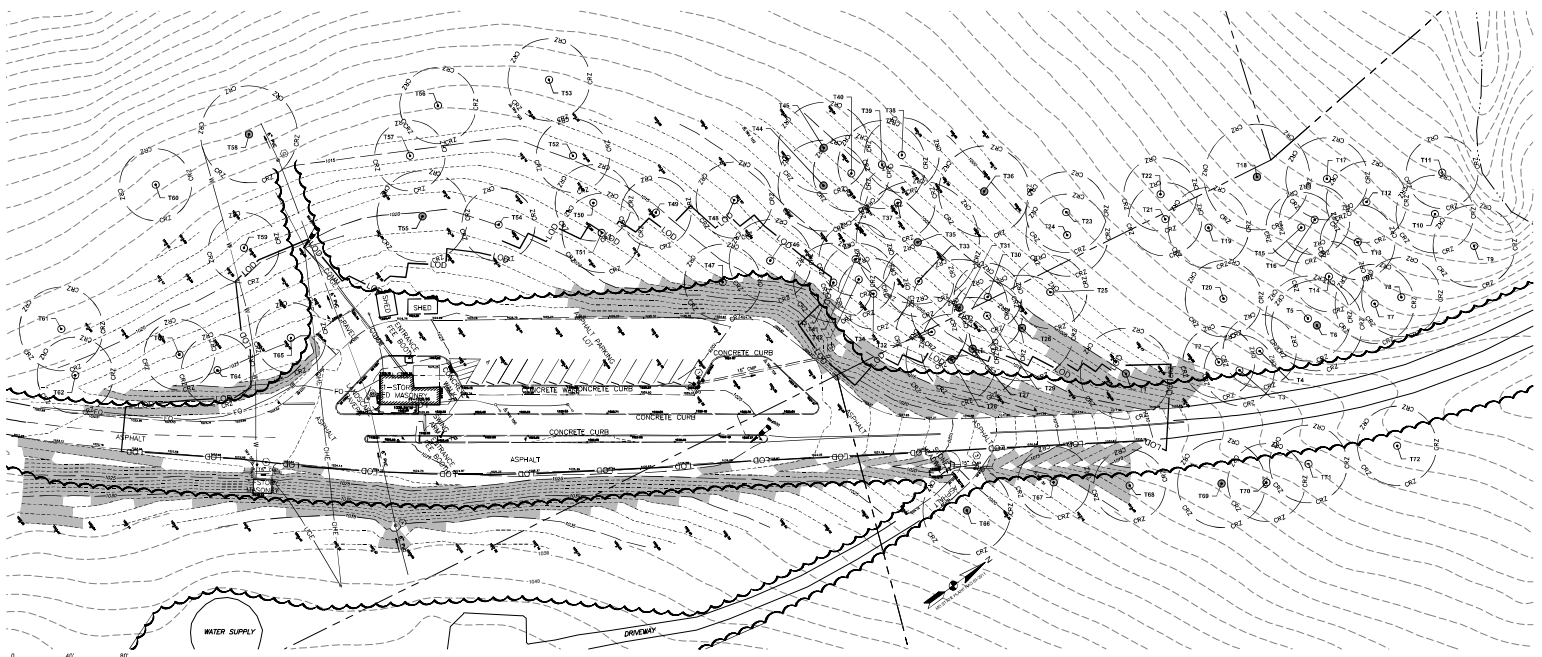
Under existing conditions, POS-4 has a drainage area of 38.56 acres consisting of 1.21 acres of impervious area with the remaining area consisting of a combination of woods and meadow areas. This point of study is a point in an existing storm drain outfall located on the north side of the roadway. The ditch captures run-off from the existing roadway and the forested area to the south of the ditch. The existing time of concentration (Tc) is 36 minutes. The travel path is shown on the drainage area map. The hydrologic summary for the existing conditions is shown below. Detailed hydraulic/hydrologic calculations are provided in Appendix M.

Under proposed conditions, POS-4 has a drainage area decreases to 37.87 acres consisting of 1.07 aces of impervious area with the remaining area consisting of a combination of woods and meadow area. The Tc path remains unchanged at 36 minutes. No new stormwater management facilities will be constructed within this drainage area.

Table 6: POS-4 Hydrologic Summary							
	Total Area (acres)	CN	Impervious Area (acres)	Tc (min)	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
Existing	38.56	63	1.21	36	6.73	23.23	66.38
Proposed	37.87	63	1.07	36	6.70	23.11	66.05
				% Change	-0.45%	-0.51%	-0.49%

Since the drainage area experiences a decrease in peak run-off from existing to proposed conditions, quantity control is not required for this study point.

NATURAL RESOURCE MAP



LEGEND:

- CURB AND GUTTER
- PROPERTY LINE
- W — WATERLINE PAINT MARK
- COMM — UNDERGROUND COMMUNICATION PAINT
- UGE — UNDERGROUND ELECTRIC PAINT
- G — GAS LINE PAINT MARK
- X — FENCE
- EXISTING 1' CONTOUR
- EXISTING 5' CONTOUR
- LIGHT POLE
- LOD — LIMIT OF DISTURBANCE
- STEEP SLOPES (15% OR GREATER)
- EX. TREE AND CRITICAL ROOT ZONE
- EX. TREE AND CRITICAL ROOT ZONE FOR 30" + TREES
- TREE LINE
- FORESTED AREA

PROPERTY INFORMATION: (PROJECT LIMITS)

PARCEL NUMBER:	0217
ACCOUNT NUMBER:	003419
ADC MAP/GRID:	MAP 27 / GRID 11K
LIBER/FOLIO:	N/A / N/A
TAX MAP:	N/A
WSSC GRID:	N/A
PROJECT LIMITS:	1.63 ACRES
FEMA MAP:	24043C0340D

SOIL DESCRIPTIONS: (MAJOR COMPONENTS ONLY)

HnC—HAZEL CHANNERY SILT LOAM, 8-15% SLOPES: THE HAZEL COMPONENT MAKES UP 85 PERCENT OF THE MAP UNIT. SLOPES ARE 8 TO 15 PERCENT. THE PARENT MATERIAL CONSISTS OF LOAMY RESIDUUM WEATHERED FROM PHYLLITE. DEPTH TO A ROOT RESTRICTIVE LAYER, BEDROCK, LITHIC, IS 20 TO 40 INCHES. THE NATURAL DRAINAGE CLASS IS WELL DRAINED. WATER MOVEMENT IN THE MOST RESTRICTIVE LAYER IS HIGH. AVAILABLE WATER TO A DEPTH OF 60 INCHES (OR RESTRICTED DEPTH IS LOW. SHRINK-SWELL POTENTIAL IS LOW. THIS SOIL IS NOT FLOODED. IT IS NOT PONDED. THERE IS NO ZONE OF WATER SATURATION WITHIN A DEPTH OF 72 INCHES. ORGANIC MATTER CONTENT IN THE SURFACE HORIZON IS ABOUT 1 PERCENT. NONIRRIGATED LAND CAPABILITY CLASSIFICATION IS 3E. THIS SOIL DOES NOT MEET HYDRIC CRITERIA.

MAPPED SOIL TYPES

SYMBOL	DESCRIPTION	HYDRIC	HIGHLY ERODIBLE
HnC	Hazel channery silt loam, 8–15%	No	No

MDE TABLE 5.1

FEDERAL	PRESENT (Y/N)
WETLANDS	NO
MAJOR WATERWAYS	NO
FLOODPLAINS	NO
STATE	
TIDAL AND NONTIDAL WETLANDS	NO
WETLANDS OF SPECIAL STATE CONCERN	NO
WETLAND BUFFERS	NO
STREAM BUFFERS	NO
PERENNIAL SPRINGS	NO
FLOODPLAINS	NO
FORESTS	YES
FOREST BUFFERS	NO
CRITICAL AREAS	NO
LOCAL	
STEEP SLOPES	AS SHOWN ON THE PLAN
HIGHLY ERODIBLE SOILS	NO
ENHANCED STREAM BUFFERS	NO
TOPOGRAPHY/SLOPES	AS SHOWN
SPRINGS	NO
SEEPS	NO
INTERMITTENT STREAMS	NO
VEGETATIVE COVER	NO
SOILS	AS LISTED ON THE PLAN
BEDROCK/GEOLOGY	NO
EXISTING DRAINAGE AREA	SEE DA MAPS

ZIGER | SNEAD ARCHITECTS
1006 Morton Street
Baltimore, Maryland 21201
410.576.9131
zigersnead.com

STRUCTURAL ENGINEER
Albrecht Engineering
3500 Boston Street
Suite 329, MS-12
Baltimore, MD 21224
410-522-5870

LANDSCPE ARCHITECT
Fluora Teefer Landscape Architects
800 N. Charles St
Suite 300
Baltimore, MD 21201
410-528-8305

MECHANICAL ENGINEER
James Posey Associates
11155 Red Run Blvd.
Suite 310
Baltimore, MD 21117
410-266-6100

GEOTECHNICAL ENGINEER
Schnabel Engineering
9800 Jeb Stuart Pkwy
Suite 200
Glen Allen, VA 23059
804-264-3222

CIVIL ENGINEER
AMT Engineering, Inc.
800 King Farm Blvd
4th Floor
Rockville, MD 20850
301-881-2545

COST ESTIMATOR
Fonella Group, LLC
5180 Parkstone Dr.
Suite 250
Chantilly, VA 20151
703-560-2200

Professional Certification.
I certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, license number 32151, expiration date 7/18/2021.

GREENBRIER STATE PARK
CHARGE STATION

STATE OF MARYLAND - DEPARTMENT OF GENERAL SERVICES

301 WEST PRESTON STREET
BALTIMORE, MD 21201

USING AGENCY APPROVAL
NAME: DATE:

DGS APPROVAL
TITLE:
PROJECT MANAGER: DATE:
ASST. SECRETARY OF FPD&C: DATE:

NO.	REVISION TITLE	DATE

Design Development 30 October 2020

CAD DWG FILE: ZNDE APP A-MDE NATURAL RESOURCE MAP.DWG
DRAWN BY: AMT
CHECKED BY: AMT

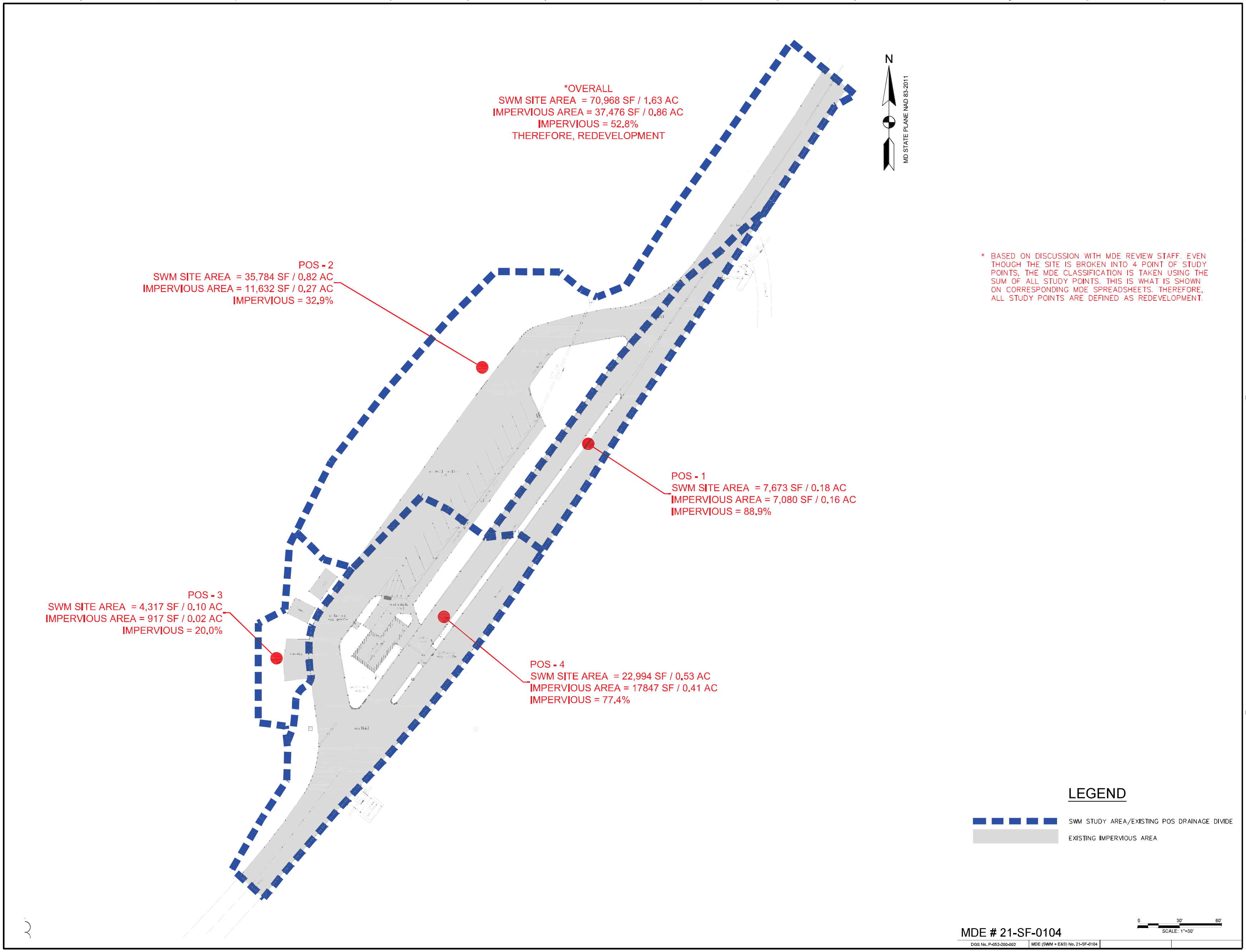
PROJECT NUMBER: 2015.00
DATE: 30 October 2020

MDE NATURAL RESOURCE MAP

MDE-1

X:\ROCKVILLE\20-0424.001 - GREENBRIER STATE PARK GATE HOUSE\DS-CAD\ZMDE APP A-MDE NATURAL RESOURCE MAP.DWG, 10/29/2020 12:20 PM, MERNEST

MDE CLASSIFICATION MAP



MDE # 21-SF-0104

DGS No. P-052-200-002 | MDE (SWM + E&S) No. 21-SF-0104

ZIGER | SNEAD ARCHITECTS
1006 Morton Street
Baltimore, Maryland 21201
410.576.9131
zigersnead.com

STRUCTURAL ENGINEER
Albrecht Engineering
3500 Boston Street
Suite 329, MS-12
Baltimore, MD 21224
410-522-5870

LANDSCAPE ARCHITECT
Floura Teeter Landscape Architects
800 N. Charles St
Suite 300
Baltimore, MD 21201
410-528-8395

MECHANICAL ENGINEER
James Posey Associates
11155 Red Run Blvd.
Suite 310
Baltimore, MD 21117
410-265-6100

GEOTECHNICAL ENGINEER
Schnabel Engineering
9800 Jeb Stuart Pkwy
Suite 200
Glen Allen, VA 23059
804-264-3222

CIVIL ENGINEER
AMT Engineering, Inc.
800 King Farm Blvd
4th Floor
Rockville, MD 20850
301-881-2545

COST ESTIMATOR
Forella Group, LLC
5180 Parkstone Dr.
Suite 250
Chantilly, VA 20151
703-560-2200

Professional Certification:
I certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, license number 32151, expiration date 7/18/2021.

GREENBRIER STATE PARK
CHARGE STATION

STATE OF MARYLAND - DEPARTMENT OF GENERAL SERVICES
301 WEST PRESTON STREET
BALTIMORE, MD 21201

USING AGENCY APPROVAL
NAME: DATE:
DGS APPROVAL
TITLE:
PROJECT MANAGER: DATE:
ASST. SECRETARY OF FPD&C: DATE:

NO.	REVISION TITLE	DATE
	Design Development	30 October 2020

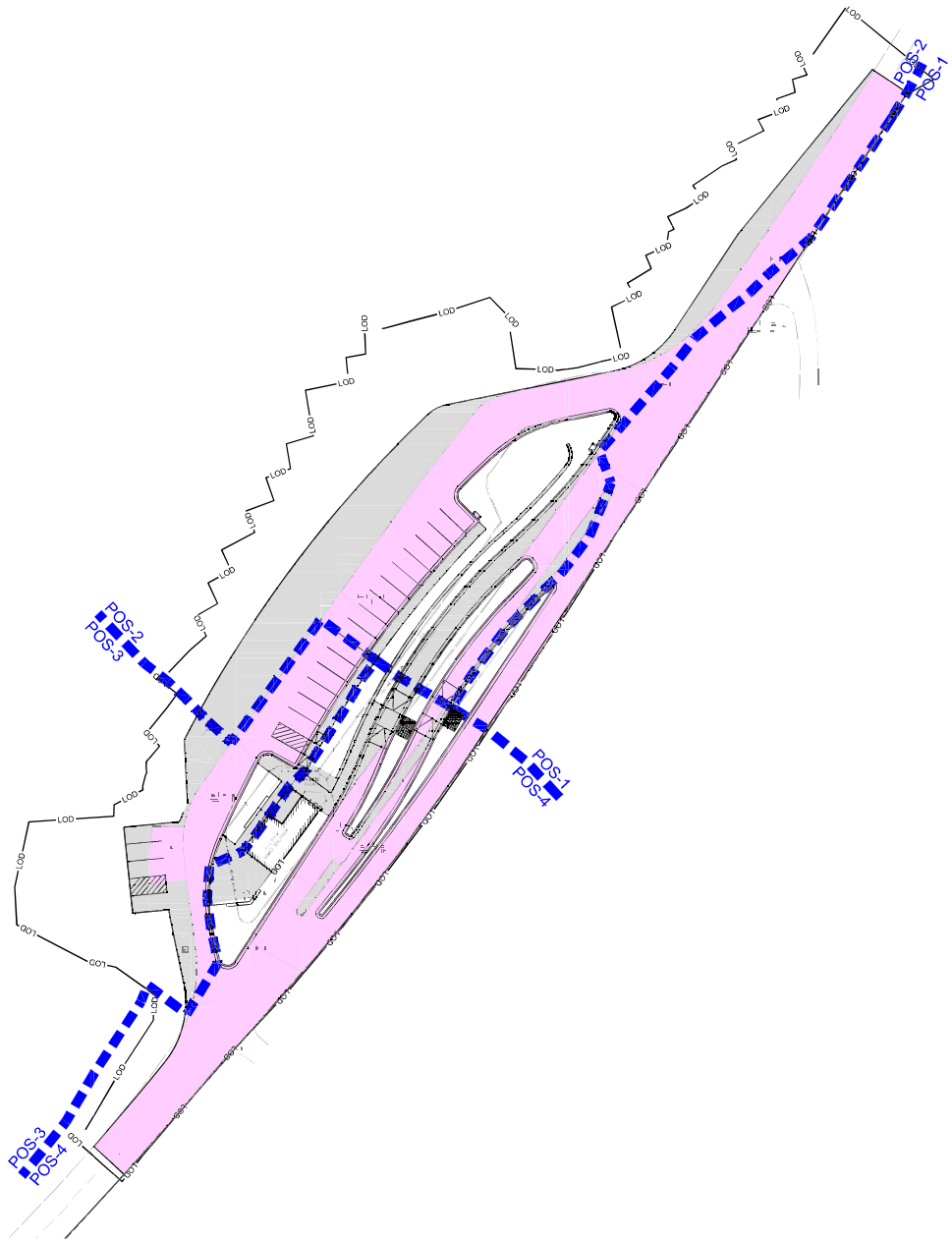
CAD DWG FILE:
DRAWN BY: AMT
CHECKED BY: AMT

PROJECT NUMBER: 2015.00
DATE: 30 October 2020

MDE
CLASSIFICATION
MAP

MDE-1

MDE IMPERVIOUS AREA SUMMARY



POS-1 PROPOSED IMPERVIOUS AREA SUMMARY

	A	PROPOSED IMPERVIOUS AREA	0 SF	0.000 AC
	B	WAIVER REQUESTED IMPERVIOUS AREA	4,873 SF	0.112 AC

POS-2 PROPOSED IMPERVIOUS AREA SUMMARY

	A	PROPOSED IMPERVIOUS AREA	9,370 SF	0.215 AC
	B	WAIVER REQUESTED IMPERVIOUS AREA	10,546 SF	0.242 AC

POS-3 PROPOSED IMPERVIOUS AREA SUMMARY

	A	PROPOSED IMPERVIOUS AREA	2,727 SF	0.063 AC
	B	WAIVER REQUESTED IMPERVIOUS AREA	4,879 SF	0.112 AC

POS-4 PROPOSED IMPERVIOUS AREA SUMMARY

	A	PROPOSED IMPERVIOUS AREA	2,586 SF	0.059 AC
	B	WAIVER REQUESTED IMPERVIOUS AREA	8,417 SF	0.193 AC

LEGEND

PROPOSED POS DRAINAGE DIVIDE

MDE # 21-SF-0104

DGS No. P-482-200-002 | MDE (SWM + ESD) No. 21-SF-2104

0 30' 60'
SCALE: 1"=30'

ZIGER | SNEAD ARCHITECTS
1006 Morton Street
Baltimore, Maryland 21201
410.576.9131
zigersnead.com

STRUCTURAL ENGINEER
Albrecht Engineering
3500 Boston Street
Suite 329, MS-12
Baltimore, MD 21224
410-522-5870

LANDSCPE ARCHITECT
Fluora Teefer Landscape Architects
800 N. Charles St
Suite 300
Baltimore, MD 21201
410-528-8305

MECHANICAL ENGINEER
James Posey Associates
11155 Red Run Blvd.
Suite 310
Baltimore, MD 21117
410-266-6100

GEOTECHNICAL ENGINEER
Schnabel Engineering
9800 Jeb Stuart Pkwy
Suite 200
Glen Allen, VA 23059
804-264-3222

CIVIL ENGINEER
AMT Engineering, Inc.
800 King Farm Blvd
4th Floor
Rockville, MD 20850
301-881-2545

COST ESTIMATOR
Fonella Group, LLC
5180 Parkstone Dr.
Suite 250
Chantilly, VA 20151
703-560-2200

Professional Certification.
I certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, license number 32151, expiration date 7/18/2021.

GREENBRIER STATE PARK
CHARGE STATION

STATE OF MARYLAND - DEPARTMENT OF GENERAL SERVICES

301 WEST PRESTON STREET
BALTIMORE, MD 21201

USING AGENCY APPROVAL

NAME: DATE:

DGS APPROVAL

TITLE:

PROJECT MANAGER: DATE:

ASST. SECRETARY OF FPD&C: DATE:

NO.	REVISION TITLE	DATE
	Design Development	30 October 2020

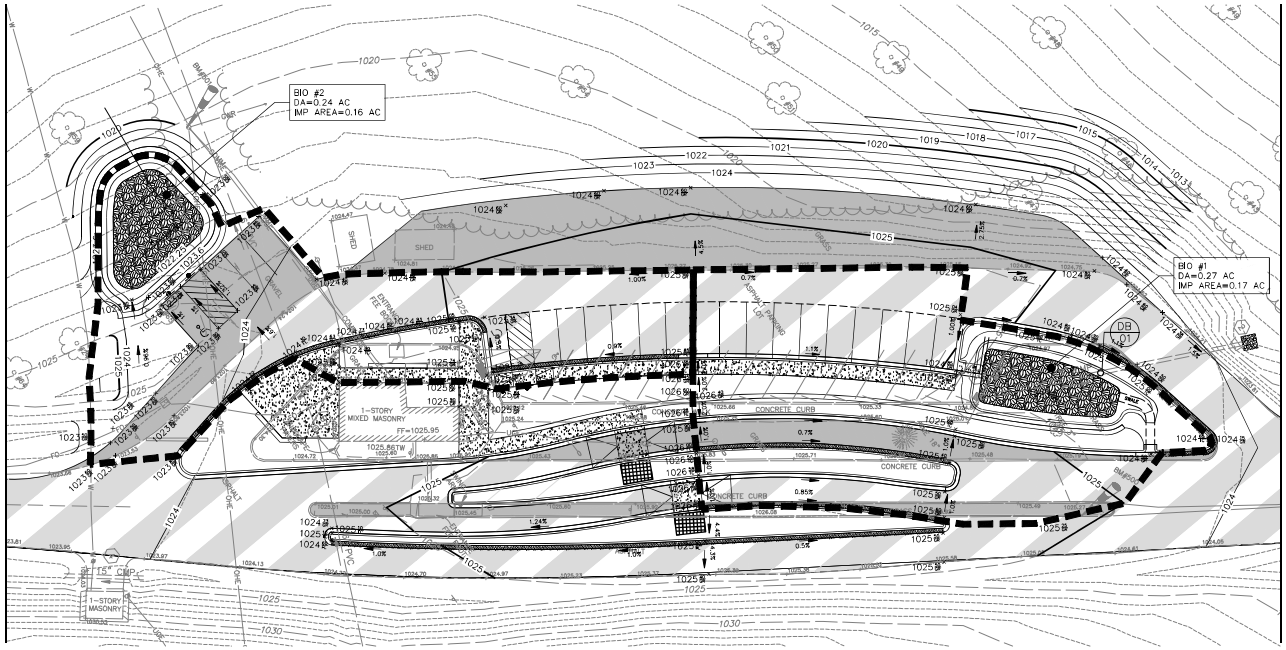
CAD DWG FILE:
DRAWN BY: AMT
CHECKED BY: AMT

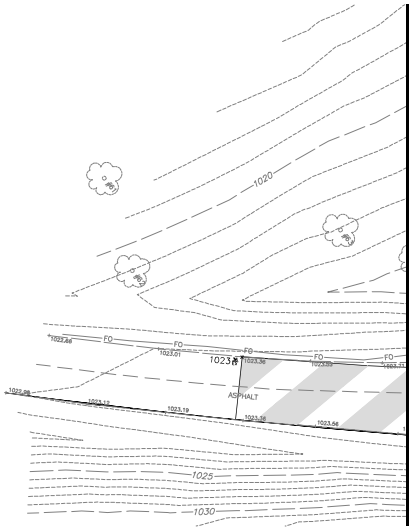
PROJECT NUMBER: 2015.00
DATE: 30 October 2020

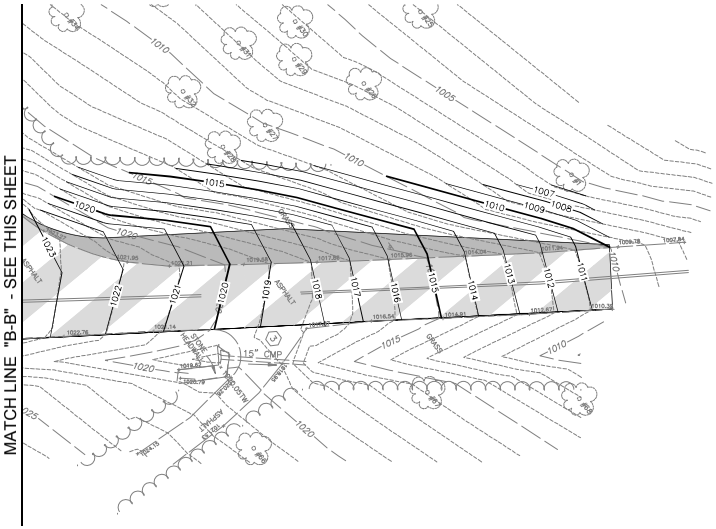
MDE
IMPERVIOUS
AREA SUMMARY

MDE-2

ESD DRAINAGE AREA MAP







MD STATE PLANE NAD 83

SCALE: 1"=20'

MDE # 21-SF-0104

DGS No. P-052-200-002 | MDE (SWM + E&S) No. 21-SF-0104

ZIGER | SNEAD ARCHITECTS
1006 Morton Street
Baltimore, Maryland 21201
410.576.9131
zigersnead.com

STRUCTURAL ENGINEER
Albrecht Engineering
3500 Boston Street
Suite 329, MS-12
Baltimore, MD 21224
410-522-5870

LANDSCPE ARCHITECT
Fluora Teeter Landscape Architects
800 N. Charles St
Suite 300
Baltimore, MD 21201
410-528-8305

MECHANICAL ENGINEER
James Posey Associates
11155 Red Run Blvd.
Suite 310
Baltimore, MD 21117
410-266-6100

GEOTECHNICAL ENGINEER
Schnabel Engineering
9800 Jeb Stuart Pkwy
Suite 200
Glen Allen, VA 23059
804-264-3222

CIVIL ENGINEER
AMT Engineering, Inc.
800 King Farm Blvd
4th Floor
Rockville, MD 20850
301-881-2545

COST ESTIMATOR
Fonella Group, LLC
5180 Parkstone Dr.
Suite 250
Chantilly, VA 20151
703-560-2200

Professional Certification.
I certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, license number 32151, expiration date 7/18/2021.

GREENBRIER STATE PARK CHARGE STATION

STATE OF MARYLAND - DEPARTMENT OF GENERAL SERVICES
301 WEST PRESTON STREET
BALTIMORE, MD 21201

USING AGENCY APPROVAL

NAME: DATE:

DGS APPROVAL

TITLE:

PROJECT MANAGER: DATE:

ASST. SECRETARY OF FPD&C: DATE:

NO.	REVISION TITLE	DATE
	Design Development	30 October 2020

CAD DWG FILE: CW101 - P052200002.DWG
DRAWN BY: AMT
CHECKED BY: AMT

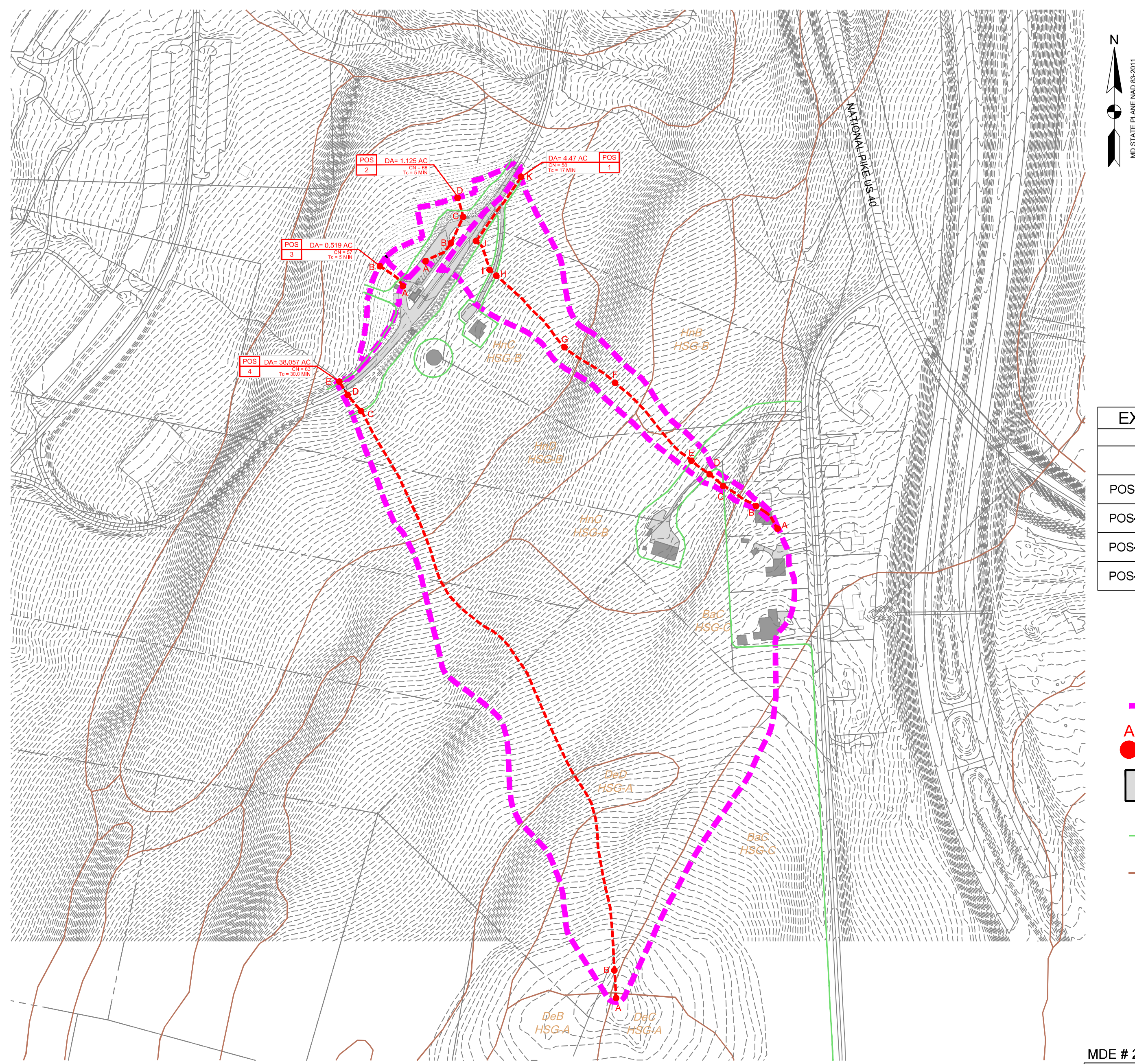
PROJECT NUMBER: 2015.00
DATE: 30 October 2020

STORMWATER MANAGEMENT PLAN

CW.101

X:\ROCKVILLE\20-0424.001 - GREENBRIER STATE PARK GATE HOUSE\05-CAD\CW101 - P052200002.DWG, 2/24/2021 1:55 PM, MTAYLOR

EXISTING CONDITIONS DRAINAGE AREA MAP



MDE # 21-SF-0104

DGS No. P-052-200-002 | MDE (SWM + E&S) No. 21-SF-0104

SCALE: 1"=150'

EXISTING H/H SUMMARY TABLE

	DA	Tc	CN	Q1	Q2	Q10	Q100
	acres	min.		CFS	CFS	CFS	CFS
POS-1	4.47	17.0	58	0.13	0.44	2.61	9.13
POS-2	1.13	5.0	66	0.37	0.74	2.01	4.96
POS-3	0.52	5.0	57	0.02	0.07	0.48	1.59
POS-4	38.06	36.0	63	2.86	6.73	23.23	66.38

LEGEND

DRAINAGE DIVIDE

A — B TIME OF CONCENTRATION

IMPERVIOUS AREA

EXISTING TREE LINE

HnD HSG-B SOIL TYPE AND BOUNDARY

ZIGER | SNEAD ARCHITECTS

1006 Morton Street
Baltimore, Maryland 21201
410.576.9131
zigersnead.com

STRUCTURAL ENGINEER
Albrecht Engineering
3500 Boston Street
Suite 329, MS-12
Baltimore, MD 21224
410-522-5870

LANDSCPE ARCHITECT
Fluora Teeter Landscape Architects
800 N. Charles St
Suite 300
Baltimore, MD 21201
410-528-8395

MECHANICAL ENGINEER
James Posey Associates
11155 Red Run Blvd,
Suite 310
Baltimore, MD 21117
410-265-6100

GEOTECHNICAL ENGINEER
Schnabel Engineering
9800 Jeb Stuart Pkwy
Suite 200
Glen Allen, VA 23059
804-264-3222

CIVIL ENGINEER
AMT Engineering, Inc.
800 King Farm Blvd
4th Floor
Rockville, MD 20850
301-881-2545

COST ESTIMATOR
Forella Group, LLC
5180 Parkstone Dr.
Suite 250
Chantilly, VA 20151
703-560-2200

Professional Certification:
I certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, license number 32151, expiration date 7/18/2021.

GREENBRIER STATE PARK CHARGE STATION

STATE OF MARYLAND - DEPARTMENT OF GENERAL SERVICES
301 WEST PRESTON STREET
BALTIMORE, MD 21201

USING AGENCY APPROVAL

NAME: DATE:

DGS APPROVAL

TITLE:

PROJECT MANAGER: DATE:

ASST. SECRETARY OF FPD&C: DATE:

NO.	REVISION TITLE	DATE
	Design Development	30 October 2020

CAD DWG FILE:

DRAWN BY: AMT

CHECKED BY: AMT

PROJECT NUMBER: 2015.00

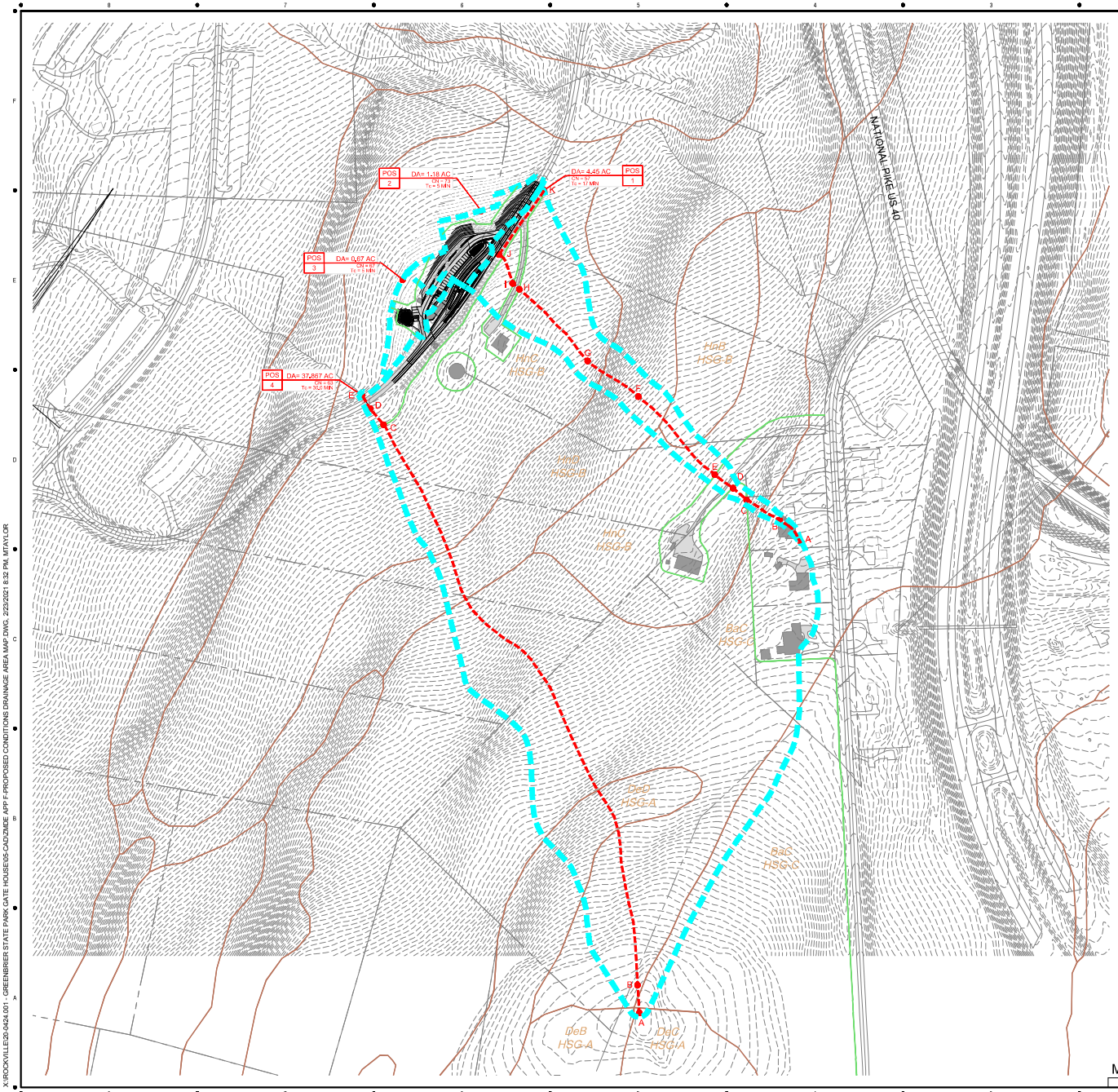
DATE: 30 October 2020

EXISTING CONDITIONS DRAINAGE AREA MAP

EX DAM

X:\ROCKVILLE\20-0424.001 - GREENBRIER STATE PARK GATE HOUSE\05-CAD\ZMDE APP E-EXISTING CONDITIONS DRAINAGE AREA MAP.DWG, 2/23/2021 8:34 PM, MTAYLOR

PROPOSED CONDITIONS DRAINAGE AREA MAP



N

MD STATE PLANE NAD 83-2011

PROPOSED H/H SUMMARY TABLE

	DA	Tc	CN	Q1	Q2	Q10	Q100
	acres	min.		CFS	CFS	CFS	CFS
POS-1	4.45	17.0	58	0.13	0.44	2.60	9.10
POS-2	1.18	5.0	74	0.88	1.39	2.99	6.40
POS-3	0.67	5.0	68	0.26	0.49	1.26	3.05
POS-4	37.87	36.0	63	2.84	6.70	23.11	66.05

LEGEND

- DRAINAGE DIVIDE
- A — B TIME OF CONCENTRATION
- IMPERVIOUS AREA
- EXISTING TREE LINE
- SOIL TYPE AND BOUNDARY (HnD HSG-B)

MDE # 21-SF-0104

DGS No. P-982-000-002 | MDE (SWM + E&S) No. 21-SF-0104

0 150' 300'

SCALE: 1"=150'

ZIGER | SNEAD ARCHITECTS

1006 Morton Street
Baltimore, Maryland 21201
410.576.9131
zigersnead.com

STRUCTURAL ENGINEER
Albrecht Engineering
3500 Boston Street
Suite 329, MS-12
Baltimore, MD 21224
410-522-5870

LANDSCPE ARCHITECT
Fluora Teeter Landscape Architects
800 N. Charles St
Suite 300
Baltimore, MD 21201
410-528-8305

MECHANICAL ENGINEER
James Posey Associates
11155 Red Run Blvd.
Suite 310
Baltimore, MD 21117
410-266-6100

GEOTECHNICAL ENGINEER
Schnabel Engineering
9800 Jeb Stuart Pkwy
Suite 200
Glen Allen, VA 23059
804-264-3222

CIVIL ENGINEER
AMT Engineering, Inc.
800 King Farm Blvd
4th Floor
Rockville, MD 20850
301-881-2545

COST ESTIMATOR
Fonella Group, LLC
5180 Parkstone Dr.
Suite 250
Chantilly, VA 20151
703-560-2200

Professional Certification.
I certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, license number 32151, expiration date 7/18/2021.

GREENBRIER STATE PARK
CHARGE STATION

STATE OF MARYLAND - DEPARTMENT OF GENERAL SERVICES

301 WEST PRESTON STREET
BALTIMORE, MD 21201

USING AGENCY APPROVAL
NAME: DATE:

DGS APPROVAL
TITLE:
PROJECT MANAGER: DATE:
ASST. SECRETARY OF FPD&C: DATE:

NO.	REVISION TITLE	DATE
	Design Development	30 October 2020

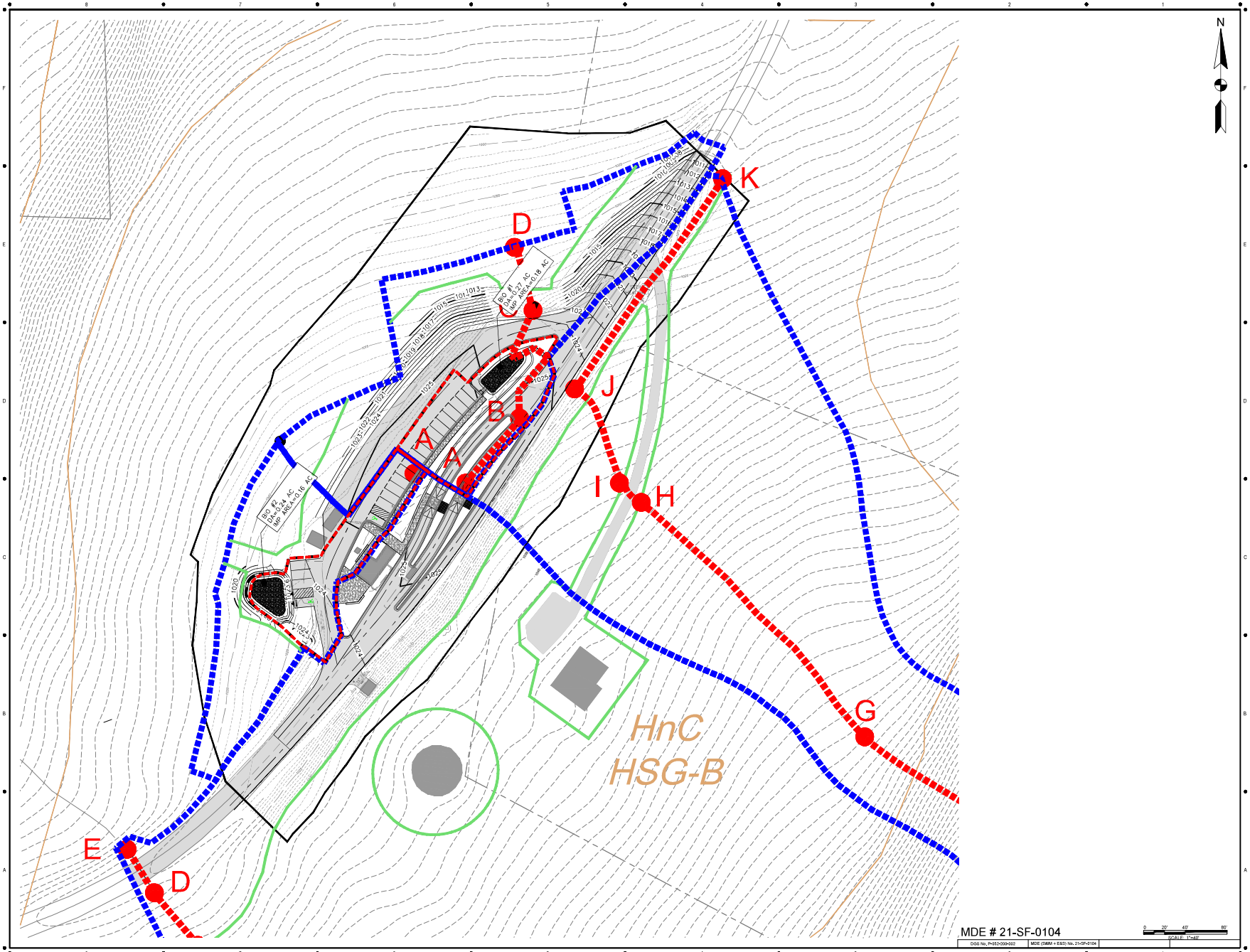
CAD DWG FILE:
DRAWN BY: AMT
CHECKED BY: AMT

PROJECT NUMBER: 2015.00
DATE: 30 October 2020

PROPOSED
CONDITIONS
DRAINAGE
AREA MAP

PR DAM

X:\ROCKVILLE\20-0424.001 - GREENBRIER STATE PARK GATE HOUSE\DS-CAD\2MDE APP F-PROPOSED CONDITIONS DRAINAGE AREA MAP.DWG, 2/23/2021 8:32 PM, MTAYLOR



ZIGER | SNEAD ARCHITECTS

1006 Morton Street
Baltimore, Maryland 21201
410.576.9131
zigersnead.com

STRUCTURAL ENGINEER
Albrecht Engineering
3500 Boston Street
Suite 329, MS-12
Baltimore, MD 21224
410-522-5870

LANDSCPE ARCHITECT
Fluora Teefer Landscape Architects
800 N. Charles St
Suite 300
Baltimore, MD 21201
410-528-8305

MECHANICAL ENGINEER
James Posey Associates
11155 Red Run Blvd.
Suite 310
Baltimore, MD 21117
410-266-6100

GEOTECHNICAL ENGINEER
Schnabel Engineering
9800 Jeb Stuart Pkwy
Suite 200
Glen Allen, VA 23059
804-264-3222

CIVIL ENGINEER
AMT Engineering, Inc.
800 King Farm Blvd
4th Floor
Rockville, MD 20850
301-881-2545

COST ESTIMATOR
Fanella Group, LLC
5180 Parkstone Dr.
Suite 250
Chantilly, VA 20151
703-560-2200

Professional Certification.
I certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, license number 32151, expiration date 7/18/2021.

GREENBRIER STATE PARK
CHARGE STATION

STATE OF MARYLAND - DEPARTMENT OF GENERAL SERVICES

301 WEST PRESTON STREET
BALTIMORE, MD 21201

USING AGENCY APPROVAL

NAME: DATE:

DGS APPROVAL

TITLE:

PROJECT MANAGER: DATE:

ASST. SECRETARY OF FPD&C: DATE:

NO.	REVISION TITLE	DATE
	Design Development	30 October 2020

CAD DWG FILE:
DRAWN BY: AMT
CHECKED BY: AMT

PROJECT NUMBER: 2015.00
DATE: 30 October 2020

PROPOSED
CONDITIONS WITH SWM
DRAINAGE AREA MAP

PR DAM W/SWM

DGS No. P-B82-000-002 | MDE (SWM + E&S) No. 21-SF-0104

X:\ROCKVILLE\20-0424.001 - GREENBRIER STATE PARK GATE HOUSE\DS-CAD\DMDE APP F-PROPOSED CONDITIONS WITH SWM DRAINAGE AREA MAP.DWG, 2/24/2021 8:36 AM, MTAYLOR

NRCS WEB SOIL SURVEY

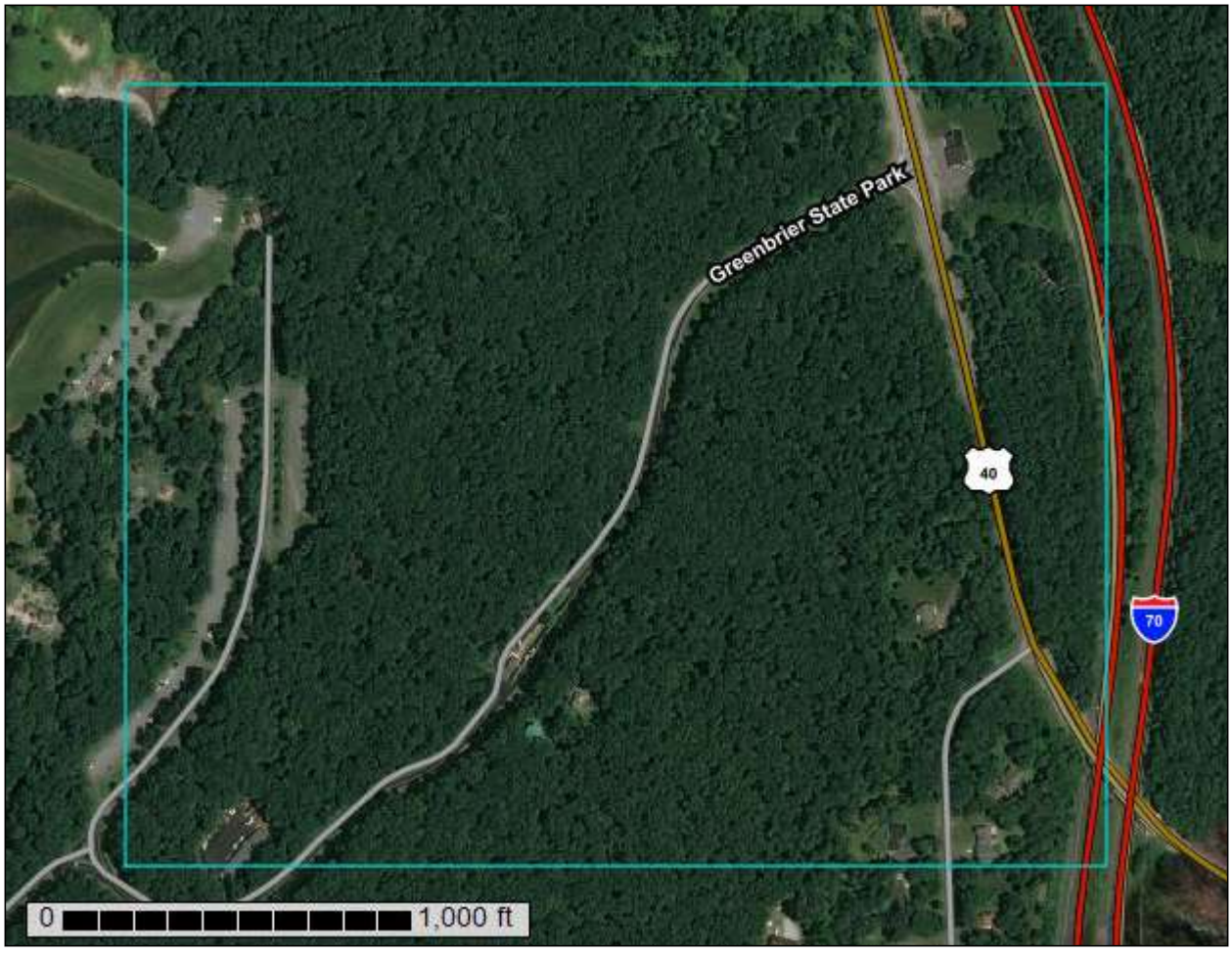
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Washington County, Maryland



July 20, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

77° 37' 7" W 275000 275100 275200 275300 275400 275500 275600 275700 275800 275900 276000 276100 276200 77° 36' 14" W

39° 32' 34" N 4380300 4380200 4380100 4380000 4379900 4379800 4379700 4379600 4379500 39° 32' 8" N

Map Scale: 1:5,770 if printed on A landscape (11" x 8.5") sheet.

N

Meters 0 50 100 200 300

Feet 0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Maryland
Survey Area Data: Version 20, Jun 11, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 28, 2019—Sep 15, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AmB	Airmont cobbly loam, 3 to 8 percent slopes, extremely stony	0.3	0.2%
AmD	Airmont cobbly loam, 8 to 25 percent slopes, extremely stony	17.8	12.3%
BaC	Bagtown cobbly loam, 8 to 15 percent slopes, extremely stony	20.0	13.8%
HnB	Hazel channery silt loam, 3 to 8 percent slopes	6.8	4.7%
HnC	Hazel channery silt loam, 8 to 15 percent slopes	80.3	55.5%
HnD	Hazel channery silt loam, 15 t0 25 percent slopes	13.8	9.5%
HrE	Hazel-Rock outcrop complex, 25 to 45 percent slopes	5.7	4.0%
W	Water	0.1	0.1%
Totals for Area of Interest		**144.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the

scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Washington County, Maryland

AmB—Airmont cobbly loam, 3 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: kxsx
Elevation: 400 to 2,000 feet
Mean annual precipitation: 33 to 46 inches
Mean annual air temperature: 40 to 64 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Airmont and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Airmont

Setting

Landform: Drainageways
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Loamy colluvium derived from quartzite

Typical profile

H1 - 0 to 1 inches: cobbly loam
H2 - 1 to 12 inches: loam
H3 - 12 to 29 inches: sandy clay loam
H4 - 29 to 70 inches: cobbly loam

Properties and qualities

Slope: 3 to 8 percent
Percent of area covered with surface fragments: 1.0 percent
Depth to restrictive feature: 14 to 30 inches to fragipan
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 10 to 20 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Other vegetative classification: Very Rocky, Acid Soils (RA2)
Hydric soil rating: No

Minor Components

Thurmont
Percent of map unit: 5 percent
Hydric soil rating: No

Deposit
Percent of map unit: 5 percent
Hydric soil rating: No

Weverton
Percent of map unit: 4 percent
Hydric soil rating: No

Unnamed soils
Percent of map unit: 1 percent
Landform: Drainageways
Hydric soil rating: Yes

AmD—Airmont cobbly loam, 8 to 25 percent slopes, extremely stony

Map Unit Setting
National map unit symbol: kxsy
Elevation: 400 to 2,000 feet
Mean annual precipitation: 33 to 46 inches
Mean annual air temperature: 40 to 64 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition
Airmont and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Airmont

Setting
Landform: Drainageways
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Loamy colluvium derived from quartzite

Typical profile
H1 - 0 to 1 inches: cobbly loam
H2 - 1 to 12 inches: loam
H3 - 12 to 29 inches: sandy clay loam
H4 - 29 to 70 inches: very cobbly loam

Properties and qualities

Slope: 8 to 25 percent
Percent of area covered with surface fragments: 14.5 percent
Depth to restrictive feature: 14 to 30 inches to fragipan
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 10 to 20 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Other vegetative classification: Very Rocky, Acid Soils (RA2)
Hydric soil rating: No

Minor Components

Thurmont

Percent of map unit: 5 percent
Hydric soil rating: No

Deposit

Percent of map unit: 5 percent
Hydric soil rating: No

Weverton

Percent of map unit: 4 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 1 percent
Landform: Drainageways
Hydric soil rating: Yes

BaC—Bagtown cobbly loam, 8 to 15 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: kxt5
Elevation: 500 to 3,500 feet
Mean annual precipitation: 25 to 55 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 115 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Bagtown and similar soils: 85 percent

Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bagtown

Setting
Parent material: Loamy colluvium derived from quartzite and/or sandstone

Typical profile
H1 - 0 to 8 inches: extremely stony loam

Properties and qualities
Slope: 8 to 15 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 72 inches to lithic bedrock
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 42 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.3 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Weverton
Percent of map unit: 5 percent
Hydric soil rating: No

Thurmont
Percent of map unit: 5 percent
Hydric soil rating: No

Braddock
Percent of map unit: 4 percent
Hydric soil rating: No

Unnamed soils
Percent of map unit: 1 percent
Landform: Drainageways
Hydric soil rating: Yes

HnB—Hazel channery silt loam, 3 to 8 percent slopes

Map Unit Setting
National map unit symbol: ky39

Elevation: 400 to 3,500 feet
Mean annual precipitation: 25 to 55 inches
Mean annual air temperature: 50 to 59 degrees F
Frost-free period: 115 to 220 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hazel and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hazel

Setting

Parent material: Loamy residuum weathered from phyllite

Typical profile

H1 - 0 to 10 inches: channery silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Thurmont

Percent of map unit: 5 percent
Hydric soil rating: No

Braddock

Percent of map unit: 5 percent
Hydric soil rating: No

Trego

Percent of map unit: 5 percent
Hydric soil rating: No

HnC—Hazel channery silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: ky3c
Elevation: 400 to 2,000 feet
Mean annual precipitation: 35 to 50 inches
Mean annual air temperature: 50 to 59 degrees F
Frost-free period: 140 to 220 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hazel and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hazel

Setting

Parent material: Loamy residuum weathered from phyllite

Typical profile

H1 - 0 to 10 inches: channery silt loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Trego

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils, shallow

Percent of map unit: 5 percent
Hydric soil rating: No

Thurmont

Percent of map unit: 5 percent
Hydric soil rating: No

HnD—Hazel channery silt loam, 15 t0 25 percent slopes

Map Unit Setting

National map unit symbol: ky3g
Elevation: 400 to 2,000 feet
Mean annual precipitation: 35 to 50 inches
Mean annual air temperature: 50 to 59 degrees F
Frost-free period: 140 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Hazel and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hazel

Setting

Parent material: Loamy residuum weathered from phyllite

Typical profile

H1 - 0 to 2 inches: channery silt loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 0.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Unnamed soils, shallow

Percent of map unit: 5 percent
Hydric soil rating: No

Trego

Percent of map unit: 5 percent
Hydric soil rating: No

Thurmont

Percent of map unit: 5 percent
Hydric soil rating: No

HrE—Hazel-Rock outcrop complex, 25 to 45 percent slopes

Map Unit Setting

National map unit symbol: ky3z
Elevation: 500 to 4,000 feet
Mean annual precipitation: 8 to 45 inches
Mean annual air temperature: 45 to 59 degrees F
Frost-free period: 110 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Hazel and similar soils: 45 percent
Rock outcrop: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hazel

Setting

Parent material: Loamy residuum weathered from phyllite

Typical profile

H1 - 0 to 2 inches: channery silt loam

Properties and qualities

Slope: 25 to 45 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 0.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

H1 - 0 to 60 inches: unweathered bedrock

Properties and qualities

Slope: 25 to 45 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 5.95 in/hr)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Weverton

Percent of map unit: 5 percent
Hydric soil rating: No

Airmont

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils shallow

Percent of map unit: 5 percent
Hydric soil rating: No

W—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

MDE SWM CALCULATOR

MDE Sediment & Stormwater Plan Review for State & Federal Projects

SWM CALCULATOR

Project Description:	Greenbrier State Park Charge Station	Job #	20-0424
Point of Investigation #:	POS-1	Contract #	P-052-200-020
MDE Tracking No.:	21-SF-0104	Date:	2/19/2021
		Designed by:	AMT
		Reviewed by:	AMT

Determine Development Classification for the Reconstruction Activities: Version 2 - Oct 2018

County:		WASHINGTON		
SWM Study Area:	A_s	1.63	acres	
Existing Impervious Surface Area:	A_{EXi}	0.86	acres	
Percent Existing Imperviousness (Report to WQSS Col. D):	%I	52.8%	>40%	= (0.86 / 1.63) x 100
Development Classification for Reconstruction:		**Redevelopment**		

MDE Sediment & Stormwater Plan Review for State & Federal Projects

SWM Calculator

Project Description: Greenbrier State Park Charge Station
Point of Investigation #: POS-1
MDE Tracking No.: 21-SF-0104

Job # 20-0424
Contract # P-052-200-020
Date: 2/19/2021
Designed by: AMT
Reviewed by: AMT

Redevelopment POI

STEP 1 - Site / Drainage Area Data

Existing Condition Drainage Area:	A_E	4.47	acres
Proposed Condition Drainage Area:	A_P	4.45	acres
Existing Impervious (Imp.) Area within LOD:	A_{EI}	0.16	acres >>>> Report to WQSS **Col. B**
Proposed Imp. Area within LOD:	A_{PI}	0.11	acres >>>> Report to WQSS **Col. C**
Area for which WQ is Not Req'd (i.e. 3.3.A Waiver):	A_{MI}	0.11	acres >>>> Report to WQSS **Col. E**
Loss of Existing Water Quality (Area):	A_{LI}	0.00	acres >>>> Report to WQSS **Col. F**
Loss of Existing ESD_v/WQ_v (Volume):	$ESD_{V\ Loss}$	0.0	cubic feet
Loss of Existing Recharge (Volume):	$Re_{v\ Loss}$	0.0	cubic feet
Reconstructed Imp. Area Already Treated (Area):	A_{RECi}	0.00	acres >>>> Report to WQSS **Col. G**
Existing Imp. Area outside of LOD Shifted in/out of POI:	A_{SHIFT}	0.00	acres
Will POI qualify for a Cp_V Waiver under Section 3.3.B of the Guidelines?	Cp_{VW}	No	

STEP 2 - Determine the Impervious Area Requiring Treatment (IART):

IART from Redevelopment:
For Re-dev'l Classification, **$IART_{RE\text{-}DEV'L}$ = 50% of (A_{EI} - A_{MI} - A_{RECi})**
For New Dev'l Classification, **$IART_{RE\text{-}DEV'L}$** = 0

$IART_{RE\text{-}DEV'L}$ = **0.03** acres >>>> Report to ESD Summary Sheet **Col. 1**
>>>> Should match WQSS **Col. I**

IART from New Development:
For Re-dev'l Classification, **$IART_{NEW} = \Delta Ai = A_{PI} - A_{EI}$**
For New Dev'l Classification, **$IART_{NEW} = A_{PI} - A_{MI} - A_{RECi}$**

$IART_{NEW}$ = **-0.05** acres >>>> Report to ESD Summary Sheet **Col. 2**
>>>> Should match WQSS **Col. J**

Total IART:
$IART = IART_{RE\text{-}DEV'L} + IART_{NEW} + A_{LI}$

IART = **-0.02** acres

STEP 3 - Determine the Required Environmental Site Design Volume for Treating Redevelopment ($ESD_{V\ RE\text{-}DEV'L}$):

$ESD_{V\ RE\text{-}DEV'L}$ = $P_E \times R_V \times IART_{RE\text{-}DEV'L} \times 3630^{\dagger}$, Where:

† conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 1.00 in.

R_V = 0.95, $R_V = 0.05 + (0.009)(I)$; where: I = 100 %,

$IART_{RE\text{-}DEV'L}$ = 0.03 acres

$ESD_{V\ RE\text{-}DEV'L}$: **103** cubic feet >>> Report to ESD Summary Sheet **Col. 3**

STEP 4 - Determine the Environmental Site Design Volume Reduction from Decreasing Impervious Area ($ESD_{V\ reducedAi}$): (for Redevelopment Classification when ΔAi<0)

1. Determine $ESD_{V\ reducedAi}$ Applied to Project:

$ESD_{V\ reducedAi}$ = P_E x R_V x $IART_{NEW}$ x 3630†, where: † conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 1.00 in.

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

$IART_{NEW}$ = _____

$ESD_{V\ reducedAi}$: -172 cubic feet»»»Report to ESD Summary Sheet **Col. 4a**

2. Determine $ESD_{V\ reducedAi}$ Applied to POI:

$ESD_{V\ reducedAi}$ = P_E x R_V x $IART_{NEW}$ x 3630†, where: † conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 2.60 in.* *2.6 inches is being used regardless of soil type.

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

$IART_{NEW}$ = -0.05 acres

$ESD_{V\ reducedAi}$: -448 cubic feet»»»Report to ESD Summary Sheet **Col. 4b**

STEP 5 - Determine the Required Environmental Site Design Volume for Treating New Development ($ESD_{V\ NEW}$) for POI:

~~**1. Determine $ESD_{V\ NEW}$ for 3.3.B Waiver:**~~

~~$ESD_{V\ NEW}$ = P_E x R_V x $IART_{NEW}$ x 3630†, where:~~ ~~† conversion factor (43,560sf/ac)/(12 in/ft)~~

~~P_E = 1.00 in.~~

~~R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,~~

~~$IART_{NEW}$ = 0.00 acres~~

$ESD_{V\ NEW}$: 0 cubic feet»»» Report to ESD Summary Sheet **Col. 5a**

~~**2. Determine Weighted P_E:**~~

~~HSG~~	~~% Imperv. (I)~~	~~$IART_{NEW}$~~	~~P_E in~~	~~P_E x $IART_{NEW}$~~
~~A~~	~~100.0%~~		~~2.6~~	
~~B~~	~~100.0%~~		~~2.6~~	
~~C~~	~~100.0%~~		~~2.2~~	
~~D~~	~~100.0%~~		~~2.0~~	
~~Total~~				~~0.000~~

~~**3. Determine $ESD_{V\ NEW}$ when there is No Waiver or No Impervious Reduction (i.e. ΔAi >=0):**~~

~~$ESD_{V\ NEW}$ = Weighted P_E x R_V x $IART_{NEW}$ x 3630†, where:~~ ~~† conversion factor (43,560sf/ac)/(12 in/ft)~~

~~Weighted P_E = $\sum(P_E \times IART_{NEW})/\sum IART_{NEW}$~~

~~Weighted P_E = 0.00 in.~~

~~R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,~~

~~$IART_{NEW}$ = 0.00 acres~~

$ESD_{V\ NEW}$: 0 cubic feet»»» Report to ESD Summary Sheet **Col. 5b**

STEP 6 - Determine the Required Environmental Site Design Volume for the Shifted Impervious Area ($ESD_{V\ SHIFT}$) in/out of POI:

Determine $ESD_{V\ SHIFT}$:

$ESD_{V\ SHIFT}$ = P_E x R_V x A_{SHIFT} x 3630†, where:

† conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 2.60 in.*

*2.6 inches is being used regardless of soil type.

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

A_{SHIFT} = 0 acres

$ESD_{V\ SHIFT}$: 0 cubic feet»» Report to ESD Summary Sheet **Col. 6**

STEP 7 - Determine the Required Environmental Site Design Volume from Loss of Existing SWM ($ESD_{V\ Loss}$):

$ESD_{V\ Loss}$: 0 cubic feet»» Report to ESD Summary Sheet **Col. 7**

STEP 8 - Determine the Required Environmental Site Design Volume for the POI ($ESD_{V\ POI}$):

$ESD_{V\ POI}$:

$ESD_{V\ reducedAi}$ (Step 4.2) + $ESD_{V\ NEW}$ (Step 5.3) + $ESD_{V\ SHIFT}$ (Step 6) + $ESD_{V\ Loss}$ (Step 7) = -448 cubic feet»» Report to ESD Summary Sheet **Col. 8**

If (A_P -A_E) > 0, provide separate calculations demonstrating that the Proposed Condition 1-Year Discharge Rate (Q1P) <= the Existing Condition 1-Year Discharge Rate (Q1E).

STEP 9 - Determine the Required Recharge Volume (Re_V):

~~1. Determine Weighted Soil Specific Recharge Factor (S):~~

~~HSG~~	~~S in~~	~~A_{NEW} ac~~	~~S * A_{NEW}~~
~~A~~	~~0.38~~		
~~B~~	~~0.26~~		
~~C~~	~~0.13~~		
~~D~~	~~0.07~~		
~~Total~~		~~0.00~~	~~0.0000~~

~~2. Determine the Required Recharge Volume ($Re_{V\ NEW}$) for New Development:~~

~~$Re_{V\ NEW}$ = Weighted S x R_v x A_{NEW} x 3630†, where:~~

~~† conversion factor (43,560sf/ac)/(12 in/ft)~~

~~Weighted S = $\sum(S \times A_{NEW})/\sum A_{NEW}$~~

~~Weighted S = 0.00 in~~ ###

~~R_v = 0.95, R_v = 0.05 + (0.009)(I); where: I = 100 %,~~

~~A_{NEW} = IART$_{NEW,}$ if IART$_{NEW}$ > 0; otherwise 0.00 acres~~

~~A_{NEW} = 0.00 acres~~

$Re_{V\ NEW}$: 0 cubic feet

~~3. Determine Loss of Existing Recharge Volume ($Re_{V\ Loss}$):~~

$Re_{V\ Loss}$: 0 cubic feet

4. Determine Total Recharge Volume (Re_v):

$Re_{V\ NEW}$ + $Re_{V\ Loss}$ = Re_v: 0 cubic feet»» Report to ESD Summary Sheet **Col. 10**

STEP 10 - Designer's Notes:

MDE Sediment & Stormwater Plan Review for State & Federal Projects

SWM CALCULATOR

Project Description:	Greenbrier State Park Charge Station	Job #	20-0424
Point of Investigation #:	POS-2	Contract #	P-052-200-020
MDE Tracking No.:	21-SF-0104	Date:	2/19/2021
		Designed by:	AMT
		Reviewed by:	AMT

Determine Development Classification for the Reconstruction Activities: Version 2 - Oct 2018

County:		WASHINGTON		
SWM Study Area:	A_s	1.63	acres	
Existing Impervious Surface Area:	A_{EXi}	0.86	acres	
Percent Existing Imperviousness (Report to WQSS Col. D):	%I	52.8%	>40%	= (0.86 / 1.63) x 100
Development Classification for Reconstruction:		**Redevelopment**		

MDE Sediment & Stormwater Plan Review for State & Federal Projects

SWM Calculator

Project Description: Greenbrier State Park Charge Station
Point of Investigation #: POS-2
MDE Tracking No.: 21-SF-0104

Job # 20-0424
Contract # P-052-200-020
Date: 2/19/2021
Designed by: AMT
Reviewed by: AMT

Redevelopment POI

STEP 1 - Site / Drainage Area Data

Existing Condition Drainage Area:	A_E	1.13	acres
Proposed Condition Drainage Area:	A_P	1.18	acres
Existing Impervious (Imp.) Area within LOD:	A_{EI}	0.27	acres >>>> Report to WQSS **Col. B**
Proposed Imp. Area within LOD:	A_{PI}	0.46	acres >>>> Report to WQSS **Col. C**
Area for which WQ is Not Req'd (i.e. 3.3.A Waiver):	A_{MI}	0.24	acres >>>> Report to WQSS **Col. E**
Loss of Existing Water Quality (Area):	A_{LI}	0.00	acres >>>> Report to WQSS **Col. F**
Loss of Existing ESD_v/WQ_v (Volume):	$ESD_{V\ Loss}$	0.0	cubic feet
Loss of Existing Recharge (Volume):	$Re_{v\ Loss}$	0.0	cubic feet
Reconstructed Imp. Area Already Treated (Area):	A_{RECi}	0.00	acres >>>> Report to WQSS **Col. G**
Existing Imp. Area outside of LOD Shifted in/out of POI:	A_{SHIFT}	0.00	acres
Will POI qualify for a Cp_V Waiver under Section 3.3.B of the Guidelines?	Cp_{VW}	No	

STEP 2 - Determine the Impervious Area Requiring Treatment (IART):

IART from Redevelopment:
For Re-dev'l Classification, **$IART_{RE\text{-}DEV'L}$ = 50% of (A_{EI} - A_{MI} - A_{RECi})**
For New Dev'l Classification, **$IART_{RE\text{-}DEV'L}$** = 0

$IART_{RE\text{-}DEV'L}$ = **0.02** acres >>>> Report to ESD Summary Sheet **Col. 1**
>>>> Should match WQSS **Col. I**

IART from New Development:
For Re-dev'l Classification, **$IART_{NEW} = \Delta Ai = A_{PI} - A_{EI}$**
For New Dev'l Classification, **$IART_{NEW} = A_{PI} - A_{MI} - A_{RECi}$**

$IART_{NEW}$ = **0.19** acres >>>> Report to ESD Summary Sheet **Col. 2**
>>>> Should match WQSS **Col. J**

Total IART:
$IART = IART_{RE\text{-}DEV'L} + IART_{NEW} + A_{LI}$

IART = **0.21** acres

STEP 3 - Determine the Required Environmental Site Design Volume for Treating Redevelopment ($ESD_{V\ RE\text{-}DEV'L}$):

$ESD_{V\ RE\text{-}DEV'L}$ = P_E x R_V x $IART_{RE\text{-}DEV'L}$ x 3630†, Where: † conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 1.00 in.

R_V = 0.95, $R_V = 0.05 + (0.009)(I)$; where: I = 100 %,

$IART_{RE\text{-}DEV'L}$ = 0.02 acres

$ESD_{V\ RE\text{-}DEV'L}$: **69** cubic feet >>> Report to ESD Summary Sheet **Col. 3**

STEP 4 - Determine the Environmental Site Design Volume Reduction from Decreasing Impervious Area ($ESD_{V\ reducedAi}$): (for Redevelopment Classification when ΔAi<0)

~~**1. Determine $ESD_{V\ reducedAi}$ Applied to Project:**~~

~~$ESD_{V\ reducedAi}$ = P_E x R_V x $IART_{NEW}$ x 3630†, where:~~ ~~† conversion factor (43,560sf/ac)/(12 in/ft)~~

~~P_E = 1.00 in.~~

~~R_V = 0.95, R_v = 0.05 + (0.009)(I); where: I = 100 %,~~

~~$IART_{NEW}$ =~~

$ESD_{V\ reducedAi}$: 0 cubic feet»»»Report to ESD Summary Sheet **Col. 4a**

~~**2. Determine $ESD_{V\ reducedAi}$ Applied to POI:**~~

~~$ESD_{V\ reducedAi}$ = P_E x R_V x $IART_{NEW}$ x 3630†, where:~~ ~~† conversion factor (43,560sf/ac)/(12 in/ft)~~

~~P_E = 2.60 in.*~~ ~~*2.6 inches is being used regardless of soil type.~~

~~R_V = 0.95, R_v = 0.05 + (0.009)(I); where: I = 100 %,~~

~~$IART_{NEW}$ = 0.00 acres~~

$ESD_{V\ reducedAi}$: 0 cubic feet»»»Report to ESD Summary Sheet **Col. 4b**

STEP 5 - Determine the Required Environmental Site Design Volume for Treating New Development ($ESD_{V\ NEW}$) for POI:

~~**1. Determine $ESD_{V\ NEW}$ for 3.3.B Waiver:**~~

~~$ESD_{V\ NEW}$ = P_E x R_V x $IART_{NEW}$ x 3630†, where:~~ ~~† conversion factor (43,560sf/ac)/(12 in/ft)~~

~~P_E = 1.00 in.~~

~~R_V = 0.95, R_v = 0.05 + (0.009)(I); where: I = 100 %,~~

~~$IART_{NEW}$ = 0.00 acres~~

$ESD_{V\ NEW}$: 0 cubic feet»»» Report to ESD Summary Sheet **Col. 5a**

2. Determine Weighted P_E:

HSG	% Imperv. (I)	$IART_{NEW}$	P_E in	P_E x $IART_{NEW}$
A	100.0%		2.6	
B	100.0%	0.19	2.6	0.494
C	100.0%		2.2	
D	100.0%		2.0	
Total		**0.19**		**0.494**

3. Determine $ESD_{V\ NEW}$ when there is No Waiver or No Impervious Reduction (i.e. ΔAi >=0):

$ESD_{V\ NEW}$ = Weighted P_E x R_V x $IART_{NEW}$ x 3630†, where: † conversion factor (43,560sf/ac)/(12 in/ft)

Weighted P_E = $\sum(P_E \times IART_{NEW})/\sum IART_{NEW}$

2.60 Weighted P_E = 2.6 in.

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

$IART_{NEW}$ = 0.19 acres

$ESD_{V\ NEW}$: 1,704 cubic feet»»» Report to ESD Summary Sheet **Col. 5b**

STEP 6 - Determine the Required Environmental Site Design Volume for the Shifted Impervious Area ($ESD_{V\ SHIFT}$) in/out of POI:

Determine $ESD_{V\ SHIFT}$:

$ESD_{V\ SHIFT}$ = P_E x R_V x A_{SHIFT} x 3630†, where: † conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 2.60 in.* *2.6 inches is being used regardless of soil type.

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

A_{SHIFT} = 0 acres

$ESD_{V\ SHIFT}$: 0 cubic feet»» Report to ESD Summary Sheet **Col. 6**

STEP 7 - Determine the Required Environmental Site Design Volume from Loss of Existing SWM ($ESD_{V\ Loss}$):

$ESD_{V\ Loss}$: 0 cubic feet»» Report to ESD Summary Sheet **Col. 7**

STEP 8 - Determine the Required Environmental Site Design Volume for the POI ($ESD_{V\ POI}$):

$ESD_{V\ POI}$:
$ESD_{V\ reducedAi}$ (Step 4.2) + $ESD_{V\ NEW}$ (Step 5.3) + $ESD_{V\ SHIFT}$ (Step 6) + $ESD_{V\ Loss}$ (Step 7)
1,704 cubic feet»» Report to ESD Summary Sheet **Col. 8**

If **(A_P -A_E) > 0,** provide separate calculations demonstrating that the Proposed Condition 1-Year Discharge Rate (Q1P) **<=** the Existing Condition 1-Year Discharge Rate (Q1E).

STEP 9 - Determine the Required Recharge Volume (Re_V):

1. Determine Weighted Soil Specific Recharge Factor (S):

HSG	S in	A_{NEW} ac	S * A_{NEW}
A	0.38		
B	0.26	0.19	0.0494
C	0.13		
D	0.07		
Total		**0.19**	**0.0494**

2. Determine the Required Recharge Volume ($Re_{V\ NEW}$) for New Development:

$Re_{V\ NEW}$ = Weighted S x R_V x A_{NEW} x 3630†, where: † conversion factor (43,560sf/ac)/(12 in/ft)

Weighted S = $\sum(S \times A_{NEW})/\sum A_{NEW}$

Weighted S = 0.26 in

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

A_{NEW} = $IART_{NEW}$, if $IART_{NEW}$ > 0; otherwise 0.00 acres

A_{NEW} = 0.19 acres

$Re_{V\ NEW}$: 170 cubic feet

3. Determine Loss of Existing Recharge Volume ($Re_{V\ Loss}$):

$Re_{V\ Loss}$: 0 cubic feet

4. Determine Total Recharge Volume (Re_V):

$Re_{V\ NEW}$ + $Re_{V\ Loss}$ = Re_V: 170 cubic feet»» Report to ESD Summary Sheet **Col. 10**

STEP 10 - Designer's Notes:

MDE Sediment & Stormwater Plan Review for State & Federal Projects

SWM CALCULATOR

Project Description:	Greenbrier State Park Charge Station	Job #	20-0424
Point of Investigation #:	POS-3	Contract #	P-052-200-020
MDE Tracking No.:	21-SF-0104	Date:	2/19/2021
		Designed by:	AMT
		Reviewed by:	AMT

Determine Development Classification for the Reconstruction Activities: Version 2 - Oct 2018

County:		WASHINGTON		
SWM Study Area:	A_s	1.63	acres	
Existing Impervious Surface Area:	A_{EXi}	0.86	acres	
Percent Existing Imperviousness (Report to WQSS Col. D):	%I	52.8%	>40%	= (0.86 / 1.63) x 100
Development Classification for Reconstruction:		**Redevelopment**		

MDE Sediment & Stormwater Plan Review for State & Federal Projects

SWM Calculator

Project Description: Greenbrier State Park Charge Station
Point of Investigation #: POS-3
MDE Tracking No.: 21-SF-0104

Job # 20-0424
Contract # P-052-200-020
Date: 2/19/2021
Designed by: AMT
Reviewed by: AMT

Redevelopment POI

STEP 1 - Site / Drainage Area Data

Existing Condition Drainage Area:	A_E	0.52	acres
Proposed Condition Drainage Area:	A_P	0.67	acres
Existing Impervious (Imp.) Area within LOD:	A_{EI}	0.02	acres >>>> Report to WQSS **Col. B**
Proposed Imp. Area within LOD:	A_{PI}	0.17	acres >>>> Report to WQSS **Col. C**
Area for which WQ is Not Req'd (i.e. 3.3.A Waiver):	A_{MI}	0.11	acres >>>> Report to WQSS **Col. E**
Loss of Existing Water Quality (Area):	A_{LI}	0.00	acres >>>> Report to WQSS **Col. F**
Loss of Existing ESD_v/WQ_v (Volume):	$ESD_{V\ Loss}$	0.0	cubic feet
Loss of Existing Recharge (Volume):	$Re_{v\ Loss}$	0.0	cubic feet
Reconstructed Imp. Area Already Treated (Area):	A_{RECi}	0.00	acres >>>> Report to WQSS **Col. G**
Existing Imp. Area outside of LOD Shifted in/out of POI:	A_{SHIFT}	0.00	acres
Will POI qualify for a Cp_V Waiver under Section 3.3.B of the Guidelines?	Cp_{VW}	No	

STEP 2 - Determine the Impervious Area Requiring Treatment (IART):

IART from Redevelopment:
For Re-dev'l Classification, $IART_{RE\text{-}DEV'L} = 50\%\ of\ (A_{EI} - A_{MI} - A_{RECi})$
For New Dev'l Classification, $IART_{RE\text{-}DEV'L} = 0$

$IART_{RE\text{-}DEV'L}$ = **-0.05** acres >>>> Report to ESD Summary Sheet **Col. 1**
>>>> Should match WQSS **Col. I**

IART from New Development:
For Re-dev'l Classification, $IART_{NEW} = \Delta Ai = A_{PI} - A_{EI}$
For New Dev'l Classification, $IART_{NEW} = A_{PI} - A_{MI} - A_{RECi}$

$IART_{NEW}$ = **0.15** acres >>>> Report to ESD Summary Sheet **Col. 2**
>>>> Should match WQSS **Col. J**

Total IART:
$IART = IART_{RE\text{-}DEV'L} + IART_{NEW} + A_{LI}$

IART = **0.10** acres

STEP 3 - Determine the Required Environmental Site Design Volume for Treating Redevelopment ($ESD_{V\ RE\text{-}DEV'L}$):

$ESD_{V\ RE\text{-}DEV'L} = P_E \times R_V \times IART_{RE\text{-}DEV'L} \times 3630^{\dagger}$, Where:

† conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 1.00 in.

R_V = 0.95, $R_V = 0.05 + (0.009)(I)$; where: I = 100 %,

$IART_{RE\text{-}DEV'L}$ = -0.05 acres

$ESD_{V\ RE\text{-}DEV'L}$: (172) cubic feet >>> Report to ESD Summary Sheet **Col. 3**

STEP 4 - Determine the Environmental Site Design Volume Reduction from Decreasing Impervious Area ($ESD_{V\ reducedAi}$): (for Redevelopment Classification when ΔAi<0)

1. Determine $ESD_{V\ reducedAi}$ Applied to Project:

$ESD_{V\ reducedAi}$ = P_E x R_V x $IART_{NEW}$ x 3630†, where: † conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 1.00 in.

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

$IART_{NEW}$ = _____

$ESD_{V\ reducedAi}$: 0 cubic feet»»»Report to ESD Summary Sheet **Col. 4a**

2. Determine $ESD_{V\ reducedAi}$ Applied to POI:

$ESD_{V\ reducedAi}$ = P_E x R_V x $IART_{NEW}$ x 3630†, where: † conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 2.60 in.* *2.6 inches is being used regardless of soil type.

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

$IART_{NEW}$ = 0.00 acres

$ESD_{V\ reducedAi}$: 0 cubic feet»»»Report to ESD Summary Sheet **Col. 4b**

STEP 5 - Determine the Required Environmental Site Design Volume for Treating New Development ($ESD_{V\ NEW}$) for POI:

1. Determine $ESD_{V\ NEW}$ for 3.3.B Waiver:

$ESD_{V\ NEW}$ = P_E x R_V x $IART_{NEW}$ x 3630†, where: † conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 1.00 in.

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

$IART_{NEW}$ = 0.00 acres

$ESD_{V\ NEW}$: 0 cubic feet»»» Report to ESD Summary Sheet **Col. 5a**

2. Determine Weighted P_E:

HSG	% Imperv. (I)	$IART_{NEW}$	P_E in	P_E x $IART_{NEW}$
A	100.0%		2.6	
B	100.0%	0.15	2.6	0.390
C	100.0%		2.2	
D	100.0%		2.0	
Total		**0.15**		**0.390**

3. Determine $ESD_{V\ NEW}$ when there is No Waiver or No Impervious Reduction (i.e. ΔAi >=0):

$ESD_{V\ NEW}$ = Weighted P_E x R_V x $IART_{NEW}$ x 3630†, where: † conversion factor (43,560sf/ac)/(12 in/ft)

Weighted P_E = $\sum(P_E \times IART_{NEW})/\sum IART_{NEW}$

2.60 Weighted P_E = 2.6 in.

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

$IART_{NEW}$ = 0.15 acres

$ESD_{V\ NEW}$: 1,345 cubic feet»»» Report to ESD Summary Sheet **Col. 5b**

STEP 6 - Determine the Required Environmental Site Design Volume for the Shifted Impervious Area ($ESD_{V\ SHIFT}$) in/out of POI:

Determine $ESD_{V\ SHIFT}$:

$ESD_{V\ SHIFT}$ = P_E x R_V x A_{SHIFT} x 3630†, where: † conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 2.60 in.* *2.6 inches is being used regardless of soil type.

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

A_{SHIFT} = 0 acres

$ESD_{V\ SHIFT}$: 0 cubic feet»» Report to ESD Summary Sheet **Col. 6**

STEP 7 - Determine the Required Environmental Site Design Volume from Loss of Existing SWM ($ESD_{V\ Loss}$):

$ESD_{V\ Loss}$: 0 cubic feet»» Report to ESD Summary Sheet **Col. 7**

STEP 8 - Determine the Required Environmental Site Design Volume for the POI ($ESD_{V\ POI}$):

$ESD_{V\ POI}$:
$ESD_{V\ reducedAi}$ (Step 4.2) + $ESD_{V\ NEW}$ (Step 5.3) + $ESD_{V\ SHIFT}$ (Step 6) + $ESD_{V\ Loss}$ (Step 7) = **1,345** cubic feet»» Report to ESD Summary Sheet **Col. 8**

If **(A_P -A_E) > 0,** provide separate calculations demonstrating that the Proposed Condition 1-Year Discharge Rate (Q1P) **<=** the Existing Condition 1-Year Discharge Rate (Q1E).

STEP 9 - Determine the Required Recharge Volume (Re_V):

1. Determine Weighted Soil Specific Recharge Factor (S):

HSG	S in	A_{NEW} ac	S * A_{NEW}
A	0.38		
B	0.26	0.15	0.0390
C	0.13		
D	0.07		
Total		**0.15**	**0.0390**

2. Determine the Required Recharge Volume ($Re_{V\ NEW}$) for New Development:

$Re_{V\ NEW}$ = Weighted S x R_V x A_{NEW} x 3630†, where: † conversion factor (43,560sf/ac)/(12 in/ft)

Weighted S = $\sum(S \times A_{NEW})/\sum A_{NEW}$

Weighted S = 0.26 in ###

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

A_{NEW} = $IART_{NEW}$, if $IART_{NEW}$ > 0; otherwise 0.00 acres

A_{NEW} = 0.15 acres

$Re_{V\ NEW}$: 134 cubic feet

3. Determine Loss of Existing Recharge Volume ($Re_{V\ Loss}$):

$Re_{V\ Loss}$: 0 cubic feet

4. Determine Total Recharge Volume (Re_V):

$Re_{V\ NEW}$ + $Re_{V\ Loss}$ = Re_V: 134 cubic feet»» Report to ESD Summary Sheet **Col. 10**

STEP 10 - Designer's Notes:

MDE Sediment & Stormwater Plan Review for State & Federal Projects

SWM CALCULATOR

Project Description:	Greenbrier State Park Charge Station	Job #	20-0424
Point of Investigation #:	POS-4	Contract #	P-052-200-020
MDE Tracking No.:	21-SF-0104	Date:	2/19/2021
		Designed by:	AMT
		Reviewed by:	AMT

Determine Development Classification for the Reconstruction Activities: Version 2 - Oct 2018

County:		WASHINGTON		
SWM Study Area:	A_s	1.63	acres	
Existing Impervious Surface Area:	A_{EXi}	0.86	acres	
Percent Existing Imperviousness (Report to WQSS Col. D):	%I	52.8%	>40%	= (0.86 / 1.63) x 100
Development Classification for Reconstruction:		**Redevelopment**		

MDE Sediment & Stormwater Plan Review for State & Federal Projects

SWM Calculator

Project Description: Greenbrier State Park Charge Station
Point of Investigation #: POS-4
MDE Tracking No.: 21-SF-0104

Job # 20-0424
Contract # P-052-200-020
Date: 2/19/2021
Designed by: AMT
Reviewed by: AMT

Redevelopment POI

STEP 1 - Site / Drainage Area Data

Existing Condition Drainage Area:	A_E	1.62	acres
Proposed Condition Drainage Area:	A_P	1.62	acres
Existing Impervious (Imp.) Area within LOD:	A_{EI}	0.41	acres >>>> Report to WQSS **Col. B**
Proposed Imp. Area within LOD:	A_{PI}	0.25	acres >>>> Report to WQSS **Col. C**
Area for which WQ is Not Req'd (i.e. 3.3.A Waiver):	A_{MI}	0.19	acres >>>> Report to WQSS **Col. E**
Loss of Existing Water Quality (Area):	A_{LI}	0.00	acres >>>> Report to WQSS **Col. F**
Loss of Existing ESD_v/WQ_v (Volume):	$ESD_{V\ Loss}$	0.0	cubic feet
Loss of Existing Recharge (Volume):	$Re_{v\ Loss}$	0.0	cubic feet
Reconstructed Imp. Area Already Treated (Area):	A_{RECi}	0.00	acres >>>> Report to WQSS **Col. G**
Existing Imp. Area outside of LOD Shifted in/out of POI:	A_{SHIFT}	0.00	acres
Will POI qualify for a Cp_V Waiver under Section 3.3.B of the Guidelines?	Cp_{VW}	No	

STEP 2 - Determine the Impervious Area Requiring Treatment (IART):

IART from Redevelopment:
For Re-dev'l Classification, **$IART_{RE\text{-}DEV'L} = 50\%\ of\ (A_{EI} - A_{MI} - A_{RECi})$**
For New Dev'l Classification, **$IART_{RE\text{-}DEV'L} = 0$**

$IART_{RE\text{-}DEV'L}$ = **0.11** acres >>>> Report to ESD Summary Sheet **Col. 1**
>>>> Should match WQSS **Col. I**

IART from New Development:
For Re-dev'l Classification, **$IART_{NEW} = \Delta Ai = A_{PI} - A_{EI}$**
For New Dev'l Classification, **$IART_{NEW} = A_{PI} - A_{MI} - A_{RECi}$**

$IART_{NEW}$ = **-0.16** acres >>>> Report to ESD Summary Sheet **Col. 2**
>>>> Should match WQSS **Col. J**

Total IART:
$IART = IART_{RE\text{-}DEV'L} + IART_{NEW} + A_{LI}$

IART = **-0.05** acres

STEP 3 - Determine the Required Environmental Site Design Volume for Treating Redevelopment ($ESD_{V\ RE\text{-}DEV'L}$):

$ESD_{V\ RE\text{-}DEV'L} = P_E \times R_V \times IART_{RE\text{-}DEV'L} \times 3630^{\dagger}$, Where:

† conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 1.00 in.

R_V = 0.95, $R_V = 0.05 + (0.009)(I)$; where: I = 100 %,

$IART_{RE\text{-}DEV'L}$ = 0.11 acres

$ESD_{V\ RE\text{-}DEV'L}$: **379** cubic feet >>> Report to ESD Summary Sheet **Col. 3**

STEP 4 - Determine the Environmental Site Design Volume Reduction from Decreasing Impervious Area ($ESD_{V\ reducedAi}$): (for Redevelopment Classification when ΔAi<0)

1. Determine $ESD_{V\ reducedAi}$ Applied to Project:

$ESD_{V\ reducedAi}$ = P_E x R_V x $IART_{NEW}$ x 3630†, where: † conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 1.00 in.

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

$IART_{NEW}$ = _____

$ESD_{V\ reducedAi}$: -552 cubic feet»»»Report to ESD Summary Sheet **Col. 4a**

2. Determine $ESD_{V\ reducedAi}$ Applied to POI:

$ESD_{V\ reducedAi}$ = P_E x R_V x $IART_{NEW}$ x 3630†, where: † conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 2.60 in.* *2.6 inches is being used regardless of soil type.

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

$IART_{NEW}$ = -0.16 acres

$ESD_{V\ reducedAi}$: -1,435 cubic feet»»»Report to ESD Summary Sheet **Col. 4b**

STEP 5 - Determine the Required Environmental Site Design Volume for Treating New Development ($ESD_{V\ NEW}$) for POI:

~~**1. Determine $ESD_{V\ NEW}$ for 3.3.B Waiver:**~~

~~$ESD_{V\ NEW}$ = P_E x R_V x $IART_{NEW}$ x 3630†, where:~~ ~~† conversion factor (43,560sf/ac)/(12 in/ft)~~

~~P_E = 1.00 in.~~

~~R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,~~

~~$IART_{NEW}$ = 0.00 acres~~

$ESD_{V\ NEW}$: 0 cubic feet»»» Report to ESD Summary Sheet **Col. 5a**

~~**2. Determine Weighted P_E:**~~

~~HSG~~	~~% Imperv. (I)~~	~~$IART_{NEW}$~~	~~P_E in~~	~~P_E x $IART_{NEW}$~~
~~A~~	~~100.0%~~		~~2.6~~	
~~B~~	~~100.0%~~		~~2.6~~	
~~C~~	~~100.0%~~		~~2.2~~	
~~D~~	~~100.0%~~		~~2.0~~	
~~Total~~				~~0.000~~

~~**3. Determine $ESD_{V\ NEW}$ when there is No Waiver or No Impervious Reduction (i.e. ΔAi >=0):**~~

~~$ESD_{V\ NEW}$ = Weighted P_E x R_V x $IART_{NEW}$ x 3630†, where:~~ ~~† conversion factor (43,560sf/ac)/(12 in/ft)~~

~~Weighted P_E = $\sum(P_E \times IART_{NEW})/\sum IART_{NEW}$~~

~~Weighted P_E = 0.00 in.~~

~~R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,~~

~~$IART_{NEW}$ = 0.00 acres~~

$ESD_{V\ NEW}$: 0 cubic feet»»» Report to ESD Summary Sheet **Col. 5b**

STEP 6 - Determine the Required Environmental Site Design Volume for the Shifted Impervious Area ($ESD_{V\ SHIFT}$) in/out of POI:

Determine $ESD_{V\ SHIFT}$:

$ESD_{V\ SHIFT}$ = P_E x R_V x A_{SHIFT} x 3630†, where:

† conversion factor (43,560sf/ac)/(12 in/ft)

P_E = 2.60 in.*

*2.6 inches is being used regardless of soil type.

R_V = 0.95, R_V = 0.05 + (0.009)(I); where: I = 100 %,

A_{SHIFT} = 0 acres

$ESD_{V\ SHIFT}$: 0 cubic feet»» Report to ESD Summary Sheet **Col. 6**

STEP 7 - Determine the Required Environmental Site Design Volume from Loss of Existing SWM ($ESD_{V\ Loss}$):

$ESD_{V\ Loss}$: 0 cubic feet»» Report to ESD Summary Sheet **Col. 7**

STEP 8 - Determine the Required Environmental Site Design Volume for the POI ($ESD_{V\ POI}$):

$ESD_{V\ POI}$:

$ESD_{V\ reducedAi}$ (Step 4.2) + $ESD_{V\ NEW}$ (Step 5.3) + $ESD_{V\ SHIFT}$ (Step 6) + $ESD_{V\ Loss}$ (Step 7): **-1,435** cubic feet»» Report to ESD Summary Sheet **Col. 8**

If $(A_P - A_E) > 0$, provide separate calculations demonstrating that the Proposed Condition 1-Year Discharge Rate (Q1P) <= the Existing Condition 1-Year Discharge Rate (Q1E).

STEP 9 - Determine the Required Recharge Volume (Re_V):

~~1. Determine Weighted Soil Specific Recharge Factor (S):~~

~~HSG~~	~~S in~~	~~A_{NEW} ac~~	~~S * A_{NEW}~~
~~A~~	~~0.38~~		
~~B~~	~~0.26~~		
~~C~~	~~0.13~~		
~~D~~	~~0.07~~		
~~Total~~		~~0.00~~	~~0.0000~~

~~2. Determine the Required Recharge Volume ($Re_{V\ NEW}$) for New Development:~~

~~$Re_{V\ NEW}$ = Weighted S x R_v x A_{NEW} x 3630†, where:~~

~~† conversion factor (43,560sf/ac)/(12 in/ft)~~

~~Weighted S = $\sum(S \times A_{NEW})/\sum A_{NEW}$~~

~~Weighted S = 0.00 in~~

~~R_v = 0.95, R_v = 0.05 + (0.009)(I); where: I = 100 %,~~

~~A_{NEW} = IART$_{NEW}$, if IART$_{NEW}$ > 0; otherwise 0.00 acres~~

~~A_{NEW} = 0.00 acres~~

$Re_{V\ NEW}$: 0 cubic feet

~~3. Determine Loss of Existing Recharge Volume ($Re_{V\ Loss}$):~~

$Re_{V\ Loss}$: 0 cubic feet

4. Determine Total Recharge Volume (Re_V):

$Re_{V\ NEW}$ + $Re_{V\ Loss}$ = Re_V: 0 cubic feet»» Report to ESD Summary Sheet **Col. 10**

STEP 10 - Designer's Notes:

STORMWATER FACILITY DESIGN CALCULATIONS

Micro-Bioretention Design

Project: **Greenbrier**
Name: **Micro-Bioretention #1**

MB-1

BIORETENTION DESIGN

Drainage Area:	0.27	acres	
Impervious Area:	0.17	acres	
Percent Impervious:	63.0%		
Rv (0.05+009(I))	0.62		
Target Pe	2.16	inches	
Target ESDv	1,305	cubic feet	ESDv = Pe * Rv * DA / 12
Max ESDv	1,571	cubic feet	Max PE of 2.6"

BIORETENTION SIZING SUMMARY

Surface Area of Filter Media:	780	square feet	
Design ESDv Ponding Depth:	0.75	foot	
Surface Area at Ponding Elevation:	1,125	square feet	
Storage Provided Above Filter Media:	714	cubic feet	
2% Surface Area Check:	6.63	%	Surface Area is Adequate

Surface Area of Filter Media:	780	square feet	
Filter Media Depth, df (2.0' min.):	2	feet	
Media Void Ratio:	0.40		
Storage Provided Within Filter Media:	624	cubic feet	

Area of Filter/Impervious Area, Af/Ai:	7%	cubic feet	
Use Af/Ai:	5%		
Required Storage Above Filter:	55%	To achieve 75% Treatment Storage Requirement	
% Storage Provided Above the Filter:	55%	Storage Provided is Sufficient	
TOTAL ESDv Provided:	1,311	cubic feet	(The Smaller Amount Between: Storage Provided Above Media/Minimum Storage Volume Above Filter %, OR Max ESDv)

Pe Provided:	2.17	inches

$$\frac{=(ESD)(12)}{(Rv)(DA)}$$

Bioretention Design

Project: **Greenbrier**
Name: **Micro-Bioretention #1**

MB-1

STORAGE VOLUME (% OF ESDv) REQUIRED ABOVE SURFACE AREA

Pe	2.2	inches
Area of Filter/Impervious Area (Af/Ai):	5%	
Percent Impervious:	63.0%	

Storage Volume (% of ESDv) required above surface for Pe = 2 - 2.6 inches

	Af/Ai										
% Imp	2%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
5%	46%	4[illegible]%	39%	36%	32%	28%	26%	23%	21%	19%	18%
10%	50%	4[illegible]%	41%	36%	32%	29%	27%	25%	23%	21%	20%
15%	53%	4[illegible]%	43%	39%	35%	32%	30%	28%	26%	25%	24%
20%	55%	5[illegible]%	45%	41%	38%	35%	33%	31%	29%	28%	26%
25%	55%	5[illegible]%	46%	42%	39%	36%	34%	32%	30%	28%	27%
30%	56%	5[illegible]%	46%	42%	39%	37%	35%	32%	31%	29%	28%
35%	56%	5[illegible]%	47%	43%	40%	38%	35%	33%	31%	30%	28%
40%	57%	5[illegible]%	48%	44%	41%	38%	36%	34%	32%	31%	29%
45%	58%	5[illegible]%	48%	45%	42%	39%	37%	35%	33%	31%	30%
50%	58%	5[illegible]%	49%	45%	42%	40%	38%	36%	34%	32%	30%
55%	59%	5[illegible]%	50%	46%	43%	41%	38%	36%	34%	33%	31%
60%	59%	55%	50%	46%	44%	41%	39%	37%	35%	33%	31%
65%	59%	55%	50%	46%	43%	41%	39%	37%	35%	33%	31%
70%	59%	55%	50%	46%	43%	41%	39%	37%	35%	33%	31%
75%	59%	55%	50%	46%	43%	41%	39%	37%	35%	33%	31%
80%	59%	55%	50%	46%	43%	41%	39%	37%	35%	33%	31%
85%	59%	55%	50%	46%	43%	41%	39%	37%	35%	33%	31%
90%	59%	55%	50%	46%	43%	41%	39%	37%	35%	33%	31%
95%	59%	55%	50%	46%	43%	41%	39%	37%	35%	33%	31%

Reduced Curve Number Determination

Project: **20-0424**
Name: **Greenbrier**

POS-2: SWM-1 - 10 YR

ESD FACILITY DRAINAGE AREA SUMMARY

Facility Drainage Area:	0.27	acres
Impervious Area:	0.17	acres
ESDv Provided:	1,311	cubic feet
Rv	0.62	
Pe Provided:	2.17	inches

DETERMINE THE HYDROLOGIC DATA

Rainfall Depth:	4.15	inches
Post Development Run-Off (Qa):	1.71	inches (from TR-55/TR-20)

COMPUTE THE ADJUSTED CURVE NUMBER (CN*)

Calculated Delta Q:	1.35	inches (Pe x Rv)
Calculate Q:	0.36	inches (Qa-Delta Q)
Calculate CN*	49.6	

$$CN = \frac{200}{(P + 2Q + 2) - SQRT(5PQ + 4Q^2)}$$

Micro-Bioretention Design

Project: **Greenbrier**
Name: **Micro-Bioretention #2**

MB-2

BIORETENTION DESIGN

Drainage Area:	0.24	acres	
Impervious Area:	0.16	acres	
Percent Impervious:	66.7%		
Rv (0.05+009(I))	0.65		
Target Pe	2.40	inches	
Target ESDv	1,359	cubic feet	ESDv = Pe * Rv * DA / 12
Max ESDv	1,472	cubic feet	Max PE of 2.6"

BIORETENTION SIZING SUMMARY

Surface Area of Filter Media:	862	square feet	
Design ESDv Ponding Depth:	0.75	foot	
Surface Area at Ponding Elevation:	1,138	square feet	
Storage Provided Above Filter Media:	750	cubic feet	
2% Surface Area Check:	8.25	%	Surface Area is Adequate

Surface Area of Filter Media:	862	square feet	
Filter Media Depth, df (2.0' min.):	2	feet	
Media Void Ratio:	0.40		
Storage Provided Within Filter Media:	690	cubic feet	

Area of Filter/Impervious Area, Af/Ai:	8%	cubic feet	
Use Af/Ai:	5%		
Required Storage Above Filter:	55%	To achieve 75% Treatment Storage Requirement	
% Storage Provided Above the Filter:	55%	Storage Provided is Sufficient	
TOTAL ESDv Provided:	1,364	cubic feet	(The Smaller Amount Between: Storage Provided Above Media/Minimum Storage Volume Above Filter %, OR Max ESDv)

Pe Provided:	2.41	inches

$$\frac{=(ESD)(12)}{(Rv)(DA)}$$

Bioretention Design

Project: **Greenbrier**
Name: **Micro-Bioretention #2**

MB-2

STORAGE VOLUME (% OF ESDv) REQUIRED ABOVE SURFACE AREA

Pe	2.5	inches
Area of Filter/Impervious Area (Af/Ai):	5%	
Percent Impervious:	66.7%	

Storage Volume (% of ESDv) required above surface for Pe = 2 - 2.6 inches

% Imp	Af/Ai 2%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
5%	46%	47%	39%	36%	32%	28%	26%	23%	21%	19%	18%
10%	50%	46%	41%	36%	32%	29%	27%	25%	23%	21%	20%
15%	53%	49%	43%	39%	35%	32%	30%	28%	26%	25%	24%
20%	55%	51%	45%	41%	38%	35%	33%	31%	29%	28%	26%
25%	55%	51%	46%	42%	39%	36%	34%	32%	30%	28%	27%
30%	56%	52%	46%	42%	39%	37%	35%	32%	31%	29%	28%
35%	56%	52%	47%	43%	40%	38%	35%	33%	31%	30%	28%
40%	57%	53%	48%	44%	41%	38%	36%	34%	32%	31%	29%
45%	58%	54%	48%	45%	42%	39%	37%	35%	33%	31%	30%
50%	58%	54%	49%	45%	42%	40%	38%	36%	34%	32%	30%
55%	59%	55%	50%	46%	43%	41%	38%	36%	34%	33%	31%
60%	59%	55%	50%	46%	44%	41%	39%	37%	35%	33%	31%
65%	59%	55%	50%	46%	43%	41%	39%	37%	35%	33%	31%
70%	59%	55%	50%	46%	43%	41%	39%	37%	35%	33%	31%
75%	59%	55%	50%	46%	43%	41%	39%	37%	35%	33%	31%
80%	59%	55%	50%	46%	43%	41%	39%	37%	35%	33%	31%
85%	59%	55%	50%	46%	43%	41%	39%	37%	35%	33%	31%
90%	59%	55%	50%	46%	43%	41%	39%	37%	35%	33%	31%
95%	59%	55%	50%	46%	43%	41%	39%	37%	35%	33%	31%

Reduced Curve Number Determination

Project: **20-0424**
Name: **Greenbrier**

POS-3: SWM-2 - 10 YR

ESD FACILITY DRAINAGE AREA SUMMARY

Facility Drainage Area:	0.24	acres
Impervious Area:	0.16	acres
ESDv Provided:	1,364	cubic feet
Rv	0.65	
Pe Provided:	2.41	inches

DETERMINE THE HYDROLOGIC DATA

Rainfall Depth:	4.15	inches
Post Development Run-Off (Qa):	1.3	inches (from TR-55/TR-20)

COMPUTE THE ADJUSTED CURVE NUMBER (CN*)

Calculated Delta Q:	1.57	inches (Pe x Rv)
Calculate Q:	0.00	inches (Qa-Delta Q)
Calculate CN*	32.5	

$$CN = \frac{200}{(P + 2Q + 2) - SQRT(5PQ + 4Q^2)}$$

MDE TREATMENT PROVIDED SUMMARY WORKSHEET

PROVIDED TREATMENT: ACHIEVED P_E, TREATED ESDv, AND TREATED Re_V FOR BMPs WITH STORAGE

A	B	C	D	E	F	G	H	I	J	K	L	M
BMP	DA to BMP (acres)	Proposed Ai to BMP (acres)	I%	Rv	Provided Surface Storage (cf)	ESDv provided based on size of BMP (cf)	ESDv based on P_E = 2.6 and DA to BMP (cf)	PROVIDED ESDv (cf)	P_E Achieved (in)	Effective Impervious Area Treated [P_E=1 inch is 100%] (acres)	Weighted Soil Specific Recharge Factor S	PROVIDED RECHARGE VOLUME Re_V (cf)
SWM-1	0.27	0.17	0.63	0.62	714	1311	1571	1311	2.17	0.17	0.26	400
SWM-2	0.24	0.16	0.67	0.65	750	1364	1472	1364	2.41	0.16	0.26	400
							TOTAL:	**2,674 cf**		**0.33 ac**		**sum cf**

Column D: I% = Ai/DA → D = C/B

Column E: Rv = 0.9(I%) + 0.05 → E = 0.9D + 0.05

Column F: Provided Surface Storage = the actual storage volume from the top of media to the invert of the outlet.

Column G: ESDv provided based on size of BMP is a function of the design criteria for the BMP. For BMPs requiring min. 75% surface storage, G = F/0.75.

Column H: ESDv based on P_E = 2.6 inches is the maximum ESDv the BMP can provide.

Column I: The smaller of G vs. H determines the treated ESDv.

Column J: P_E achieved = ESDv/(Rv)(A) →J=I(12 in/ft)/(E)(B)(43,560 ac/sf).

Column K: Effective Impervious Area Treated is the equivalent amount of impervious area receiving full treatment by pro-rating partial treatment (i.e. P_E < 1 inch).

$P_E \geq 1.0$ inch is considered 100% water quality treatment. P_E = 1.0 inch and P_E = 2.6 inch have the same Effective Impervious Area Treated.

If $P_E \geq 1.0$ then K = C. If $P_E < 1.0$ then K = C x J.

Column L: Weighted Soil Specifice Recharge Factor is dependent on Hydrologic Soil Group. Use value from Step 9 of SWM Calculator.

Column M: For BMPs without underdrain and submerged gravel wetlands, provided Re_V = S x provided WQv.

For BMPs with underdrain (except SGWs), provided Re_V is equal to the storage provided below the underdrain in the media voids.

MDE ESD SUMMARY SHEET

MDE Sediment & Stormwater Plan Review
for State & Federal Projects

Project Description: Greenbrier State Park Charge Station
Contract Number: P-052-200-002
MDE Tracking Number: 21-SF-0104

Job # 20-0424
Date: 2/19/2021
Designed by: AMT
Checked by: AMT

ESD SUMMARY SHEET

Required ESD Management													Provided ESD Management						ESD_V and Re_V Requirements		Is the POI Requirement met?
Point of Investigation	Col. 1	Col. 2	Col. 3	Col. 4a	Col. 4b	Col. 5a	Col. 5b	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11	Col. 12	Col. 13	Col. 14	Col. 15	Col. 16			
	$IART_{RE-DEV'L}$	$IART_{NEW}$	$ESD_{V\ RE-DEV'L}$ (P_E=1.0 in)	$ESD_{V\ reducedAi}$ Reduction Applied to Project (P_E = 1.0 in)	$ESD_{V\ reducedAi}$ Reduction Applied to POI (P_E = 2.6 in)	$ESD_{V\ NEW}$ For 3.3.B Waivers (P_E = 1 in)	$ESD_{V\ NEW}$ (P_E = 2 to 2.6 in)	$ESD_{V\ SHIFT}$ (P_E = 2.6 in)	$ESD_{V\ Loss}$	Required ESD_V for POI =4b +5b+6 +7	Required ESD_V for PROJECT =Σ3+Σ4a +Σ5a+Σ5b +Σ6+Σ7	Required Re_V	Type of Practice	BMP Number	P_E Treated by Practice	Provided ESD_V	ESD_V from WQ Bank Debit	Provided Re_V	ESDv Project Requirement	Rev Project Requirement	
Total »»»	0.16	0.13	551	-724		0	3,049	0	0		2,876	304				2,675	0	800	Provided ESDv 2675 cf < 2876 cf CHECK: FAIL	Provided Rev 800 cf >= 304 cf CHECK: OK	
Units »»»	acres	acres	cubic feet	cubic feet	cubic feet	cubic feet	cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet			inches	Cubic feet	Cubic feet	Cubic feet			
POS-1	0.03	-0.05	103	-172	-448	0	0	0	0	0		0							Provided ESDv at POI 0 cf >= 0 cf		YES
																			ALERT! »»» For PROJECT Additional management is necessary. Please provide additional ESD practices OR provide a structural facility for PE over 1.0 inch unless a variance has been granted from MDE.		
POS-2	0.02	0.19	69	0	0	0	1,704	0	0	1,704		170	M-6. Micro-Bioretention	SWM-1	2.17	1,311.0		400.0	Provided ESDv at POI 1311 cf < 1704 cf		NO
POS-3	0.00	0.15	0	0	0	0	1,345	0	0	1,345		134	M-6. Micro-Bioretention	SWM-2	2.41	1,364		400	Provided ESDv at POI 1364 cf >= 1345 cf		YES
POS-4	0.11	-0.16	379	-552	-1,435	0	0	0	0	0		0							Provided ESDv at POI 0 cf >= 0 cf		YES
										0											
										0											
										0											
										0											
										0											
										0											
										0											
										0											
										0											
										0											
										0											
										0											
										0											
										0											
										0											
										0											
										0											

MDE WATER QUALITY SUMMARY SHEET

Water Quality Summary Sheet - June 2019

Project Description: Greenbrier State Park Charge Station
Contract No.: P052-200-002
MDE Number: 21-SF-0104

6-Digit Watershed Number or Bank Watershed: 021405 - Upper Potomac River

Date: 2/19/2021

(●) Concept Design
( ) Final Design

WATER QUALITY BANK (only for applicants with bank)

Banking Fee (acres)	0.01
Net Debit/Credit to WQ Bank (acres)	0.08

Approved by Applicant's Bank Keeper — Date

Approved by Chief, MDE Sediment and Stormwater Plan Review Division — Date

MDE Reviewer's Signature for Correctness — Date

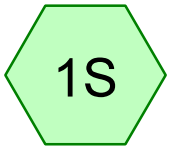
FOR MS4 TRACKING PURPOSES: Net Reduction in Impervious Area = N/A (acres)
Reconstructed Impervious Area Treated = 0.2 (acres)

*If Impervious >40% (redev'l) then I=0.5(B-E-G) and J=H
If Impervious ≤40% (new dev'l) then I=0 and J=C-E-G

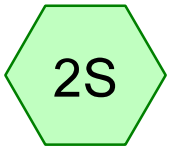
	Water Quality Required										Water Quality Provided							RESULT
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
POI	Existing Impervious Area within LOD (acres)	Proposed Impervious Area within LOD (acres)	Existing Imperviousness within SWM Study Area (0 to 100)	Area within LOD for which WQ is Not Req'd (acres)	Loss of Existing Water Quality (acres)	Reconstructed Impervious Area Already Treated (acres)	Net Increase in Impervious (acres)	IART from Redevelopment (acres)	IART from New Development (acres)	TOTAL IART (acres)	Type of Treatment	BMP Tracking Number or Practice ID	Treatment Already Provided by Existing BMP (acres)	Treated Imp. Area on-site or inside ROW (acres)	Treated Imp. Area off-site or outside ROW (acres)	P_E Treated by Practice (inches)	Effective Impervious Area Treated (acres)	WQ Summary excess/deficit (acres)
	A_{Ei}	A_{Pi}	%I	A_{Mi}	A_{Li}	A_{RECi}	ΔA_i	$IART_{RE-DEV'L}$	$IART_{NEW}$	IART			Not included in IAT				IAT	S=ΣR-ΣK
							H = C-B	I=0.5(B-E-G) or 0 *	J = H or C-E-G *	K = I+J+F								
TOTALS	0.86	0.99		0.65	0.00	0.00	0.13	0.11	0.13	0.24			0.00	0.33	0.00		0.33	0.09
1	0.16	0.11	52.8	0.11	0.00	0.00	-0.05	0.03	-0.05	-0.02	M-6. Micro-Bioretention	SWM-1	0.00	0.17	0.00	2.17	0.17	
2	0.27	0.46	52.8	0.24	0.00	0.00	0.19	0.02	0.19	0.21	M-6. Micro-Bioretention	SWM-2	0.00	0.16	0.00	2.41	0.16	
3	0.02	0.17	52.8	0.11	0.00	0.00	0.15	-0.05	0.15	0.10								
4	0.41	0.25	52.8	0.19	0.00	0.00	-0.16	0.11	-0.16	-0.05								

6/24/2019

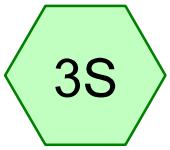
EXISTING CONDITIONS HYROLOGIC ANALYSIS



POS-1 EXISTING

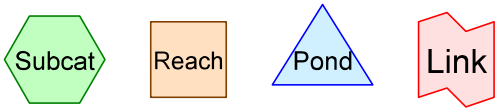


POS-2 EXISTING



POS-3 EXISTING

POS-4 EXISTING



Routing Diagram for Greenbrier- Existing DA Conditions
Prepared by {enter your company name here}, Printed 10/29/2020

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NOAA 24-hr	B	Default	24.00	1	2.86	2
2	10-Year	NOAA 24-hr	B	Default	24.00	1	4.15	2
3	100-Year	NOAA 24-hr	B	Default	24.00	1	6.56	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.466	61	>75% Grass cover, Good, HSG B (1S, 2S, 3S, 4S)
1.491	74	>75% Grass cover, Good, HSG C (1S, 4S)
0.012	96	Gravel surface, HSG B (3S)
1.220	98	Paved parking, HSG B (1S, 2S, 4S)
0.085	98	Paved parking, HSG C (4S)
0.192	98	Roofs, HSG B (3S, 4S)
0.264	98	Roofs, HSG C (1S, 4S)
1.709	30	Woods, Good, HSG A (4S)
19.157	55	Woods, Good, HSG B (1S, 2S, 3S, 4S)
17.572	70	Woods, Good, HSG C (4S)

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	2.466	1.491	0.000	0.000	3.957	>75% Grass cover, Good	1S, 2S, 3S, 4S
0.000	0.012	0.000	0.000	0.000	0.012	Gravel surface	3S
0.000	1.220	0.085	0.000	0.000	1.305	Paved parking	1S, 2S, 4S
0.000	0.192	0.264	0.000	0.000	0.456	Roofs	1S, 3S, 4S
1.709	19.157	17.572	0.000	0.000	38.438	Woods, Good	1S, 2S, 3S, 4S

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: POS-1 EXISTING Runoff Area=4.468 ac 6.09% Impervious Runoff Depth>0.23"
Flow Length=2,330' Tc=17.0 min CN=58 Runoff=0.44 cfs 0.085 af

Subcatchment 2S: POS-2 EXISTING Runoff Area=1.126 ac 23.71% Impervious Runoff Depth>0.52"
Tc=5.0 min CN=67 Runoff=0.74 cfs 0.048 af

Subcatchment 3S: POS-3 EXISTING Runoff Area=0.518 ac 1.74% Impervious Runoff Depth>0.23"
Tc=5.0 min CN=58 Runoff=0.07 cfs 0.010 af

Subcatchment 4S: POS-4 EXISTING Runoff Area=38.056 ac 3.19% Impervious Runoff Depth>0.37"
Flow Length=2,204' Tc=36.2 min CN=63 Runoff=6.73 cfs 1.175 af

Summary for Subcatchment 1S: POS-1 EXISTING

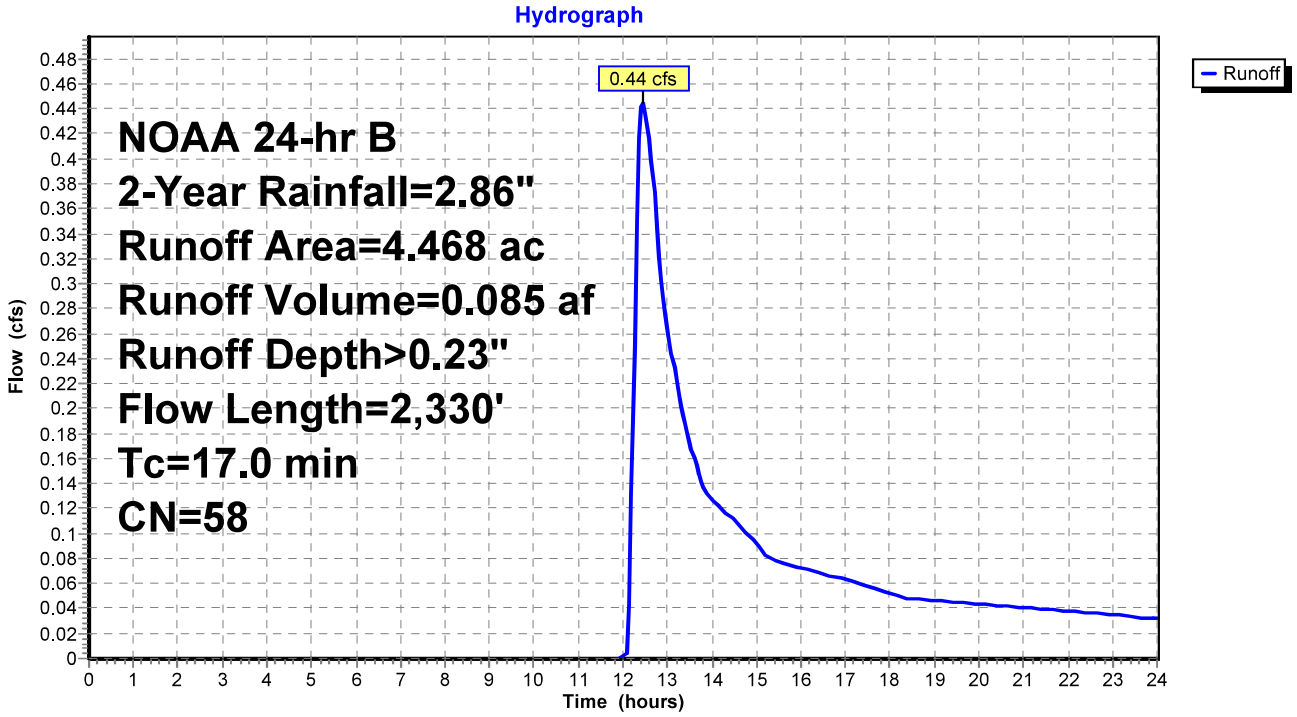
Runoff = 0.44 cfs @ 12.44 hrs, Volume= 0.085 af, Depth> 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 2-Year Rainfall=2.86"

Area (ac)	CN	Description
0.245	98	Paved parking, HSG B
3.701	55	Woods, Good, HSG B
0.431	61	>75% Grass cover, Good, HSG B
0.064	74	>75% Grass cover, Good, HSG C
0.027	98	Roofs, HSG C
4.468	58	Weighted Average
4.196		93.91% Pervious Area
0.272		6.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.0900	0.31		**Sheet Flow, Sheet Flow A-B** Grass: Short n= 0.150 P2= 3.22"
0.6	122	0.2100	3.21		**Shallow Concentrated Flow, Shallow conc B-C** Short Grass Pasture Kv= 7.0 fps
0.7	59	0.0850	1.46		**Shallow Concentrated Flow, Shallow conc C-D** Woodland Kv= 5.0 fps
0.6	71	0.0850	2.04		**Shallow Concentrated Flow, Shallow conc D-E** Short Grass Pasture Kv= 7.0 fps
3.5	347	0.1100	1.66		**Shallow Concentrated Flow, Shallow conc E-F** Woodland Kv= 5.0 fps
1.2	196	0.3100	2.78		**Shallow Concentrated Flow, Shallow conc F-G** Woodland Kv= 5.0 fps
2.8	314	0.1400	1.87		**Shallow Concentrated Flow, Shallow conc G-H** Woodland Kv= 5.0 fps
0.2	26	0.0860	2.05		**Shallow Concentrated Flow, Shallow conc H-I** Short Grass Pasture Kv= 7.0 fps
0.9	88	0.1100	1.66		**Shallow Concentrated Flow, Shallow conc I-J** Woodland Kv= 5.0 fps
0.2	247	0.0755	20.60	525.34	**Channel Flow, channel J-K** Area= 25.5 sf Perim= 18.0' r= 1.42' n= 0.025 Earth, clean & winding
0.9	760	0.0300	14.86	386.25	**Channel Flow, Channel D-E** Area= 26.0 sf Perim= 15.0' r= 1.73' n= 0.025 Earth, clean & winding
17.0	2,330	Total			

Subcatchment 1S: POS-1 EXISTING



Summary for Subcatchment 2S: POS-2 EXISTING

[49] Hint: Tc<2dt may require smaller dt

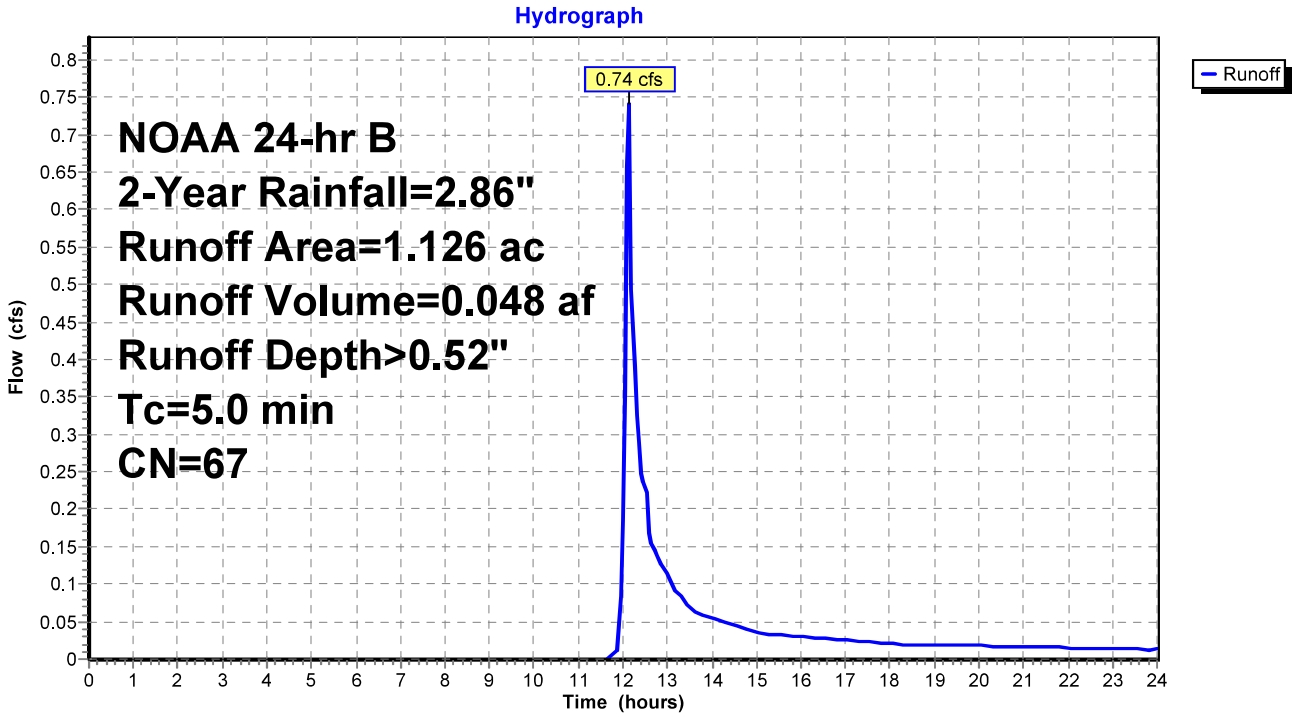
Runoff = 0.74 cfs @ 12.14 hrs, Volume= 0.048 af, Depth> 0.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 2-Year Rainfall=2.86"

Area (ac)	CN	Description
0.267	98	Paved parking, HSG B
0.479	55	Woods, Good, HSG B
0.380	61	>75% Grass cover, Good, HSG B
1.126	67	Weighted Average
0.859		76.29% Pervious Area
0.267		23.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct entry**

Subcatchment 2S: POS-2 EXISTING



Summary for Subcatchment 3S: POS-3 EXISTING

[49] Hint: Tc<2dt may require smaller dt

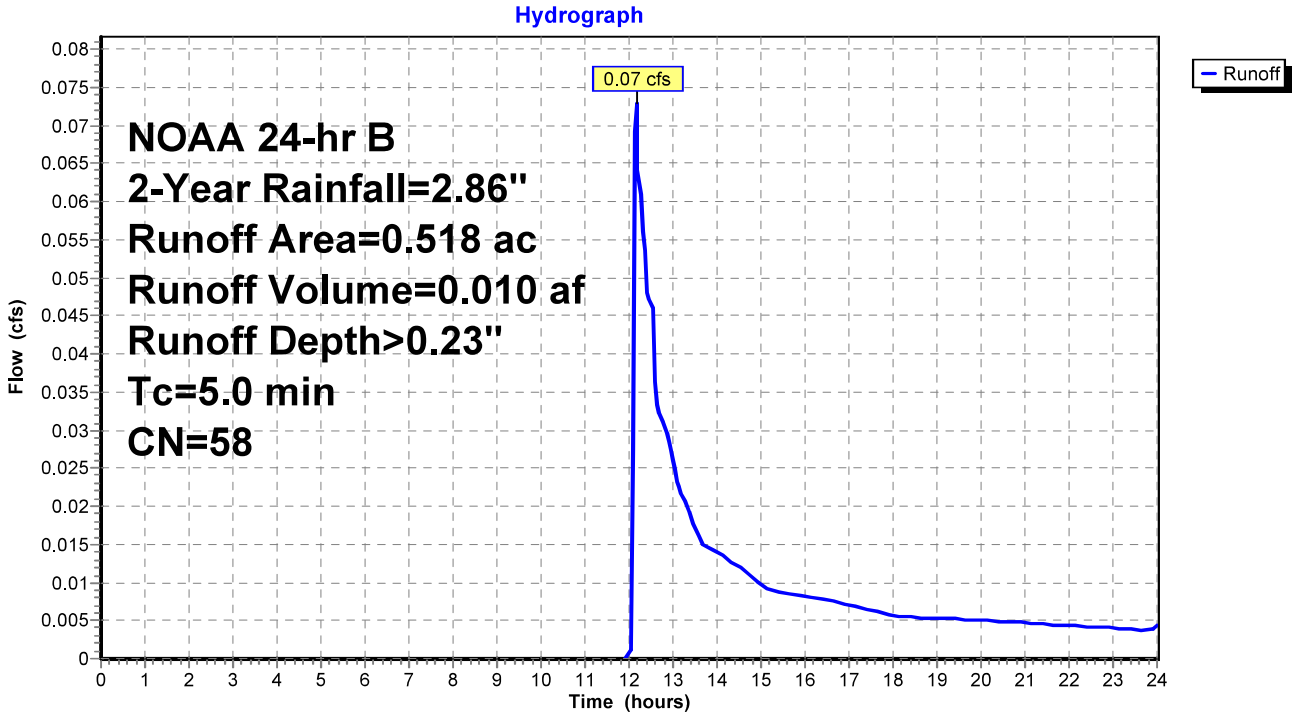
Runoff = 0.07 cfs @ 12.17 hrs, Volume= 0.010 af, Depth> 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 2-Year Rainfall=2.86"

Area (ac)	CN	Description
0.012	96	Gravel surface, HSG B
0.419	55	Woods, Good, HSG B
0.078	61	>75% Grass cover, Good, HSG B
0.009	98	Roofs, HSG B
0.518	58	Weighted Average
0.509		98.26% Pervious Area
0.009		1.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct Entry**

Subcatchment 3S: POS-3 EXISTING



Summary for Subcatchment 4S: POS-4 EXISTING

[47] Hint: Peak is 134% of capacity of segment #4

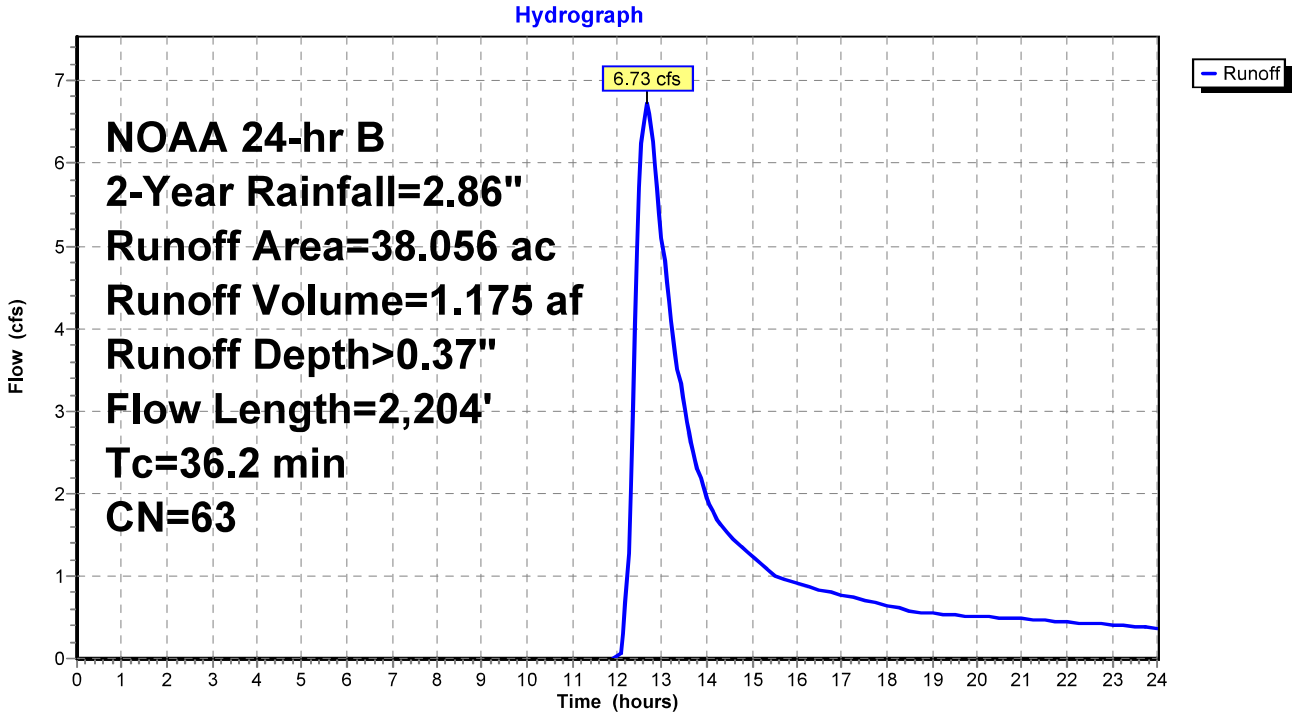
Runoff = 6.73 cfs @ 12.66 hrs, Volume= 1.175 af, Depth> 0.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 2-Year Rainfall=2.86"

Area (ac)	CN	Description
0.708	98	Paved parking, HSG B
0.085	98	Paved parking, HSG C
14.558	55	Woods, Good, HSG B
17.572	70	Woods, Good, HSG C
1.577	61	>75% Grass cover, Good, HSG B
1.427	74	>75% Grass cover, Good, HSG C
0.237	98	Roofs, HSG C
0.183	98	Roofs, HSG B
1.709	30	Woods, Good, HSG A
38.056	63	Weighted Average
36.843		96.81% Pervious Area
1.213		3.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.6	100	0.1000	0.09		**Sheet Flow, Sheet Flow A-B** Woods: Dense underbrush n= 0.800 P2= 3.22"
16.1	1,997	0.1700	2.06		**Shallow Concentrated Flow, Shallow conc B-C** Woodland Kv= 5.0 fps
0.4	65	0.1700	2.89		**Shallow Concentrated Flow, Shallow conc C-D** Short Grass Pasture Kv= 7.0 fps
0.1	42	0.0200	6.42	5.04	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, straight & clean
36.2	2,204	Total			

Subcatchment 4S: POS-4 EXISTING



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: POS-1 EXISTING Runoff Area=4.468 ac 6.09% Impervious Runoff Depth>0.73"
Flow Length=2,330' Tc=17.0 min CN=58 Runoff=2.61 cfs 0.272 af

Subcatchment 2S: POS-2 EXISTING Runoff Area=1.126 ac 23.71% Impervious Runoff Depth>1.24"
Tc=5.0 min CN=67 Runoff=2.01 cfs 0.116 af

Subcatchment 3S: POS-3 EXISTING Runoff Area=0.518 ac 1.74% Impervious Runoff Depth>0.73"
Tc=5.0 min CN=58 Runoff=0.48 cfs 0.032 af

Subcatchment 4S: POS-4 EXISTING Runoff Area=38.056 ac 3.19% Impervious Runoff Depth>0.99"
Flow Length=2,204' Tc=36.2 min CN=63 Runoff=23.23 cfs 3.139 af

Summary for Subcatchment 1S: POS-1 EXISTING

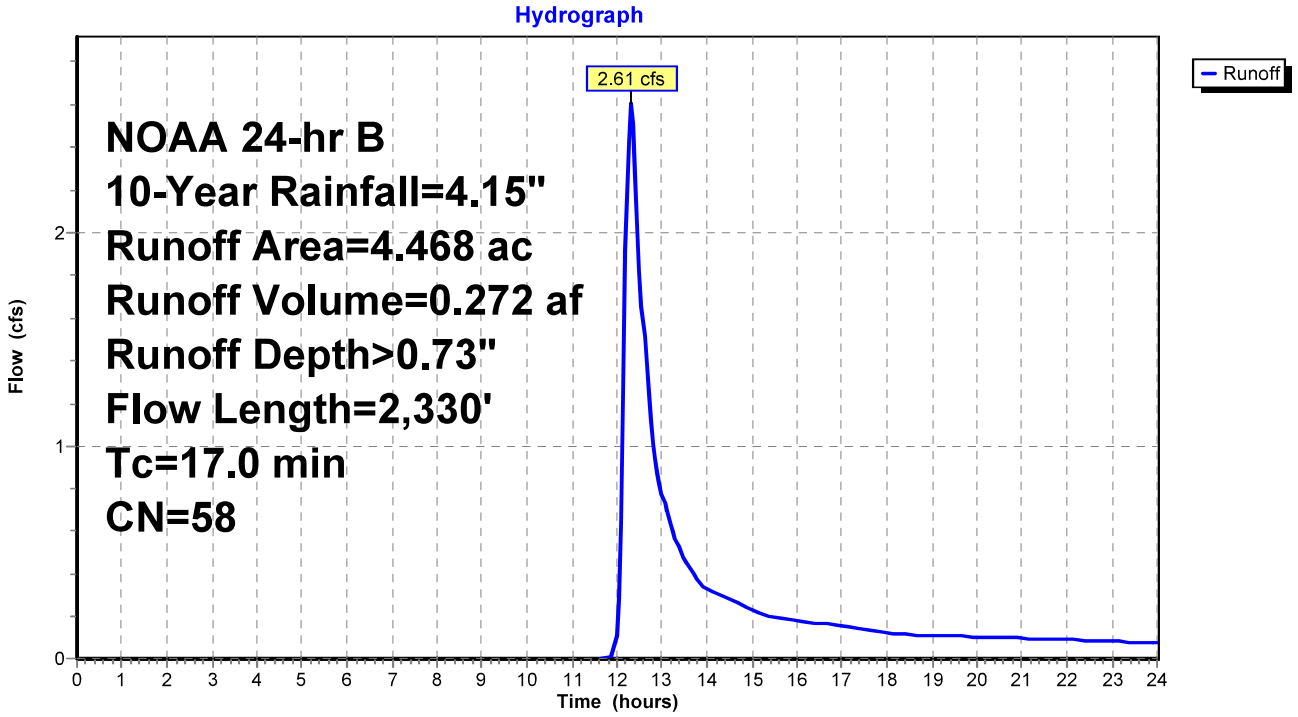
Runoff = 2.61 cfs @ 12.31 hrs, Volume= 0.272 af, Depth> 0.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 10-Year Rainfall=4.15"

Area (ac)	CN	Description
0.245	98	Paved parking, HSG B
3.701	55	Woods, Good, HSG B
0.431	61	>75% Grass cover, Good, HSG B
0.064	74	>75% Grass cover, Good, HSG C
0.027	98	Roofs, HSG C
4.468	58	Weighted Average
4.196		93.91% Pervious Area
0.272		6.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.0900	0.31		**Sheet Flow, Sheet Flow A-B** Grass: Short n= 0.150 P2= 3.22"
0.6	122	0.2100	3.21		**Shallow Concentrated Flow, Shallow conc B-C** Short Grass Pasture Kv= 7.0 fps
0.7	59	0.0850	1.46		**Shallow Concentrated Flow, Shallow conc C-D** Woodland Kv= 5.0 fps
0.6	71	0.0850	2.04		**Shallow Concentrated Flow, Shallow conc D-E** Short Grass Pasture Kv= 7.0 fps
3.5	347	0.1100	1.66		**Shallow Concentrated Flow, Shallow conc E-F** Woodland Kv= 5.0 fps
1.2	196	0.3100	2.78		**Shallow Concentrated Flow, Shallow conc F-G** Woodland Kv= 5.0 fps
2.8	314	0.1400	1.87		**Shallow Concentrated Flow, Shallow conc G-H** Woodland Kv= 5.0 fps
0.2	26	0.0860	2.05		**Shallow Concentrated Flow, Shallow conc H-I** Short Grass Pasture Kv= 7.0 fps
0.9	88	0.1100	1.66		**Shallow Concentrated Flow, Shallow conc I-J** Woodland Kv= 5.0 fps
0.2	247	0.0755	20.60	525.34	**Channel Flow, channel J-K** Area= 25.5 sf Perim= 18.0' r= 1.42' n= 0.025 Earth, clean & winding
0.9	760	0.0300	14.86	386.25	**Channel Flow, Channel D-E** Area= 26.0 sf Perim= 15.0' r= 1.73' n= 0.025 Earth, clean & winding
17.0	2,330	Total			

Subcatchment 1S: POS-1 EXISTING



Summary for Subcatchment 2S: POS-2 EXISTING

[49] Hint: Tc<2dt may require smaller dt

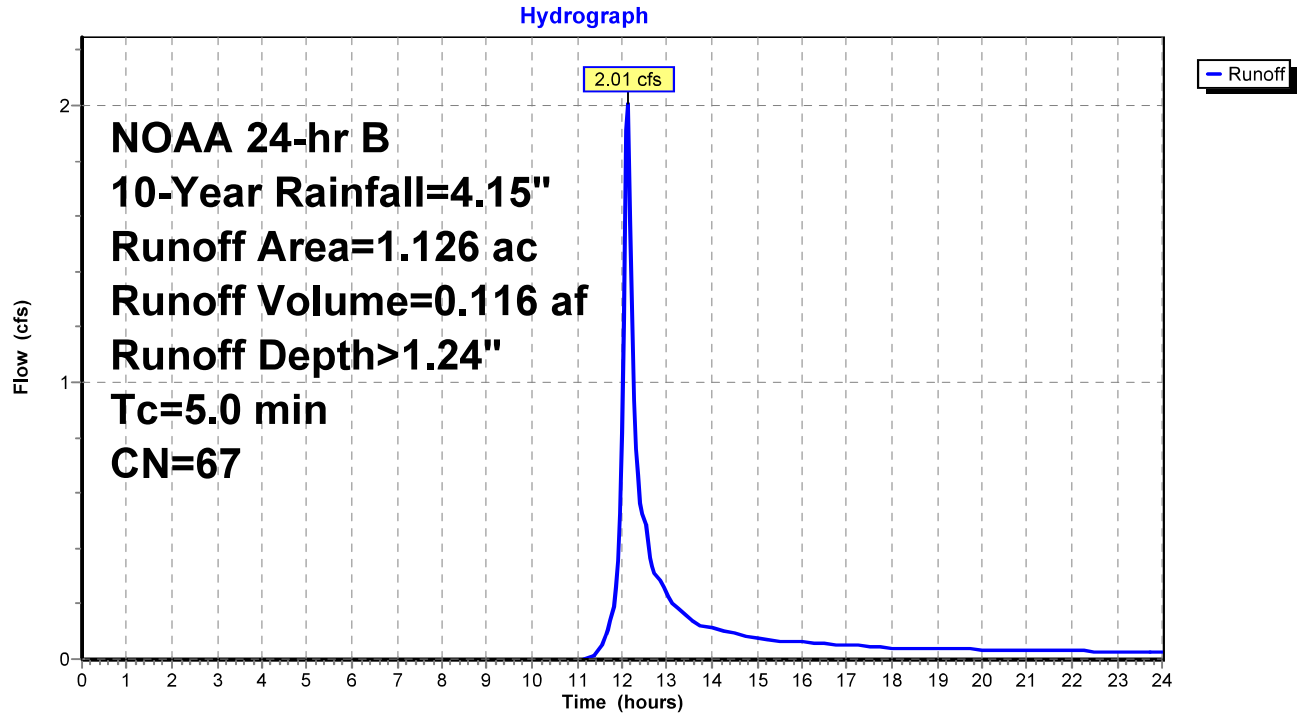
Runoff = 2.01 cfs @ 12.13 hrs, Volume= 0.116 af, Depth> 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 10-Year Rainfall=4.15"

Area (ac)	CN	Description
0.267	98	Paved parking, HSG B
0.479	55	Woods, Good, HSG B
0.380	61	>75% Grass cover, Good, HSG B
1.126	67	Weighted Average
0.859		76.29% Pervious Area
0.267		23.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct entry**

Subcatchment 2S: POS-2 EXISTING



Summary for Subcatchment 3S: POS-3 EXISTING

[49] Hint: Tc<2dt may require smaller dt

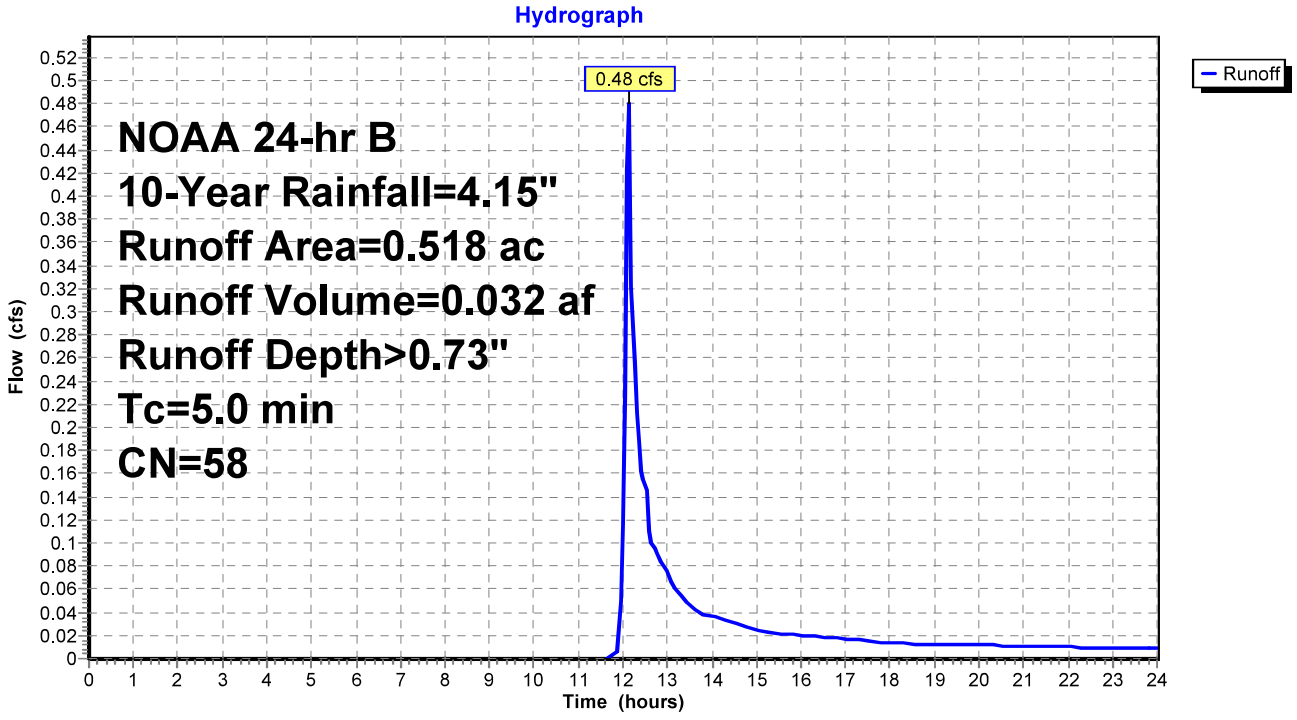
Runoff = 0.48 cfs @ 12.14 hrs, Volume= 0.032 af, Depth> 0.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 10-Year Rainfall=4.15"

Area (ac)	CN	Description
0.012	96	Gravel surface, HSG B
0.419	55	Woods, Good, HSG B
0.078	61	>75% Grass cover, Good, HSG B
0.009	98	Roofs, HSG B
0.518	58	Weighted Average
0.509		98.26% Pervious Area
0.009		1.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct Entry**

Subcatchment 3S: POS-3 EXISTING



Summary for Subcatchment 4S: POS-4 EXISTING

[47] Hint: Peak is 461% of capacity of segment #4

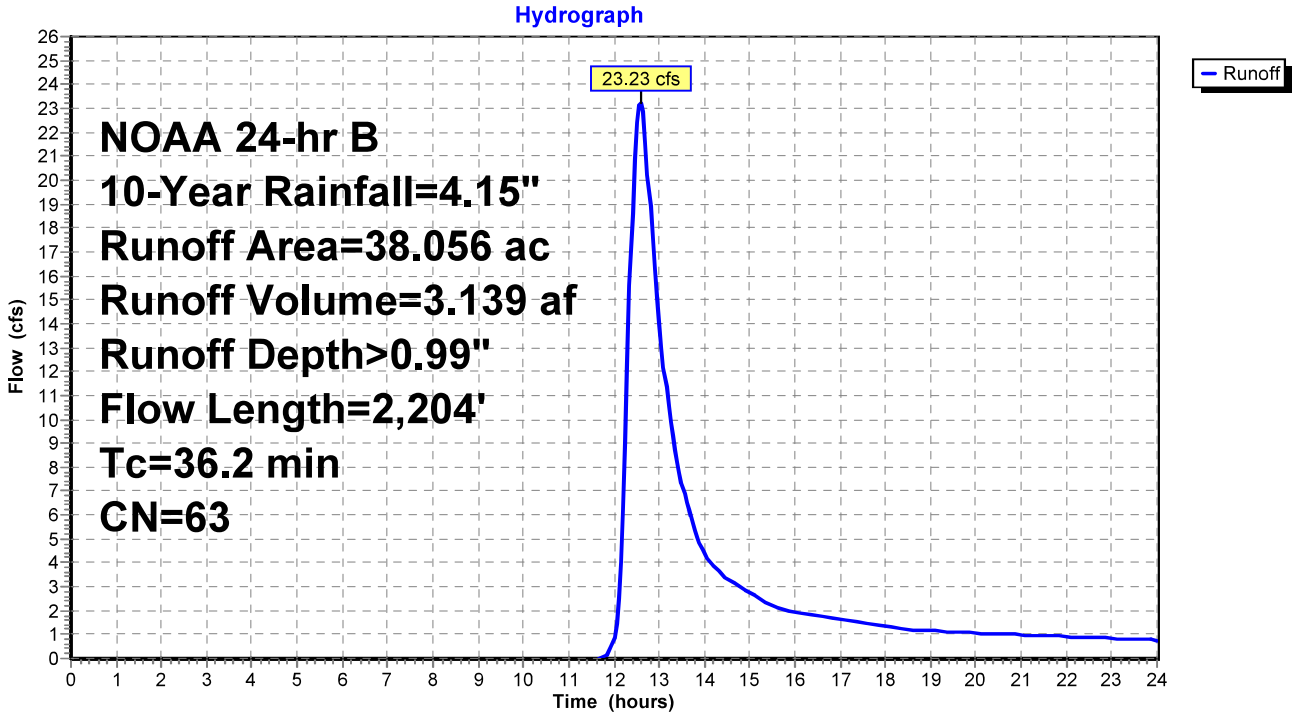
Runoff = 23.23 cfs @ 12.58 hrs, Volume= 3.139 af, Depth> 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 10-Year Rainfall=4.15"

Area (ac)	CN	Description
0.708	98	Paved parking, HSG B
0.085	98	Paved parking, HSG C
14.558	55	Woods, Good, HSG B
17.572	70	Woods, Good, HSG C
1.577	61	>75% Grass cover, Good, HSG B
1.427	74	>75% Grass cover, Good, HSG C
0.237	98	Roofs, HSG C
0.183	98	Roofs, HSG B
1.709	30	Woods, Good, HSG A
38.056	63	Weighted Average
36.843		96.81% Pervious Area
1.213		3.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.6	100	0.1000	0.09		**Sheet Flow, Sheet Flow A-B** Woods: Dense underbrush n= 0.800 P2= 3.22"
16.1	1,997	0.1700	2.06		**Shallow Concentrated Flow, Shallow conc B-C** Woodland Kv= 5.0 fps
0.4	65	0.1700	2.89		**Shallow Concentrated Flow, Shallow conc C-D** Short Grass Pasture Kv= 7.0 fps
0.1	42	0.0200	6.42	5.04	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, straight & clean
36.2	2,204	Total			

Subcatchment 4S: POS-4 EXISTING



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: POS-1 EXISTING Runoff Area=4.468 ac 6.09% Impervious Runoff Depth>2.11"
Flow Length=2,330' Tc=17.0 min CN=58 Runoff=9.13 cfs 0.784 af

Subcatchment 2S: POS-2 EXISTING Runoff Area=1.126 ac 23.71% Impervious Runoff Depth>2.96"
Tc=5.0 min CN=67 Runoff=4.96 cfs 0.277 af

Subcatchment 3S: POS-3 EXISTING Runoff Area=0.518 ac 1.74% Impervious Runoff Depth>2.11"
Tc=5.0 min CN=58 Runoff=1.59 cfs 0.091 af

Subcatchment 4S: POS-4 EXISTING Runoff Area=38.056 ac 3.19% Impervious Runoff Depth>2.55"
Flow Length=2,204' Tc=36.2 min CN=63 Runoff=66.38 cfs 8.099 af

Summary for Subcatchment 1S: POS-1 EXISTING

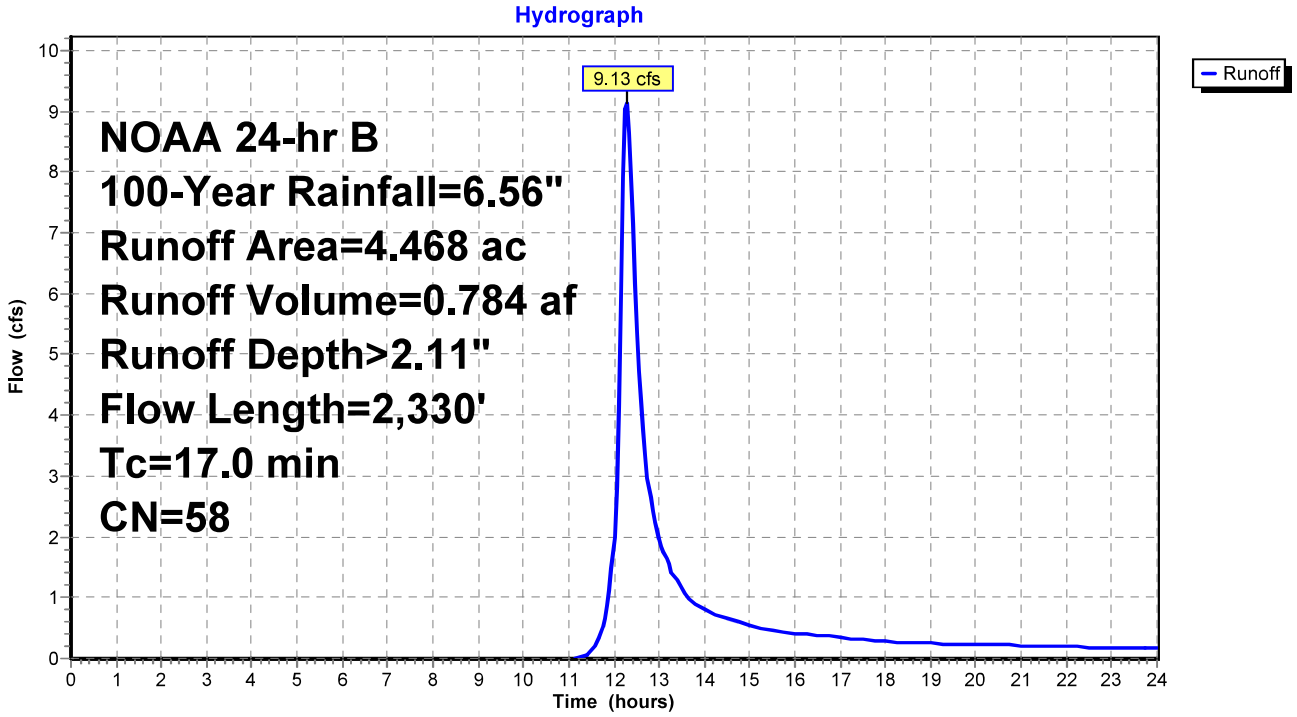
Runoff = 9.13 cfs @ 12.28 hrs, Volume= 0.784 af, Depth> 2.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 100-Year Rainfall=6.56"

Area (ac)	CN	Description
0.245	98	Paved parking, HSG B
3.701	55	Woods, Good, HSG B
0.431	61	>75% Grass cover, Good, HSG B
0.064	74	>75% Grass cover, Good, HSG C
0.027	98	Roofs, HSG C
4.468	58	Weighted Average
4.196		93.91% Pervious Area
0.272		6.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.0900	0.31		**Sheet Flow, Sheet Flow A-B** Grass: Short n= 0.150 P2= 3.22"
0.6	122	0.2100	3.21		**Shallow Concentrated Flow, Shallow conc B-C** Short Grass Pasture Kv= 7.0 fps
0.7	59	0.0850	1.46		**Shallow Concentrated Flow, Shallow conc C-D** Woodland Kv= 5.0 fps
0.6	71	0.0850	2.04		**Shallow Concentrated Flow, Shallow conc D-E** Short Grass Pasture Kv= 7.0 fps
3.5	347	0.1100	1.66		**Shallow Concentrated Flow, Shallow conc E-F** Woodland Kv= 5.0 fps
1.2	196	0.3100	2.78		**Shallow Concentrated Flow, Shallow conc F-G** Woodland Kv= 5.0 fps
2.8	314	0.1400	1.87		**Shallow Concentrated Flow, Shallow conc G-H** Woodland Kv= 5.0 fps
0.2	26	0.0860	2.05		**Shallow Concentrated Flow, Shallow conc H-I** Short Grass Pasture Kv= 7.0 fps
0.9	88	0.1100	1.66		**Shallow Concentrated Flow, Shallow conc I-J** Woodland Kv= 5.0 fps
0.2	247	0.0755	20.60	525.34	**Channel Flow, channel J-K** Area= 25.5 sf Perim= 18.0' r= 1.42' n= 0.025 Earth, clean & winding
0.9	760	0.0300	14.86	386.25	**Channel Flow, Channel D-E** Area= 26.0 sf Perim= 15.0' r= 1.73' n= 0.025 Earth, clean & winding
17.0	2,330	Total			

Subcatchment 1S: POS-1 EXISTING



Summary for Subcatchment 2S: POS-2 EXISTING

[49] Hint: Tc<2dt may require smaller dt

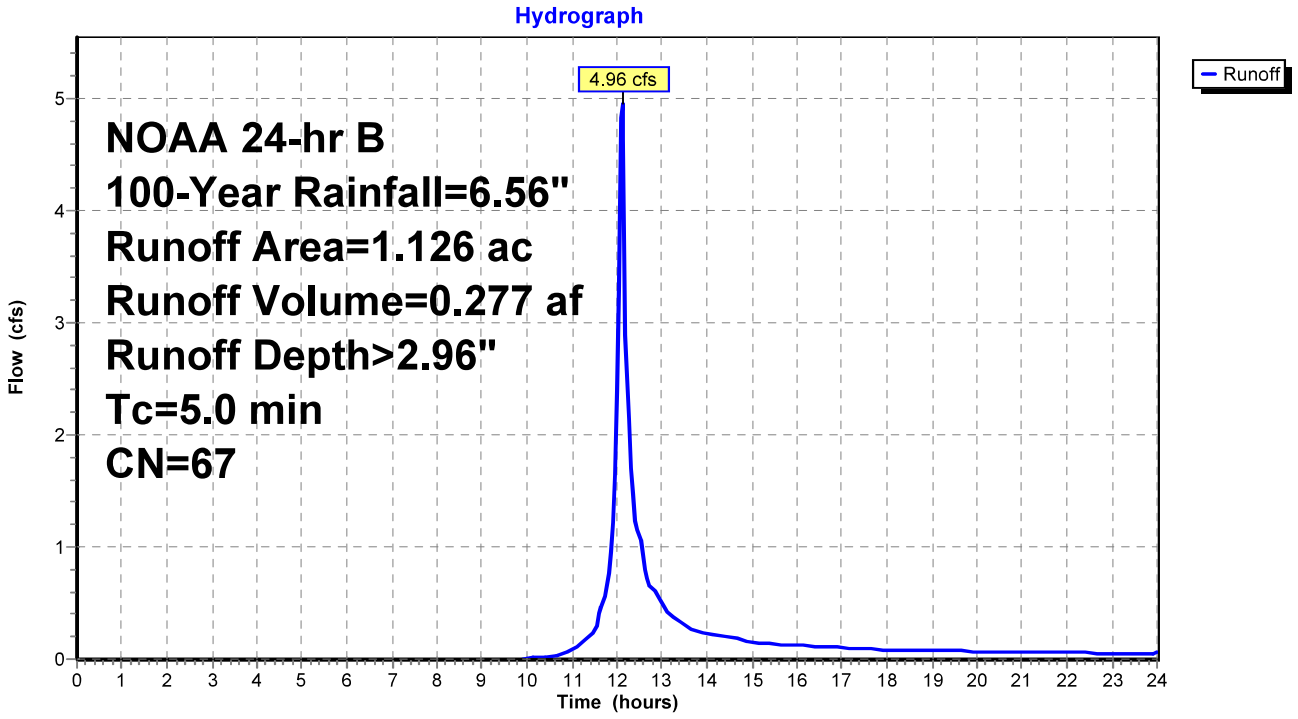
Runoff = 4.96 cfs @ 12.12 hrs, Volume= 0.277 af, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 100-Year Rainfall=6.56"

Area (ac)	CN	Description
0.267	98	Paved parking, HSG B
0.479	55	Woods, Good, HSG B
0.380	61	>75% Grass cover, Good, HSG B
1.126	67	Weighted Average
0.859		76.29% Pervious Area
0.267		23.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct entry**

Subcatchment 2S: POS-2 EXISTING



Summary for Subcatchment 3S: POS-3 EXISTING

[49] Hint: Tc<2dt may require smaller dt

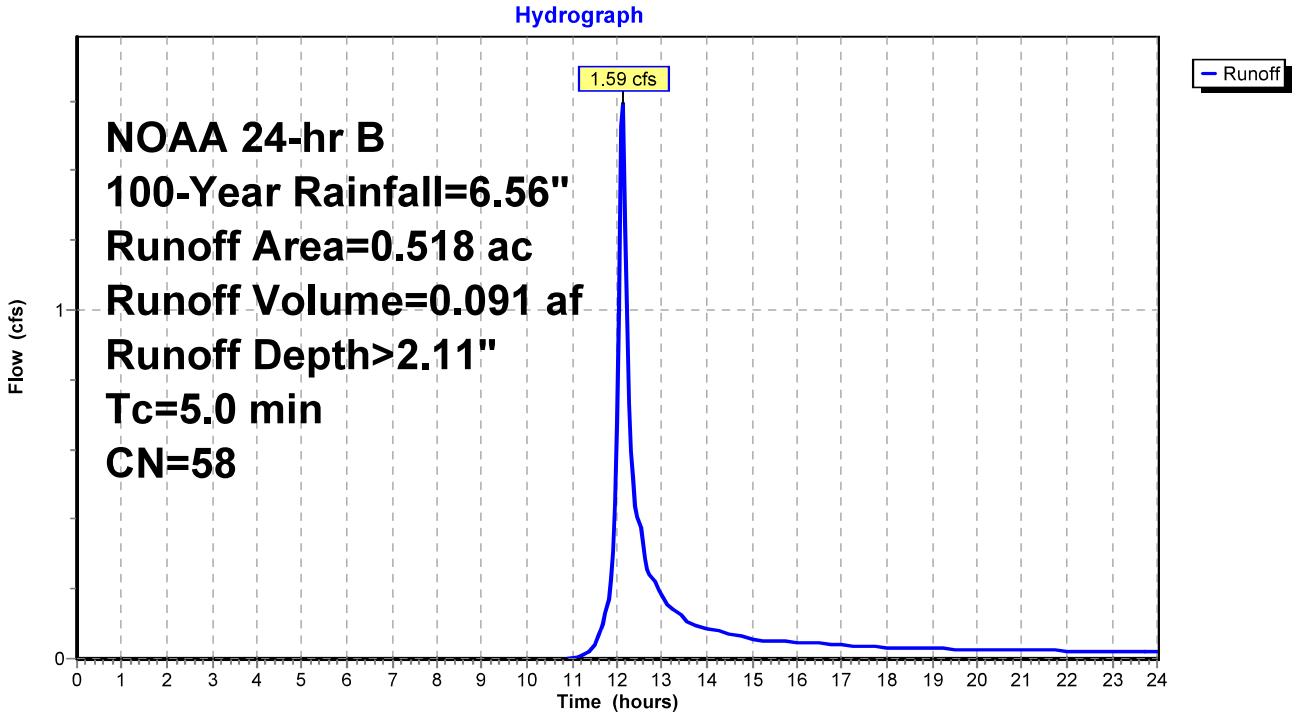
Runoff = 1.59 cfs @ 12.12 hrs, Volume= 0.091 af, Depth> 2.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 100-Year Rainfall=6.56"

Area (ac)	CN	Description
0.012	96	Gravel surface, HSG B
0.419	55	Woods, Good, HSG B
0.078	61	>75% Grass cover, Good, HSG B
0.009	98	Roofs, HSG B
0.518	58	Weighted Average
0.509		98.26% Pervious Area
0.009		1.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct Entry**

Subcatchment 3S: POS-3 EXISTING



Summary for Subcatchment 4S: POS-4 EXISTING

[47] Hint: Peak is 1317% of capacity of segment #4

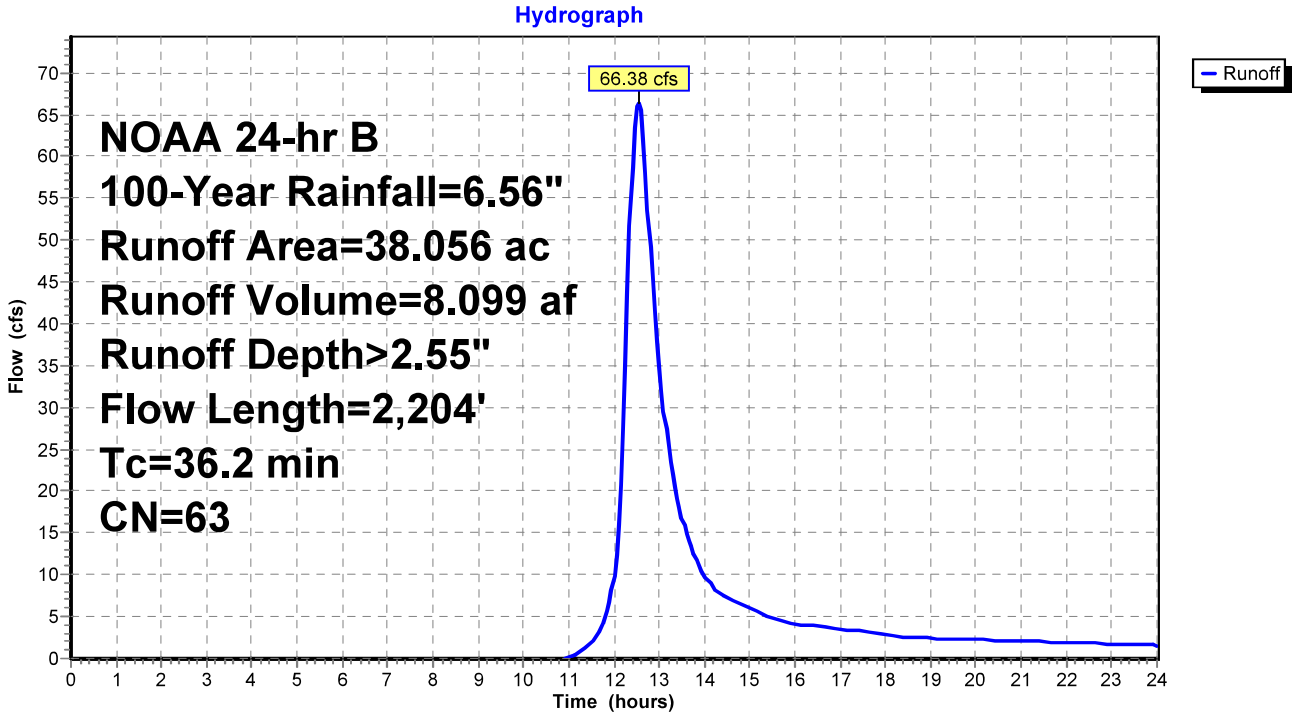
Runoff = 66.38 cfs @ 12.53 hrs, Volume= 8.099 af, Depth> 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 100-Year Rainfall=6.56"

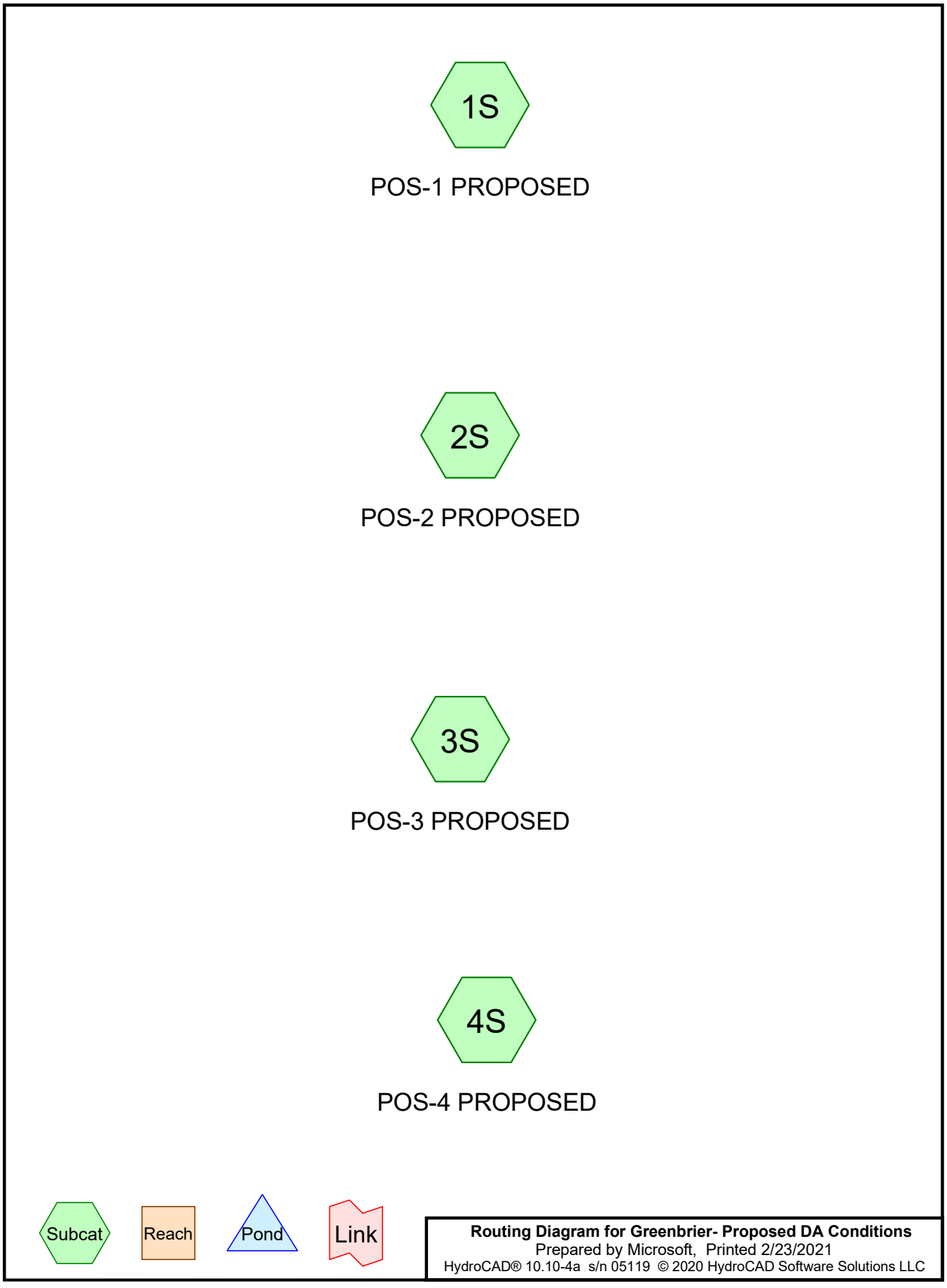
Area (ac)	CN	Description
0.708	98	Paved parking, HSG B
0.085	98	Paved parking, HSG C
14.558	55	Woods, Good, HSG B
17.572	70	Woods, Good, HSG C
1.577	61	>75% Grass cover, Good, HSG B
1.427	74	>75% Grass cover, Good, HSG C
0.237	98	Roofs, HSG C
0.183	98	Roofs, HSG B
1.709	30	Woods, Good, HSG A
38.056	63	Weighted Average
36.843		96.81% Pervious Area
1.213		3.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.6	100	0.1000	0.09		**Sheet Flow, Sheet Flow A-B** Woods: Dense underbrush n= 0.800 P2= 3.22"
16.1	1,997	0.1700	2.06		**Shallow Concentrated Flow, Shallow conc B-C** Woodland Kv= 5.0 fps
0.4	65	0.1700	2.89		**Shallow Concentrated Flow, Shallow conc C-D** Short Grass Pasture Kv= 7.0 fps
0.1	42	0.0200	6.42	5.04	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, straight & clean
36.2	2,204	Total			

Subcatchment 4S: POS-4 EXISTING



PROPOSED CONDITIONS HYDRAULIC ANALYSIS


1S
POS-1 PROPOSED
2S
POS-2 PROPOSED
3S
POS-3 PROPOSED
4S
POS-4 PROPOSED
Subcat
Reach
Pond
Link
Routing Diagram for Greenbrier- Proposed DA Conditions
Prepared by Microsoft, Printed 2/23/2021
HydroCAD® 10.10-4a s/n 05119 © 2020 HydroCAD Software Solutions LLC

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NOAA 24-hr	B	Default	24.00	1	2.86	2
2	10-Year	NOAA 24-hr	B	Default	24.00	1	4.15	2
3	100-Year	NOAA 24-hr	B	Default	24.00	1	6.56	2

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	2.746	1.491	0.000	0.000	4.238	>75% Grass cover, Good	1S, 2S, 3S, 4S
0.000	1.328	0.085	0.000	0.000	1.413	Paved parking	1S, 2S, 3S, 4S
0.000	0.003	0.000	0.000	0.000	0.003	Retaining Walls	4S
0.000	0.005	0.000	0.000	0.000	0.005	Retaining walls	2S
0.000	0.186	0.264	0.000	0.000	0.450	Roofs	1S, 4S
0.000	0.026	0.000	0.000	0.031	0.057	Sidewalks	2S, 3S, 4S
1.709	18.724	17.572	0.000	0.000	38.005	Woods, Good	1S, 2S, 3S, 4S
1.709	**23.017**	**19.413**	**0.000**	**0.031**	**44.170**	**TOTAL AREA**	

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	4S	0.00	0.00	42.0	0.0200	0.013	12.0	0.0	0.0

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: POS-1 PROPOSED Runoff Area=4.452 ac 4.94% Impervious Runoff Depth>0.23"
Flow Length=2,330' Tc=17.0 min CN=58 Runoff=0.44 cfs 0.085 af

Subcatchment 2S: POS-2 PROPOSED Runoff Area=51,450 sf 39.27% Impervious Runoff Depth>0.82"
Tc=5.0 min CN=74 Runoff=1.39 cfs 0.081 af

Subcatchment 3S: POS-3 PROPOSED Runoff Area=29,208 sf 25.96% Impervious Runoff Depth>0.56"
Tc=5.0 min CN=68 Runoff=0.49 cfs 0.031 af

Subcatchment 4S: POS-4 PROPOSED Runoff Area=1,649,465 sf 2.83% Impervious Runoff Depth>0.37"
Flow Length=2,204' Tc=36.2 min CN=63 Runoff=6.70 cfs 1.169 af

Total Runoff Area = 44.170 ac Runoff Volume = 1.366 af Average Runoff Depth = 0.37"
95.64% Pervious = 42.242 ac 4.36% Impervious = 1.928 ac

Summary for Subcatchment 1S: POS-1 PROPOSED

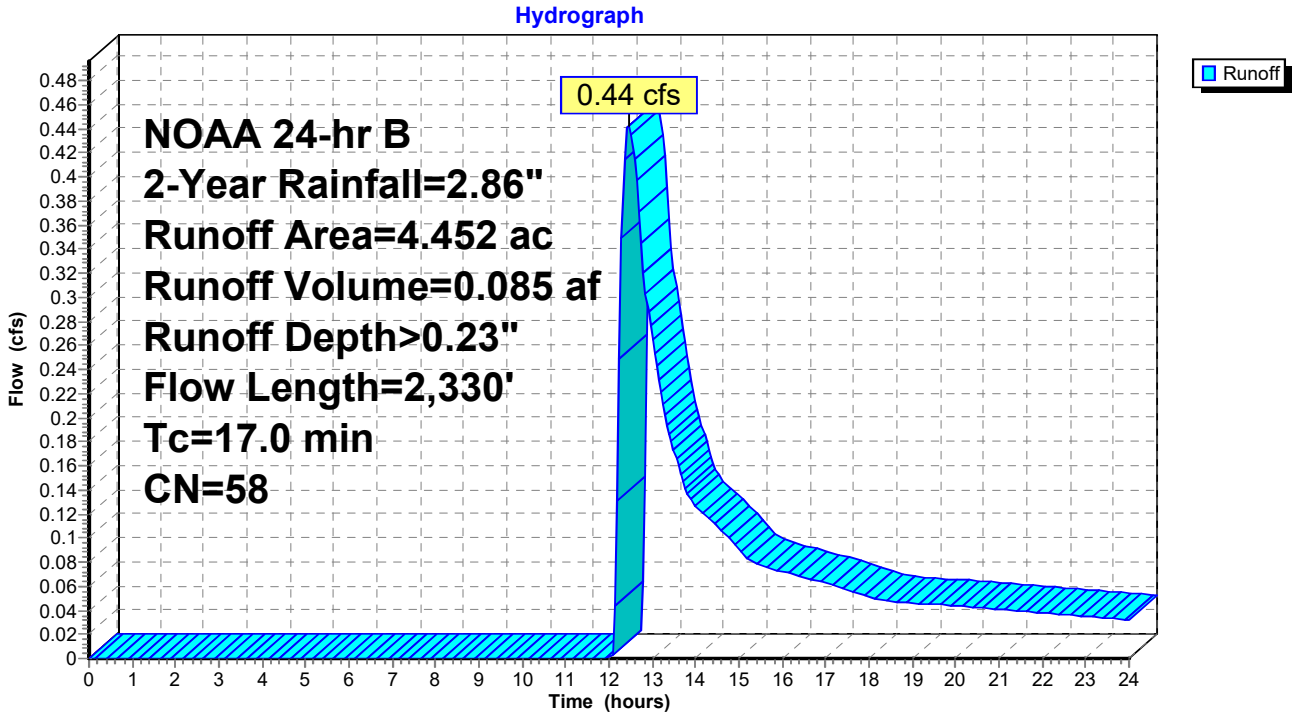
Runoff = 0.44 cfs @ 12.44 hrs, Volume= 0.085 af, Depth> 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 2-Year Rainfall=2.86"

Area (ac)	CN	Description
0.193	98	Paved parking, HSG B
3.644	55	Woods, Good, HSG B
0.524	61	>75% Grass cover, Good, HSG B
0.064	74	>75% Grass cover, Good, HSG C
0.027	98	Roofs, HSG C
4.452	58	Weighted Average
4.232		95.06% Pervious Area
0.220		4.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.0900	0.31		**Sheet Flow, Sheet Flow A-B** Grass: Short n= 0.150 P2= 3.22"
0.6	122	0.2100	3.21		**Shallow Concentrated Flow, Shallow conc B-C** Short Grass Pasture Kv= 7.0 fps
0.7	59	0.0850	1.46		**Shallow Concentrated Flow, Shallow conc C-D** Woodland Kv= 5.0 fps
0.6	71	0.0850	2.04		**Shallow Concentrated Flow, Shallow conc D-E** Short Grass Pasture Kv= 7.0 fps
3.5	347	0.1100	1.66		**Shallow Concentrated Flow, Shallow conc E-F** Woodland Kv= 5.0 fps
1.2	196	0.3100	2.78		**Shallow Concentrated Flow, Shallow conc F-G** Woodland Kv= 5.0 fps
2.8	314	0.1400	1.87		**Shallow Concentrated Flow, Shallow conc G-H** Woodland Kv= 5.0 fps
0.2	26	0.0860	2.05		**Shallow Concentrated Flow, Shallow conc H-I** Short Grass Pasture Kv= 7.0 fps
0.9	88	0.1100	1.66		**Shallow Concentrated Flow, Shallow conc I-J** Woodland Kv= 5.0 fps
0.2	247	0.0755	20.60	525.34	**Channel Flow, channel J-K** Area= 25.5 sf Perim= 18.0' r= 1.42' n= 0.025 Earth, clean & winding
0.9	760	0.0300	14.86	386.25	**Channel Flow, Channel D-E** Area= 26.0 sf Perim= 15.0' r= 1.73' n= 0.025 Earth, clean & winding
17.0	2,330	Total			

Subcatchment 1S: POS-1 PROPOSED



Summary for Subcatchment 2S: POS-2 PROPOSED

[49] Hint: Tc<2dt may require smaller dt

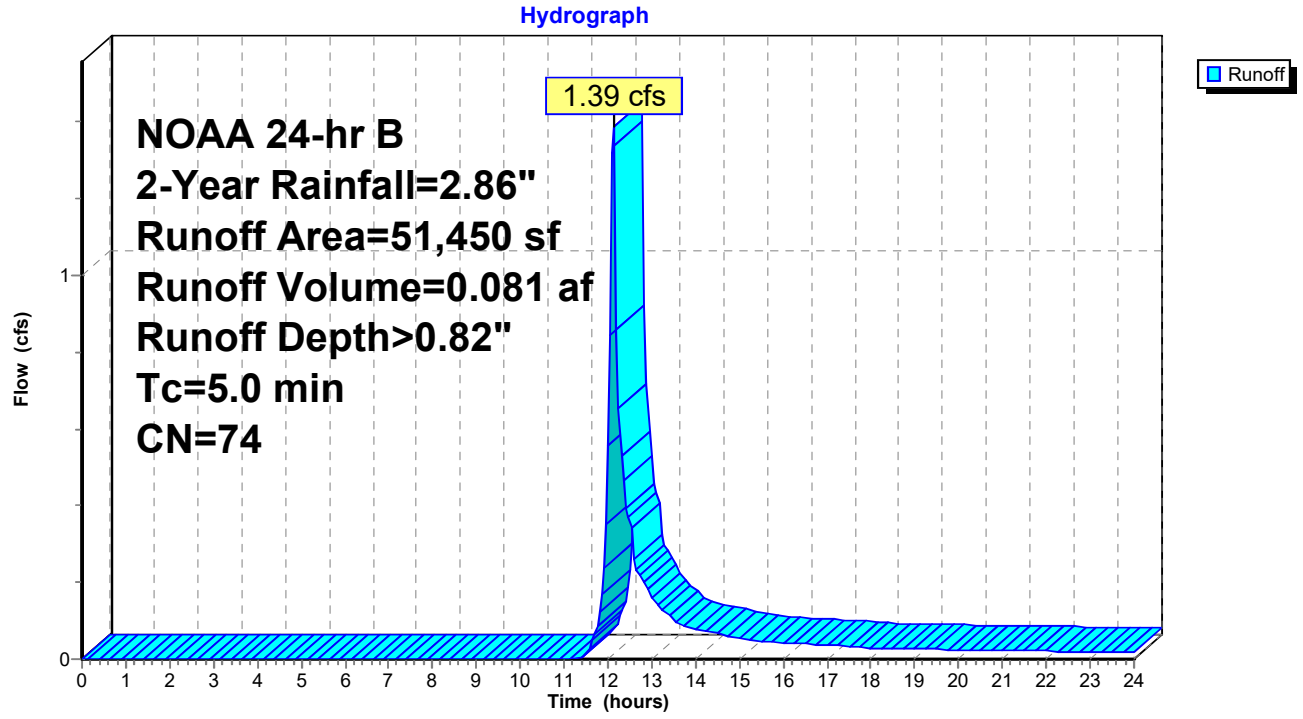
Runoff = 1.39 cfs @ 12.13 hrs, Volume= 0.081 af, Depth> 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 2-Year Rainfall=2.86"

	Area (sf)	CN	Description
	19,457	98	Paved parking, HSG B
	9,297	55	Woods, Good, HSG B
	21,947	61	>75% Grass cover, Good, HSG B
*	230	98	Retaining walls, HSG B
*	519	98	Sidewalks
	51,450	74	Weighted Average
	31,244		60.73% Pervious Area
	20,206		39.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct entry**

Subcatchment 2S: POS-2 PROPOSED



Summary for Subcatchment 3S: POS-3 PROPOSED

[49] Hint: Tc<2dt may require smaller dt

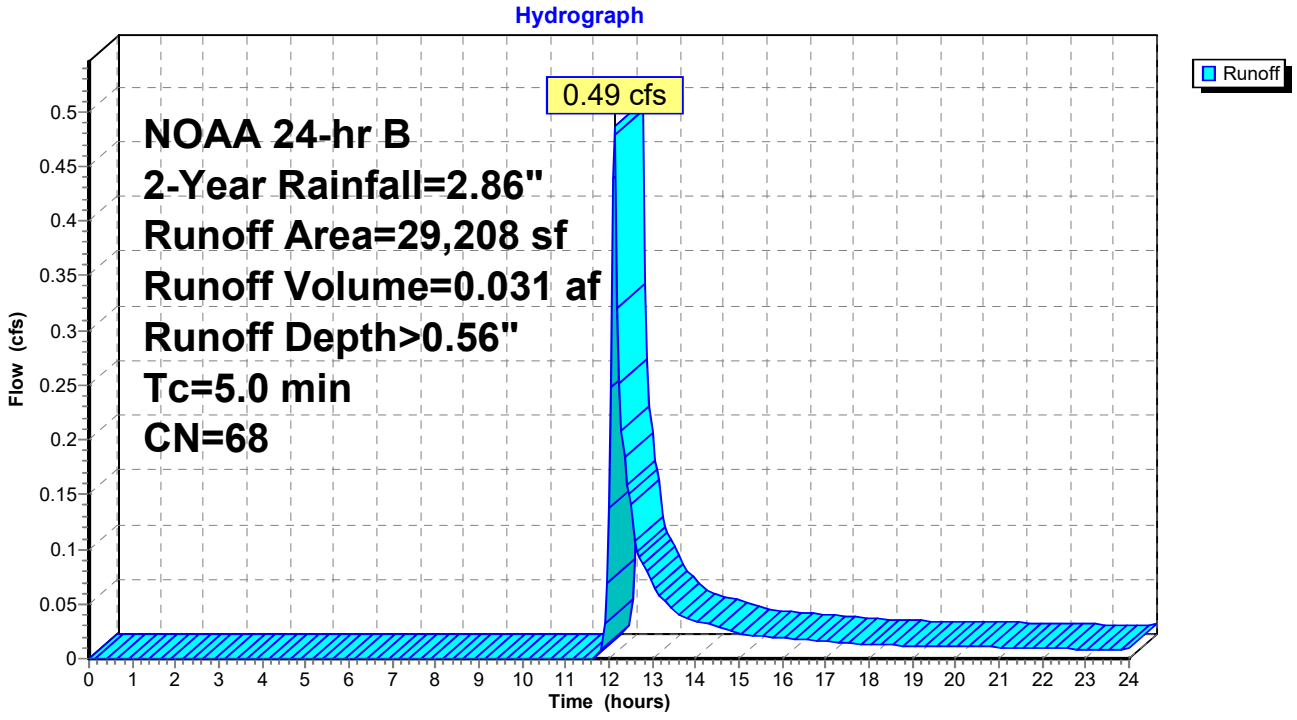
Runoff = 0.49 cfs @ 12.14 hrs, Volume= 0.031 af, Depth> 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 2-Year Rainfall=2.86"

	Area (sf)	CN	Description
	6,747	98	Paved parking, HSG B
	14,322	55	Woods, Good, HSG B
	7,304	61	>75% Grass cover, Good, HSG B
*	835	98	Sidewalks
	29,208	68	Weighted Average
	21,626		74.04% Pervious Area
	7,582		25.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct Entry**

Subcatchment 3S: POS-3 PROPOSED



Summary for Subcatchment 4S: POS-4 PROPOSED

[47] Hint: Peak is 133% of capacity of segment #4

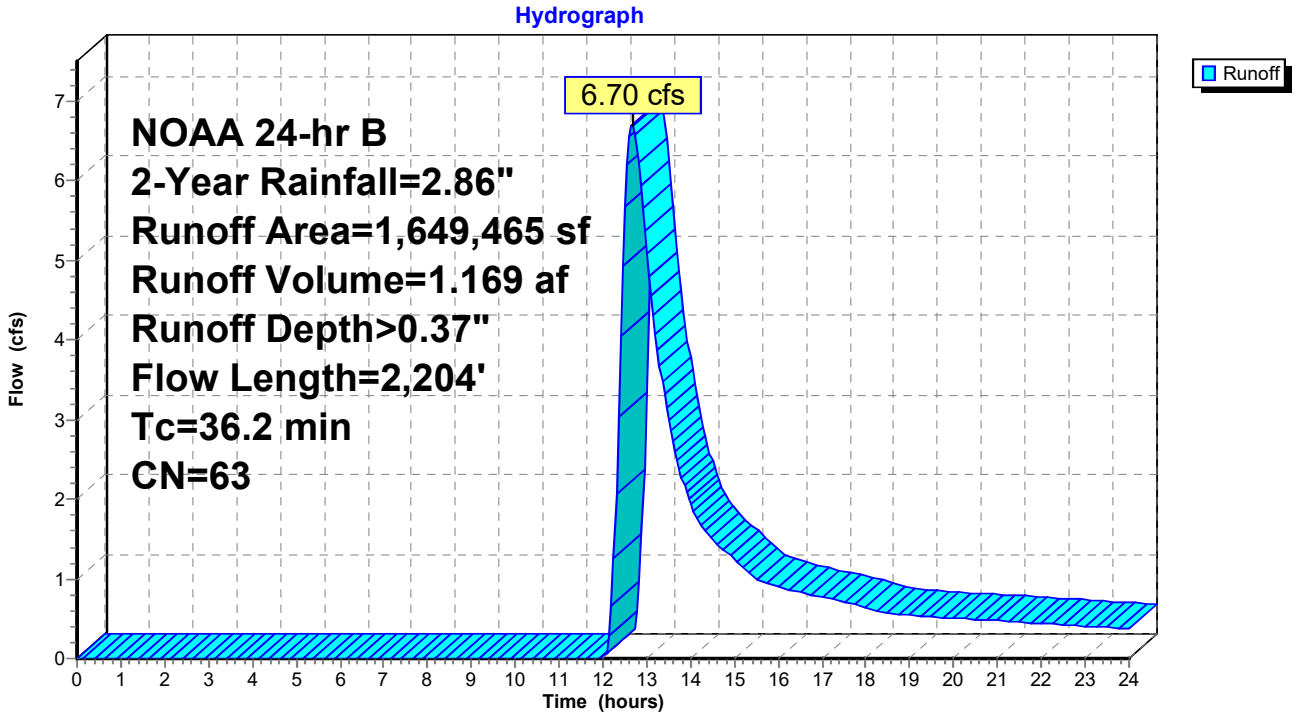
Runoff = 6.70 cfs @ 12.66 hrs, Volume= 1.169 af, Depth> 0.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 2-Year Rainfall=2.86"

	Area (sf)	CN	Description
	23,217	98	Paved parking, HSG B
	3,714	98	Paved parking, HSG C
	633,250	55	Woods, Good, HSG B
	765,427	70	Woods, Good, HSG C
	67,552	61	>75% Grass cover, Good, HSG B
	62,172	74	>75% Grass cover, Good, HSG C
	10,345	98	Roofs, HSG C
	8,090	98	Roofs, HSG B
	74,454	30	Woods, Good, HSG A
*	125	98	Retaining Walls, HSG B
*	1,119	98	Sidewalks, HSG B
	1,649,465	63	Weighted Average
	1,602,855		97.17% Pervious Area
	46,610		2.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.6	100	0.1000	0.09		**Sheet Flow, Sheet Flow A-B** Woods: Dense underbrush n= 0.800 P2= 3.22"
16.1	1,997	0.1700	2.06		**Shallow Concentrated Flow, Shallow conc B-C** Woodland Kv= 5.0 fps
0.4	65	0.1700	2.89		**Shallow Concentrated Flow, Shallow conc C-D** Short Grass Pasture Kv= 7.0 fps
0.1	42	0.0200	6.42	5.04	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, straight & clean
36.2	2,204	Total			

Subcatchment 4S: POS-4 PROPOSED



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: POS-1 PROPOSED Runoff Area=4.452 ac 4.94% Impervious Runoff Depth>0.73"
Flow Length=2,330' Tc=17.0 min CN=58 Runoff=2.60 cfs 0.271 af

Subcatchment 2S: POS-2 PROPOSED Runoff Area=51,450 sf 39.27% Impervious Runoff Depth>1.71"
Tc=5.0 min CN=74 Runoff=2.99 cfs 0.168 af

Subcatchment 3S: POS-3 PROPOSED Runoff Area=29,208 sf 25.96% Impervious Runoff Depth>1.30"
Tc=5.0 min CN=68 Runoff=1.26 cfs 0.073 af

Subcatchment 4S: POS-4 PROPOSED Runoff Area=1,649,465 sf 2.83% Impervious Runoff Depth>0.99"
Flow Length=2,204' Tc=36.2 min CN=63 Runoff=23.11 cfs 3.123 af

Total Runoff Area = 44.170 ac Runoff Volume = 3.634 af Average Runoff Depth = 0.99"
95.64% Pervious = 42.242 ac 4.36% Impervious = 1.928 ac

Summary for Subcatchment 1S: POS-1 PROPOSED

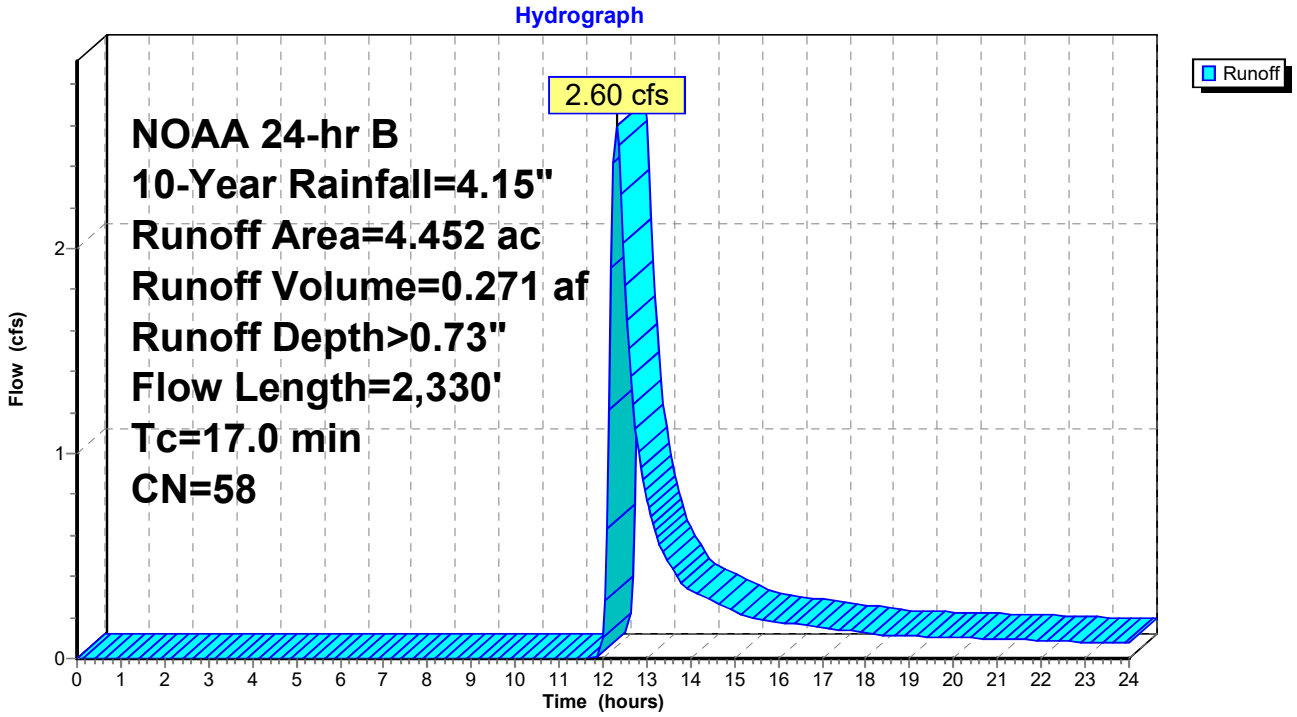
Runoff = 2.60 cfs @ 12.31 hrs, Volume= 0.271 af, Depth> 0.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 10-Year Rainfall=4.15"

Area (ac)	CN	Description
0.193	98	Paved parking, HSG B
3.644	55	Woods, Good, HSG B
0.524	61	>75% Grass cover, Good, HSG B
0.064	74	>75% Grass cover, Good, HSG C
0.027	98	Roofs, HSG C
4.452	58	Weighted Average
4.232		95.06% Pervious Area
0.220		4.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.0900	0.31		**Sheet Flow, Sheet Flow A-B** Grass: Short n= 0.150 P2= 3.22"
0.6	122	0.2100	3.21		**Shallow Concentrated Flow, Shallow conc B-C** Short Grass Pasture Kv= 7.0 fps
0.7	59	0.0850	1.46		**Shallow Concentrated Flow, Shallow conc C-D** Woodland Kv= 5.0 fps
0.6	71	0.0850	2.04		**Shallow Concentrated Flow, Shallow conc D-E** Short Grass Pasture Kv= 7.0 fps
3.5	347	0.1100	1.66		**Shallow Concentrated Flow, Shallow conc E-F** Woodland Kv= 5.0 fps
1.2	196	0.3100	2.78		**Shallow Concentrated Flow, Shallow conc F-G** Woodland Kv= 5.0 fps
2.8	314	0.1400	1.87		**Shallow Concentrated Flow, Shallow conc G-H** Woodland Kv= 5.0 fps
0.2	26	0.0860	2.05		**Shallow Concentrated Flow, Shallow conc H-I** Short Grass Pasture Kv= 7.0 fps
0.9	88	0.1100	1.66		**Shallow Concentrated Flow, Shallow conc I-J** Woodland Kv= 5.0 fps
0.2	247	0.0755	20.60	525.34	**Channel Flow, channel J-K** Area= 25.5 sf Perim= 18.0' r= 1.42' n= 0.025 Earth, clean & winding
0.9	760	0.0300	14.86	386.25	**Channel Flow, Channel D-E** Area= 26.0 sf Perim= 15.0' r= 1.73' n= 0.025 Earth, clean & winding
17.0	2,330	Total			

Subcatchment 1S: POS-1 PROPOSED



Summary for Subcatchment 2S: POS-2 PROPOSED

[49] Hint: Tc<2dt may require smaller dt

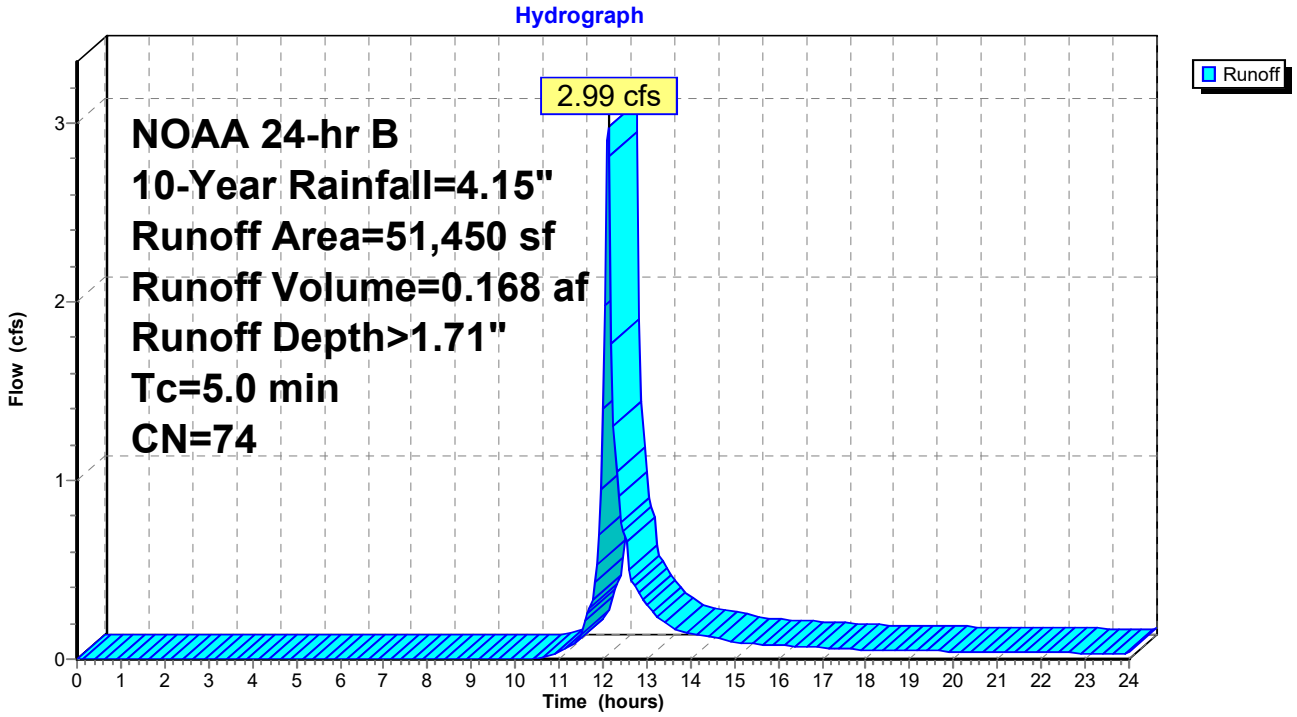
Runoff = 2.99 cfs @ 12.12 hrs, Volume= 0.168 af, Depth> 1.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 10-Year Rainfall=4.15"

	Area (sf)	CN	Description
	19,457	98	Paved parking, HSG B
	9,297	55	Woods, Good, HSG B
	21,947	61	>75% Grass cover, Good, HSG B
*	230	98	Retaining walls, HSG B
*	519	98	Sidewalks
	51,450	74	Weighted Average
	31,244		60.73% Pervious Area
	20,206		39.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct entry**

Subcatchment 2S: POS-2 PROPOSED



Summary for Subcatchment 3S: POS-3 PROPOSED

[49] Hint: Tc<2dt may require smaller dt

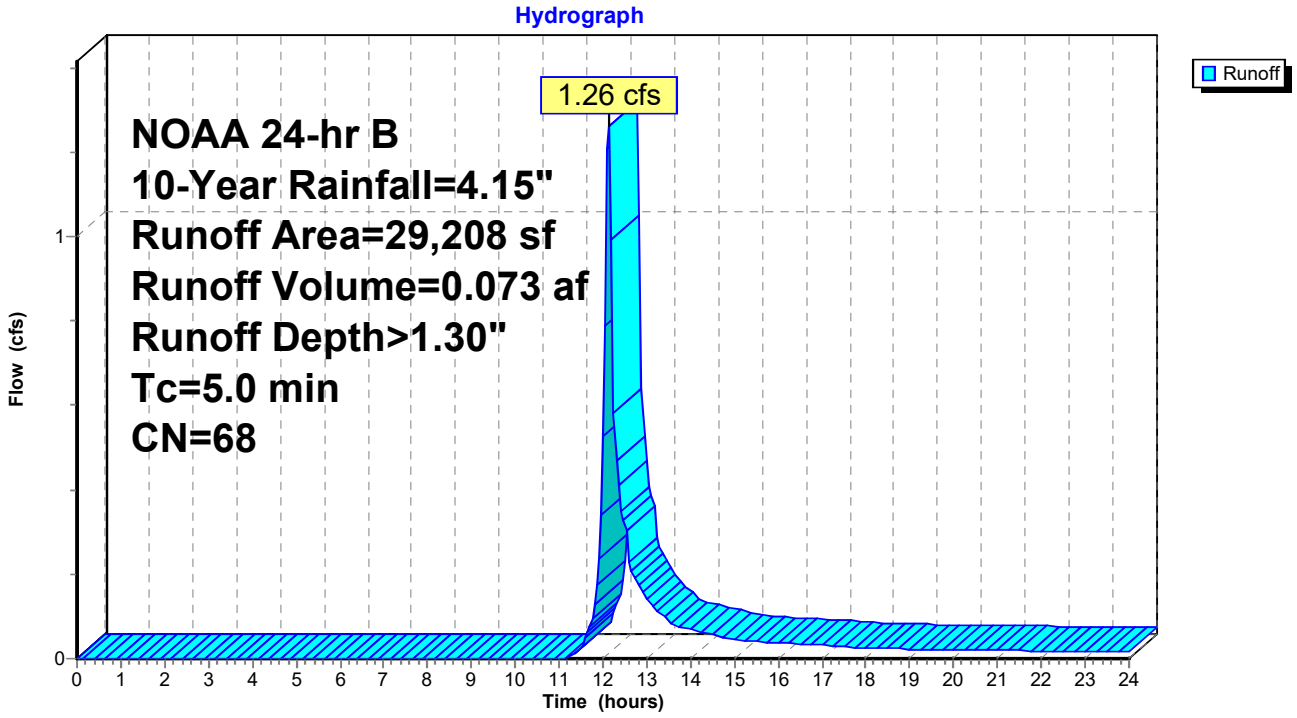
Runoff = 1.26 cfs @ 12.13 hrs, Volume= 0.073 af, Depth> 1.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 10-Year Rainfall=4.15"

	Area (sf)	CN	Description
	6,747	98	Paved parking, HSG B
	14,322	55	Woods, Good, HSG B
	7,304	61	>75% Grass cover, Good, HSG B
*	835	98	Sidewalks
	29,208	68	Weighted Average
	21,626		74.04% Pervious Area
	7,582		25.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct Entry**

Subcatchment 3S: POS-3 PROPOSED



Summary for Subcatchment 4S: POS-4 PROPOSED

[47] Hint: Peak is 459% of capacity of segment #4

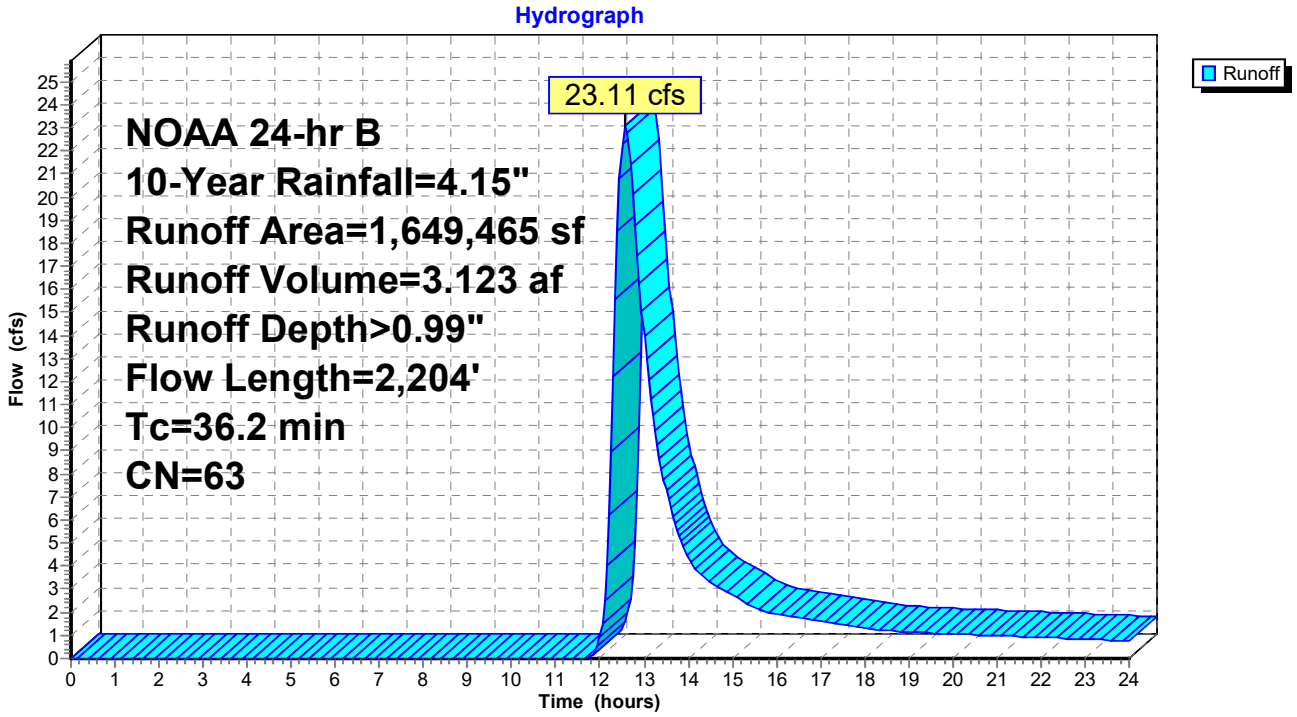
Runoff = 23.11 cfs @ 12.58 hrs, Volume= 3.123 af, Depth> 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 10-Year Rainfall=4.15"

	Area (sf)	CN	Description
	23,217	98	Paved parking, HSG B
	3,714	98	Paved parking, HSG C
	633,250	55	Woods, Good, HSG B
	765,427	70	Woods, Good, HSG C
	67,552	61	>75% Grass cover, Good, HSG B
	62,172	74	>75% Grass cover, Good, HSG C
	10,345	98	Roofs, HSG C
	8,090	98	Roofs, HSG B
	74,454	30	Woods, Good, HSG A
*	125	98	Retaining Walls, HSG B
*	1,119	98	Sidewalks, HSG B
	1,649,465	63	Weighted Average
	1,602,855		97.17% Pervious Area
	46,610		2.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.6	100	0.1000	0.09		**Sheet Flow, Sheet Flow A-B** Woods: Dense underbrush n= 0.800 P2= 3.22"
16.1	1,997	0.1700	2.06		**Shallow Concentrated Flow, Shallow conc B-C** Woodland Kv= 5.0 fps
0.4	65	0.1700	2.89		**Shallow Concentrated Flow, Shallow conc C-D** Short Grass Pasture Kv= 7.0 fps
0.1	42	0.0200	6.42	5.04	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, straight & clean
36.2	2,204	Total			

Subcatchment 4S: POS-4 PROPOSED



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: POS-1 PROPOSED Runoff Area=4.452 ac 4.94% Impervious Runoff Depth>2.11"
Flow Length=2,330' Tc=17.0 min CN=58 Runoff=9.10 cfs 0.781 af

Subcatchment 2S: POS-2 PROPOSED Runoff Area=51,450 sf 39.27% Impervious Runoff Depth>3.66"
Tc=5.0 min CN=74 Runoff=6.40 cfs 0.360 af

Subcatchment 3S: POS-3 PROPOSED Runoff Area=29,208 sf 25.96% Impervious Runoff Depth>3.06"
Tc=5.0 min CN=68 Runoff=3.05 cfs 0.171 af

Subcatchment 4S: POS-4 PROPOSED Runoff Area=1,649,465 sf 2.83% Impervious Runoff Depth>2.55"
Flow Length=2,204' Tc=36.2 min CN=63 Runoff=66.05 cfs 8.059 af

Total Runoff Area = 44.170 ac Runoff Volume = 9.371 af Average Runoff Depth = 2.55"
95.64% Pervious = 42.242 ac 4.36% Impervious = 1.928 ac

Summary for Subcatchment 1S: POS-1 PROPOSED

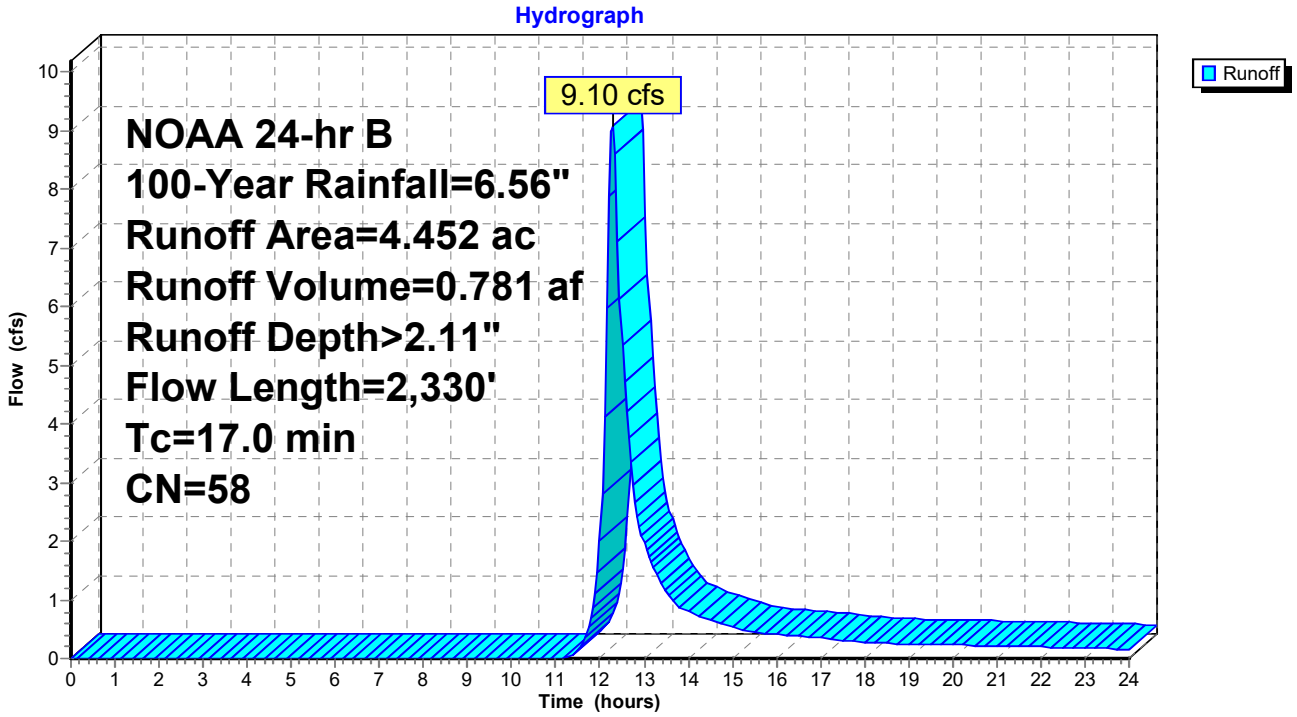
Runoff = 9.10 cfs @ 12.28 hrs, Volume= 0.781 af, Depth> 2.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 100-Year Rainfall=6.56"

Area (ac)	CN	Description
0.193	98	Paved parking, HSG B
3.644	55	Woods, Good, HSG B
0.524	61	>75% Grass cover, Good, HSG B
0.064	74	>75% Grass cover, Good, HSG C
0.027	98	Roofs, HSG C
4.452	58	Weighted Average
4.232		95.06% Pervious Area
0.220		4.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.0900	0.31		**Sheet Flow, Sheet Flow A-B** Grass: Short n= 0.150 P2= 3.22"
0.6	122	0.2100	3.21		**Shallow Concentrated Flow, Shallow conc B-C** Short Grass Pasture Kv= 7.0 fps
0.7	59	0.0850	1.46		**Shallow Concentrated Flow, Shallow conc C-D** Woodland Kv= 5.0 fps
0.6	71	0.0850	2.04		**Shallow Concentrated Flow, Shallow conc D-E** Short Grass Pasture Kv= 7.0 fps
3.5	347	0.1100	1.66		**Shallow Concentrated Flow, Shallow conc E-F** Woodland Kv= 5.0 fps
1.2	196	0.3100	2.78		**Shallow Concentrated Flow, Shallow conc F-G** Woodland Kv= 5.0 fps
2.8	314	0.1400	1.87		**Shallow Concentrated Flow, Shallow conc G-H** Woodland Kv= 5.0 fps
0.2	26	0.0860	2.05		**Shallow Concentrated Flow, Shallow conc H-I** Short Grass Pasture Kv= 7.0 fps
0.9	88	0.1100	1.66		**Shallow Concentrated Flow, Shallow conc I-J** Woodland Kv= 5.0 fps
0.2	247	0.0755	20.60	525.34	**Channel Flow, channel J-K** Area= 25.5 sf Perim= 18.0' r= 1.42' n= 0.025 Earth, clean & winding
0.9	760	0.0300	14.86	386.25	**Channel Flow, Channel D-E** Area= 26.0 sf Perim= 15.0' r= 1.73' n= 0.025 Earth, clean & winding
17.0	2,330	Total			

Subcatchment 1S: POS-1 PROPOSED



Summary for Subcatchment 2S: POS-2 PROPOSED

[49] Hint: Tc<2dt may require smaller dt

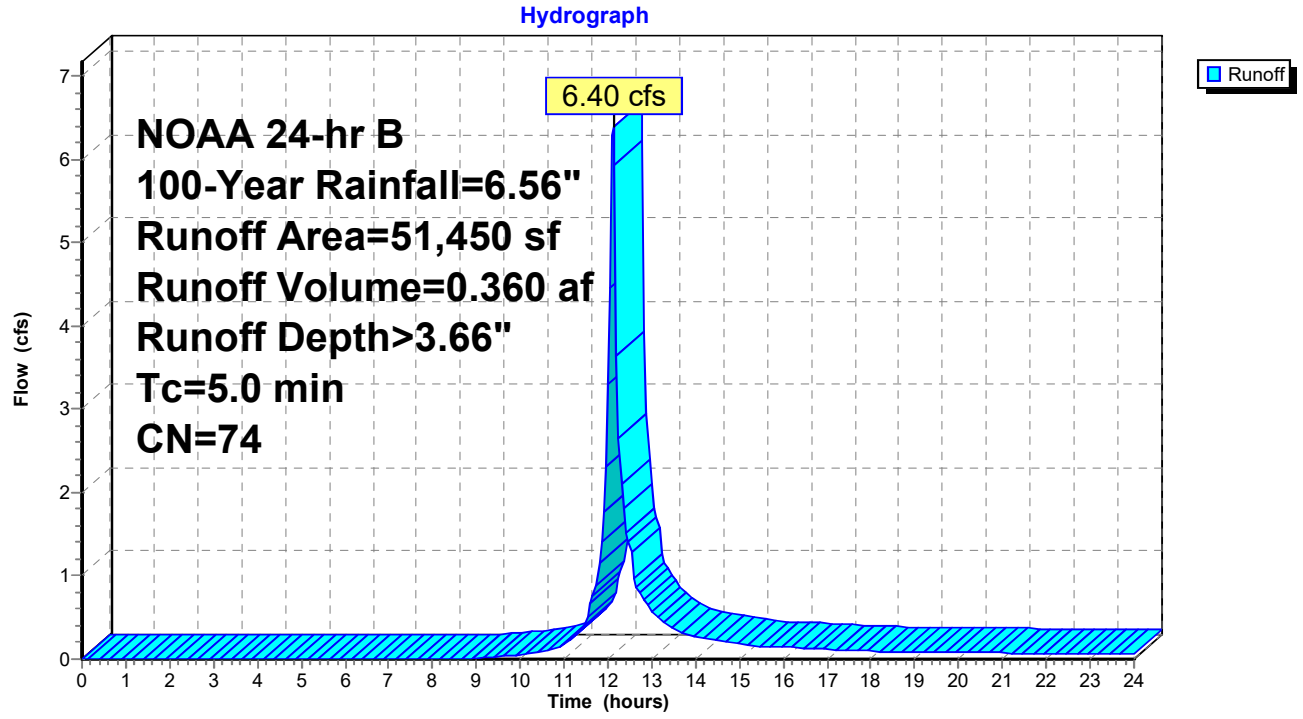
Runoff = 6.40 cfs @ 12.12 hrs, Volume= 0.360 af, Depth> 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 100-Year Rainfall=6.56"

	Area (sf)	CN	Description
	19,457	98	Paved parking, HSG B
	9,297	55	Woods, Good, HSG B
	21,947	61	>75% Grass cover, Good, HSG B
*	230	98	Retaining walls, HSG B
*	519	98	Sidewalks
	51,450	74	Weighted Average
	31,244		60.73% Pervious Area
	20,206		39.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct entry**

Subcatchment 2S: POS-2 PROPOSED



Summary for Subcatchment 3S: POS-3 PROPOSED

[49] Hint: Tc<2dt may require smaller dt

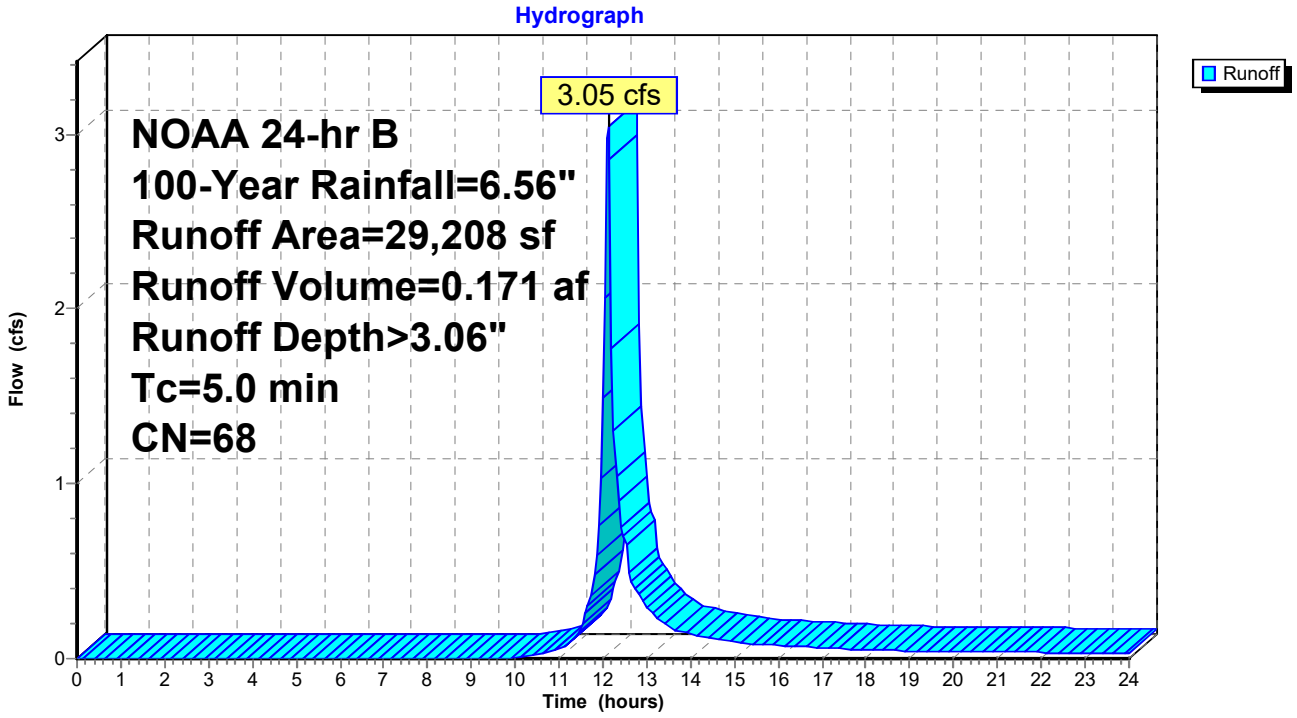
Runoff = 3.05 cfs @ 12.12 hrs, Volume= 0.171 af, Depth> 3.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 100-Year Rainfall=6.56"

	Area (sf)	CN	Description
	6,747	98	Paved parking, HSG B
	14,322	55	Woods, Good, HSG B
	7,304	61	>75% Grass cover, Good, HSG B
*	835	98	Sidewalks
	29,208	68	Weighted Average
	21,626		74.04% Pervious Area
	7,582		25.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct Entry**

Subcatchment 3S: POS-3 PROPOSED



Summary for Subcatchment 4S: POS-4 PROPOSED

[47] Hint: Peak is 1311% of capacity of segment #4

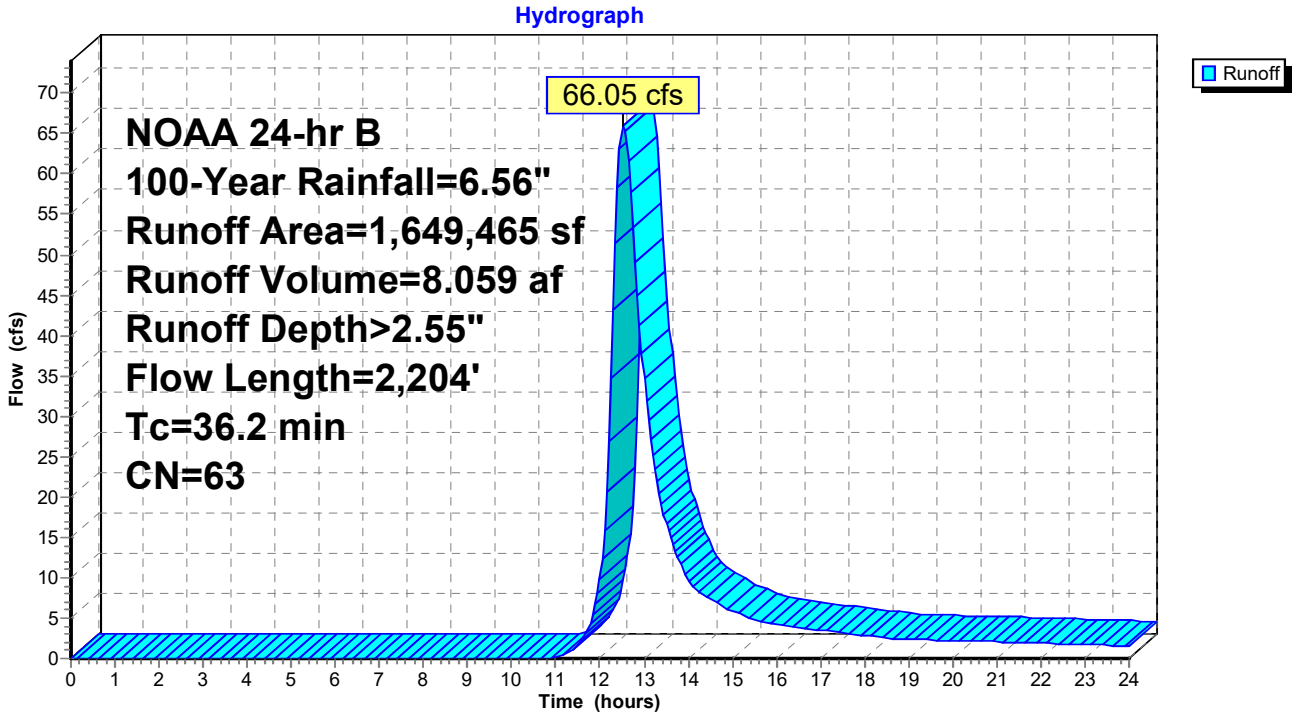
Runoff = 66.05 cfs @ 12.53 hrs, Volume= 8.059 af, Depth> 2.55"

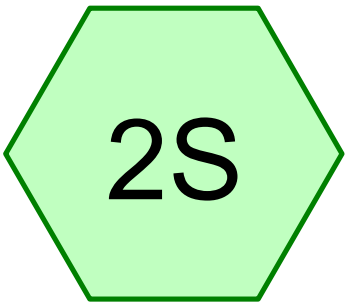
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 100-Year Rainfall=6.56"

	Area (sf)	CN	Description
	23,217	98	Paved parking, HSG B
	3,714	98	Paved parking, HSG C
	633,250	55	Woods, Good, HSG B
	765,427	70	Woods, Good, HSG C
	67,552	61	>75% Grass cover, Good, HSG B
	62,172	74	>75% Grass cover, Good, HSG C
	10,345	98	Roofs, HSG C
	8,090	98	Roofs, HSG B
	74,454	30	Woods, Good, HSG A
*	125	98	Retaining Walls, HSG B
*	1,119	98	Sidewalks, HSG B
	1,649,465	63	Weighted Average
	1,602,855		97.17% Pervious Area
	46,610		2.83% Impervious Area

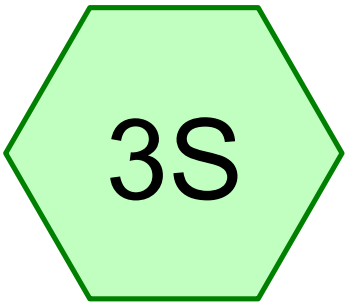
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.6	100	0.1000	0.09		**Sheet Flow, Sheet Flow A-B** Woods: Dense underbrush n= 0.800 P2= 3.22"
16.1	1,997	0.1700	2.06		**Shallow Concentrated Flow, Shallow conc B-C** Woodland Kv= 5.0 fps
0.4	65	0.1700	2.89		**Shallow Concentrated Flow, Shallow conc C-D** Short Grass Pasture Kv= 7.0 fps
0.1	42	0.0200	6.42	5.04	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, straight & clean
36.2	2,204	Total			

Subcatchment 4S: POS-4 PROPOSED





POS-2 PROPOSED
WITH SWM#1



POS-3 PROPOSED
WITH SWM#2

Subcat Reach Pond Link

Routing Diagram for Greenbrier- Proposed DA Conditions WITH SWM
Prepared by Microsoft, Printed 2/24/2021

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	10-Year	NOAA 24-hr	B	Default	24.00	1	4.15	2

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
1.316	HSG B	2S, 3S
0.000	HSG C	
0.000	HSG D	
0.541	Other	2S, 3S
1.857		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.502	0.000	0.000	0.000	0.502	>75% Grass cover, Good	2S, 3S
0.000	0.267	0.000	0.000	0.000	0.267	Paved parking	2S
0.000	0.005	0.000	0.000	0.000	0.005	Retaining walls	2S
0.000	0.000	0.000	0.000	0.270	0.270	SWM REDUCED CN AREA	2S
0.000	0.000	0.000	0.000	0.240	0.240	SWM SWM REDUCED RCN	3S
0.000	0.000	0.000	0.000	0.031	0.031	Sidewalks	2S, 3S
0.000	0.542	0.000	0.000	0.000	0.542	Woods, Good	2S, 3S
0.000	**1.316**	**0.000**	**0.000**	**0.541**	**1.857**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 2S: POS-2 PROPOSED Runoff Area=1.181 ac 24.05% Impervious Runoff Depth>1.18"
Tc=5.0 min CN=66 Runoff=1.99 cfs 0.116 af

Subcatchment 3S: POS-3 PROPOSED WITH Runoff Area=0.676 ac 2.81% Impervious Runoff Depth>0.34"
Tc=5.0 min CN=49 Runoff=0.15 cfs 0.019 af

Total Runoff Area = 1.857 ac Runoff Volume = 0.135 af Average Runoff Depth = 0.87"
83.68% Pervious = 1.554 ac 16.32% Impervious = 0.303 ac

Summary for Subcatchment 2S: POS-2 PROPOSED WITH SWM#1

[49] Hint: Tc<2dt may require smaller dt

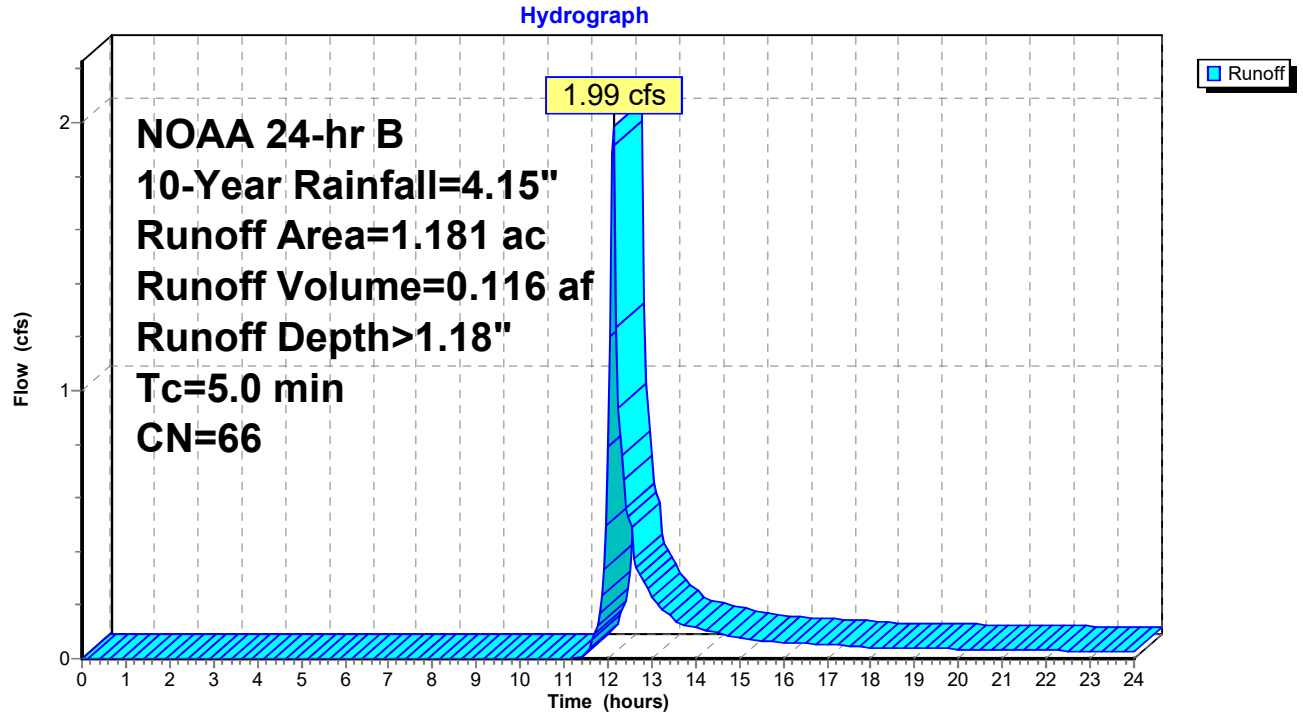
Runoff = 1.99 cfs @ 12.13 hrs, Volume= 0.116 af, Depth> 1.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 10-Year Rainfall=4.15"

	Area (ac)	CN	Description
	0.267	98	Paved parking, HSG B
	0.213	55	Woods, Good, HSG B
	0.414	61	>75% Grass cover, Good, HSG B
*	0.005	98	Retaining walls, HSG B
*	0.012	98	Sidewalks
*	0.270	50	SWM REDUCED CN AREA
	1.181	66	Weighted Average
	0.897		75.95% Pervious Area
	0.284		24.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct entry**

Subcatchment 2S: POS-2 PROPOSED WITH SWM#1



Summary for Subcatchment 3S: POS-3 PROPOSED WITH SWM#2

[49] Hint: Tc<2dt may require smaller dt

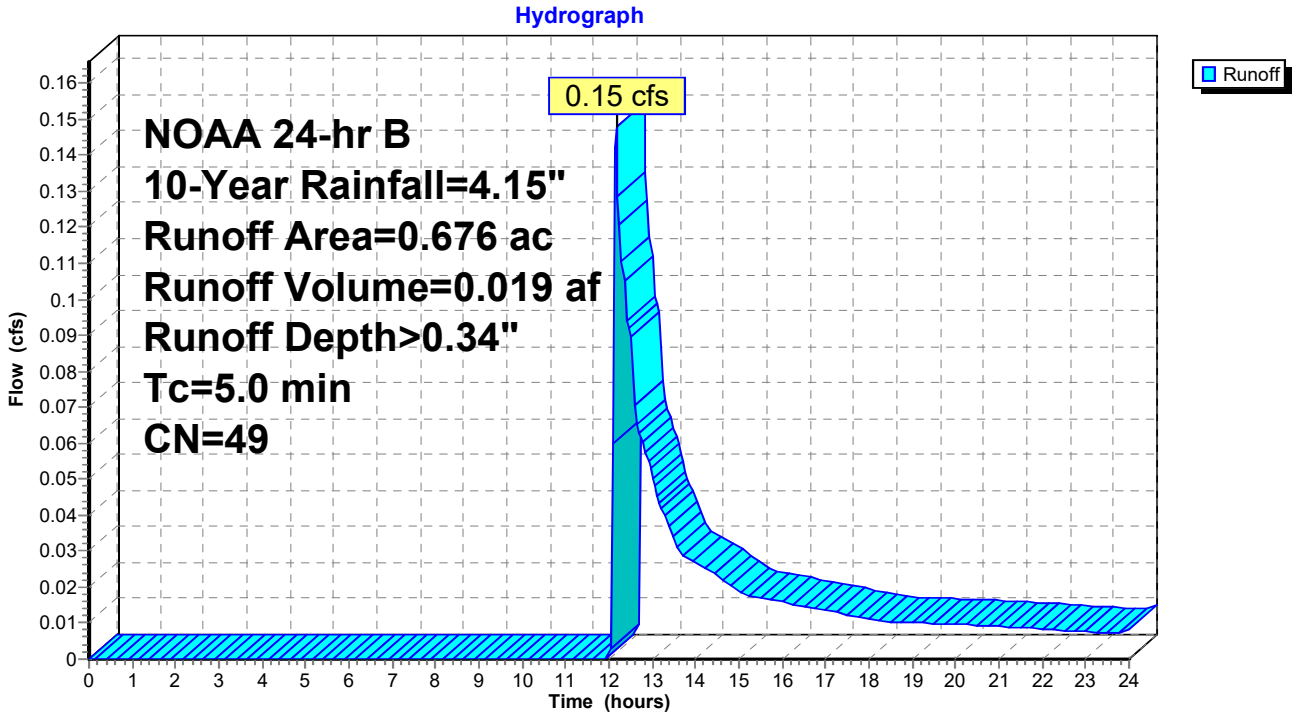
Runoff = 0.15 cfs @ 12.17 hrs, Volume= 0.019 af, Depth> 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr B 10-Year Rainfall=4.15"

	Area (ac)	CN	Description
	0.000	98	Paved parking, HSG B
	0.329	55	Woods, Good, HSG B
	0.088	61	>75% Grass cover, Good, HSG B
*	0.019	98	Sidewalks
*	0.240	33	SWM SWM REDUCED RCN
	0.676	49	Weighted Average
	0.657		97.19% Pervious Area
	0.019		2.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct Entry**

Subcatchment 3S: POS-3 PROPOSED WITH SWM#2



EXISTING POS-2 STORM DRAIN OUTFALL PHOTOS