PROFESSIONAL ENGINEERING SERVICES

WWA PROJECT NO. 220047.00

PROJECT MANUAL

CULPEPER STATION PEDESTRIAN BRIDGE

TOWN OF CULPEPER, VIRGINIA

BID SET

Rev November 11, 2022

Prepared by:

ENGINEERS
SURVEYORS
PLANNERS
ASSOCIATES

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Section 01100
Advertisement for Bids

Re: Town of Culpeper, Virginia
Culpeper Station Pedestrian Bridge

Sealed bids on the referenced project will be received by the Director of Public Services at the Public Works Building, 15038 Service Lane, Culpeper, VA 22701 until 2:00 P.M., local prevailing time, December 21, 2022, and then publicly opened.

Bids may be withdrawn using the procedure set forth in Virginia Code § 2.2-4330(B)(2).

The project will consist of construction of the following work:

- 102 feet pre-engineered pedestrian bridge
- Two (2) towers with elevators and stairs
- Restroom facility
- Associated site improvements and related incidental work

The Town will award the contract on a lump sum base bid.

Bid documents consisting of project manual and drawings are open to the public for inspection at the following locations:

- Owner: Town of Culpeper, Public Works Building, 15038 Service Lane, Culpeper, VA 22701
- Engineer: WW Associates, Inc., 1499 Crossings Centre Drive, Suite B, Forest, VA 24551, Telephone: 434-316-6080
- WW Associates, Inc., 968 Olympia Drive, Suite 1, Charlottesville, VA 22911
- Valley Construction News, 426 West Campbell Avenue, Roanoke, VA 24016
- Dodge Construction Network, www.construction.com, 877-784-9556
- eVA – Virginia's eProcurement Marketplace, https://eva.virginia.gov/

A pre-bid conference will be held at 10:00 A.M. on December 7, 2022 at the Public Works Building, 15038 Service Lane, Culpeper, VA 22701.

Bid documents in PDF format may be obtained from WW Associates, Inc. at no charge. Bidder must include contact person, email address to receive bid documents, business address and telephone number.

Bid Security: Bids shall be accompanied by a certified check or an acceptable bid bond in the amount of 5 percent of the base bid.

Bidders must be licensed as Contractors in the Commonwealth of Virginia in accordance with Title 54.1, Chapter 11 of the Code of Virginia (1950) as amended.

The Owner reserves the right to reject any Bid for failure to comply with all requirements of this Notice or any of the Contract Documents; however, it may waive any minor

defects or informalities at its sole and unfettered discretion. The Owner further reserves the right to reject any and all Bids or to Award the contract which in its judgment is in the best interest of the Owner.

End of Advertisement

Section 01200
Instructions to Bidders

1 General: To be valid for consideration, bids must be completed and submitted in accordance with these instructions to bidders.

2 Qualification of Bidders: Each bidder must be prepared to submit within 5 calendar days of the Owner's request written evidence of his qualifications for the project, including financial data, previous experience, and evidence of authority to conduct business in the jurisdiction where the project is located.

3 Examination of Bid Documents and Site

3.1 Before submitting bids, each bidder must examine bid documents thoroughly; familiarize himself with federal, state and local laws, ordinances, rules, and regulations affecting the work; and correlate his observations with the requirements of the bid documents.

3.2 Bidders are requested and expected to visit the site of the project to alert themselves to local and special conditions, which may be encountered during construction of the project. Failure to make such investigations shall not relieve the successful bidder from performing and completing the work in accordance with the contract documents.

4 Interpretations

4.1 **All questions concerning this project shall be directed to WW Associates, Inc. Telephone: (434) 316-6080, Fax: (434) 978-1444, and E-Mail: hwhite@wwassociates.net. Herbert F. White III, P.E. is the point of contact.** No oral interpretations of the bid documents will be made to any bidder. To be given consideration, requests for interpretations must be received in time to allow preparation of written response at least 5 days prior for receipt of bids. Interpretations will be written in the form of written addenda to the bid documents and mailed to all parties recorded by WW Associates, Inc. as having received bid documents, prior to scheduled receipt of bids. Only interpretations by formal written addenda will be binding.

5 Bid Submission

5.1 Submit one copy of the bid using forms furnished by WW Associates, Inc. and fill in all blank spaces on the form. Repeat notation "Contractor's Current Virginia License No. _____" on outside of inner envelope containing bid and bid security, and place this envelope within another envelope addressed to:

5.1.1 Mr. James E. Hoy, III, P.E.
Director of Public Services
Town of Culpeper
Public Works Building
15038 Service Lane
Culpeper, Virginia 22701

5.2 The inner envelope shall have noted thereon:

5.2.1 "Bid for Construction of Town of Culpeper, Virginia, Culpeper Station Pedestrian Bridge"

5.3 Bid security, bidding documents, receipt deadline for bids, and pre-bid conferences shall be as specified herein.

5.3.1 No bidder shall withdraw, modify, or cancel any part of his bid for 90 days following bid opening.

5.4 Modifications and withdrawal of bids: Bids may be modified or withdrawn by appropriate document duly executed (in the manner that a bid must be executed) and delivered to the place where the bids are to be submitted at any time prior to the receipt of bids.

5.5 Withdrawal of bids after date for submission: In accordance with Procedure (ii) of Section 11-54(A) of the Code of Virginia, the bidder will have 2 business days after the opening of bids within which to claim in writing any mistake as defined in said section and withdraw his bid, provided such mistake be proved from the Contractor's work papers. Failure to submit Contractor's work papers will be considered as a waiver of any right of withdrawal of bids after the date for submission.

5.6 Bid documents in Adobe Acrobat (PDF) format may be obtained from WW Associates, Inc. at no charge. Bidder must include contact person, email address to receive bid documents, business address and telephone number.

5.7 Bid Security: Bids shall be accompanied by a certified check or an acceptable bid bond in the amount of 5 percent of the base bid.

5.8 All Base Bid Items must be completed in their entirety; failure by the Contractor to fully complete the bid form will be considered a non-responsive bid.

6 Agreement, insurance certificate, and bonds shall be drawn on forms identical to those bound within this project manual.

6.1 Bonds shall be with a surety company acceptable to the Owner.

6.2 A Performance Bond and a Payment Bond will be required in the amount of 100 percent of the bid.

7 Award of Contract

7.1 The award of the contract will be as specified in Section 01300 – Bid Form.

7.2 Should the responsive bid from the lowest responsible bidder exceed available funds, the Owner may negotiate with the lowest responsible bidder in accordance

with Section 2.2-4318 of the Virginia Public Procurement Act to obtain a contract price within available funds.

7.3 The Owner reserves the right to reject any and all bids and waive any and all informalities and the right to disregard all nonconforming or conditional bids or counterproposals.

7.4 Submission of post-bid information shall be in accordance with the contract documents.

End of Section

Contractor _____ Date _____

VA License No. _____

Section 01300
Bid Form

Gentlemen:

The undersigned, having visited and examined the site and having carefully studied the drawings and project manual for the Town of Culpeper, Virginia, Culpeper Station Pedestrian Bridge, hereby proposes to furnish all plant, labor, equipment, materials, and services and to perform all operations necessary to execute and complete the work required for the project, in strict accordance with the drawings and technical specifications prepared by WW Associates, Inc. Engineers • Surveyors • Planners, dated May 27, 2022, revised November 11, 2022, together with addenda numbered _____, issued during bidding period and hereby acknowledged, subject to the terms and conditions of the agreement as follows:

The **Total Base Bid** is defined as all work associated with the project, except Additive Bid Item 1, complete and in accordance with the drawings and technical specifications, for the sum of:

_____Dollars

($_____).

Additive Bid Item No. 1: Is defined as all work associated with the construction of the Rest Room Facility:

_____Dollars

($_____).

Notes:

a) The basis of award for determining the low bidder shall be the lowest Total Base Bid.

b) The Total Base Bid is founded upon furnishing equipment and materials of specified manufacturers.

c) The Contractor is advised to refer to the Lines and Grades paragraph in Section 01400 – General Requirements for bidding instructions on construction stakeout services.

It is understood and agreed that the Owner, in protecting his best interest, reserves the right to:

a) Reject any or all bids.

We are properly equipped to execute work as defined in the contract documents and so covered by this bid and will enter into agreement for the execution and completion of the work in accordance with the drawings, project manual, and this bid. We further agree that if awarded the contract, we will commence the work on the date stated in the "Notice to Contractor to Proceed," and will prosecute the work and shall be substantially complete as defined in the General Conditions within 540 calendar days, and complete all obligations within 570 calendar days.

Contractor _____ Date _____

VA License No. _____

The Owner and Contractor recognize that time is of the essence with this agreement and that the Owner will suffer financial loss if the work is not completed within 540 calendar days. They also recognize the delays, expense, and difficulties involved in proving the actual loss suffered by the Owner if the work is not completed on time. Accordingly, instead of requiring any such proof, the Owner and Contractor therefore agree that, as liquidated damages for delay (but not as a penalty), the Contractor shall pay the Owner one thousand five hundred dollars ($1,000.00) for each day that expires after the time specified for substantial completion of this project.

Enclosed herewith is the following security, offered as evidence that the undersigned will enter into agreement for the execution and completion of the work in accordance with the drawings and project manual:

Certified check for the sum of_____

Name of bank_____

Bidder's bond in amount of_____

Bond issued by_____

The undersigned further agrees that in case of failure on his part to execute the said agreement within 10 consecutive calendar days after written notice being given on the award of the contract, the monies payable by the securities accompanying this bid shall be paid to the Town of Culpeper, Virginia as liquidated damages for such failure; otherwise, the securities accompanying this bid shall be returned to the undersigned.

This bid is subject to acceptance within a period of 90 days from bid submission date.

SUBMITTED on _____, 20_____.

Contractor's Current Virginia Contractor License No. _____.

If Bidder is:

An Individual

Name (typed or printed): _____

By: _____(SEAL)
(Individual's Signature)

Doing business as:_____

Business Address: _____

_____

Phone No.: _____ Fax No.: _____

A Partnership

Partnership Name: _____(SEAL)

By: _____
(Signature of general partner -- attach evidence of authority to sign)
Name (typed or printed): _____
Business Address: _____
_____
Phone No.: _____ Fax No.: _____

A Corporation

Corporation Name: _____(SEAL)
State of Incorporation: _____
Type (General Business, Professional Service, Limited Liability): _____
By: _____
(Signature -- attach evidence of authority to sign)
Name (typed or printed): _____
Title: _____ *(CORPORATE SEAL)*
Attest _____
(Signature of Corporate Secretary)
Business Address: _____
_____
Phone No.: _____ Fax No.: _____

A Joint Venture

Joint Venturer Name: _____(SEAL)
By: _____
(Signature of joint venture partner -- attach evidence of authority to sign)
Name (typed or printed): _____
Title: _____
Business Address: _____
_____
Phone No.: _____ Fax No.: _____

Joint Venturer Name: _____(SEAL)
By: _____
(Signature -- attach evidence of authority to sign)
Name (typed or printed): _____
Title: _____
Business Address: _____

Contractor _____ Date _____

VA License No. _____

_____

Phone No.: _____ Fax No.: _____

Phone and Fax Number, and Address for receipt of official communications:

_____

_____

(Each joint venture must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above.)

End of Section

Section 01400
General Requirements

1 General

1.1 Summary of Work

1.1.1 The work covered under this contract comprises the furnishing of all labor, materials, equipment, tools and services and the installation and construction of all items, and the performance of all work necessary to complete the work shown or called for on the drawings and/or this project manual.

1.1.2 All units under this Contract shall be operable, shall be installed as designed, and shall conform to the manufacturer's specifications for the particular application.

1.2 Contractor Use of Premises

1.2.1 The Contractor shall assume full responsibility for protection and safekeeping of products stored on or off premises.

1.2.2 The Contractor shall coordinate use of premises with the Owner and Engineer, and remove stored products that interfere with the operations of the Owner or other contractors.

1.2.3 The Contractor shall obtain and pay for all additional storage or work areas needed for operations under this Contract. These areas shall be subject to the same conditions as described for the Owner's property.

1.2.4 The Town Depot is an active Amtrak station serving passengers on a continual basis with facilities to include the Visitor's Center and passenger loading area adjacent to the railroad. The Contractor shall ensure that adequate pedestrian access in accordance with federal and state American with Disabilities Act (ADA) standards is maintained at all times. The Contractor is responsible for passenger safety on all access corridors adjacent to the work zone, as identified in the approved construction plans

1.3 Construction and Scheduling Sequence

1.3.1 All associated utilities shall remain in full operation during the construction period. Phases of the construction which involve the temporary interruption of essential services and demolition of existing items shall be scheduled in consultation with the Owner or their representatives, shall not be of longer duration than essential to accomplish the purpose for such interruptions, and shall be coordinated to give the Owner the ability to maintain water service. Liaison with the Owner in these matters is a salient feature of this contract.

1.3.2 Provide a written construction schedule and plan which describes in detail each major task and operation which will interfere with any existing system,

equipment, or operation. The plan shall describe the sequence and proposed method of accomplishing each task and the proposed schedule for interruptions.

1.3.3 All construction activities shall be performed inside acquired easements and right of ways designated for this project. Laydown areas for this project shall be the Contractor's responsibility. Laydown area shall be on the East side of the railroad tracks as indicated on the drawings. Coordination and scheduling of construction activities with the Town is a salient feature of this contract.

1.3.4 The Contractor shall make provisions for protecting all asphalt and concrete surfaces. Rubber tired vehicles will be required. Any damage to asphalt or concrete surfaces shall repaired/replaced in kind by the Contractor.

1.3.5 The Contractor shall create a pre-construction video of the entire project area to demonstrate pre-construction conditions. The Contractor shall provide the Owner with a DVD of the pre-construction video as a submittal.

1.3.6 Comply with all requirements of Norfolk Southern and Amtrak during construction including, but not limited to, flagging requirements.

1.4 Work Restrictions

1.4.1 Occupancy: If the Owner elects to operate any of the water line improvements under partial utilization, prior to the project's final acceptance, neither WW Associates, Inc. nor the Contractor shall be held responsible for the safety or well being of those occupants beyond the normal care and practice of the construction industry.

1.4.2 Normal working hours for the Contractor shall be 7:00 A.M. to 5:00 P.M., Monday through Friday, excluding state and federal holidays, unless otherwise approved by the Owner and WW Associates, Inc.

1.5 Contract Modification Procedures

1.5.1 Change Orders: No amount, in part or in whole, of a change order shall be included in a requisition for payment by the Contractor until the change order has been executed and copies of the change order have been distributed to the Owner and Contractor.

1.5.2 Work Orders: A work order is a device which enables the Owner to promptly order changes in the work which may involve changes in cost or contract time, or both pending preparation and execution of a formal change order.

1.5.3 Request for Change Order Proposal: The Owner may request the Contractor to submit a change order proposal for changes in contract work. The Contractor shall submit the proposal in accordance with contract

requirements within 3 days of a request by the Engineer or Owner. The Owner may issue to the Contractor a work order authorizing the required changes for an additional amount not to exceed, or a deduction of not less than the amount shown in the work order. If the Contractor is not in agreement with the amount stipulated in the work order, he shall, within a reasonable time after the issue date of the order, submit to WW Associates, Inc. an equitable proposal and develop with the Owner a mutually acceptable price for the required change in work.

1.5.4 The Contractor may initiate changes by submitting a written notice to the Engineer containing:

1.5.4.1 Description of the proposed changes.

1.5.4.2 Statement of the reason for making the changes.

1.5.4.3 Statement of the effect on the Contract Sum and the Contract Time.

1.5.4.4 Statement of the effect on the Work of separate Contractors.

1.5.4.5 Documentation supporting any change in Contract Sum or Contract Time, as appropriate.

1.6 Payment Procedures

1.6.1 Applications and Certificates for Payment: The form of each application for payment shall be EJCDC Document C-620 entitled, "Application and Certificate for Payment" accompanied by "Continuation Sheet," and "Stored Material Summary." Each application for payment by the Contractor, excluding the first, shall be accompanied by a "Contractor's Affidavit of Payment of Debts and Claims," AIA Document G706, and "Contractor's Affidavit of Release of Liens," AIA Document G706A. Each application shall be submitted on forms, copies of which are included in this project manual. Payment for stored material delivered but not incorporated in the work will be the invoiced amount only. Submit invoices with application for payment.

1.6.2 Upon recommendation by WW Associates, Inc. of the Contractor's request for partial payment, the Owner shall pay to the Contractor 95 percent of the total amount due and the Owner shall retain 5 percent of the amount due until final completion and acceptance of all work covered by the contract.

1.6.3 Schedule of Values: Submit complete schedule of values at least 10 days prior to first application for payment.

1.7 Project Meetings

1.7.1 Preconstruction conferences with the Contractor will be held after the effective date of the agreement.

1.7.2 Progress Meetings: Each month, the Contractor, Engineer, and the Owner shall hold a progress meeting to review progress to date and to resolve all questions for the upcoming month.

1.8 Progress Schedules: Submit a detailed construction schedule prior to the preconstruction conference. Revise the schedule prior to each progress meeting. Construction schedule shall be in a form that will clearly show the proposed degree of completeness of each aspect of the construction throughout the life of the contract. Bar graphs and/or PERT diagrams are acceptable forms.

1.9 Submittal Procedures

1.9.1 Shop Drawings, Product Data, and Samples: Prior to the preconstruction conference, prepare a submittal schedule satisfactory to WW Associates, Inc. fixing the dates for submission of shop drawings, product data, samples, and the like and update this schedule at each progress meeting to reflect the status of each submittal item.

1.9.1.1 Submit an electronic copy of all shop drawings in Adobe Acrobat PDF format.

1.9.1.2 A PDF electronic file of reviewed shop drawings will be returned to the Contractor.

1.9.1.3 Submit shop drawings, product data, samples, and the like as required by applicable specification sections.

1.9.1.4 Identify each item submitted using applicable specification section number and paragraph reference or drawing reference.

1.9.1.5 Shop drawings shall be approved by the Contractor and those subcontractors whose work is associated with the subject equipment as being in accordance with the contract documents prior to submission.

1.9.1.6 Failure to comply with these requirements will result in the submittal being returned unprocessed.

1.9.2 The Engineer's approval of Contractor's shop drawings will be general and shall not relieve the Contractor from the responsibility for adherence to the Contract, nor shall it relieve him of the responsibility for any errors that may exist. Where such errors or omissions are discovered later, they shall be made good by the Contractor, irrespective of any approval by the Engineer.

1.9.3 Equipment/Material Shop Drawings for any piece of equipment or item will be reviewed a maximum of one time by the Engineer. Subsequent reviews will be paid for by the General Contractor to the Engineer at the rate of $150.00 per hour and paid to the Engineer by an Owner deduct from the Contractor's monthly pay request. Contractors are cautioned to select

equipment that meets the requirements specified in the contract documents and to require their suppliers to provide detailed and accurate information in their submittal packages which can readily be approved.

1.10 Quality Control

1.10.1 Testing Laboratory Services: The Contractor will employ and pay for the services of an independent testing laboratory to perform testing specified to be done by an independent testing laboratory, unless specifically stated otherwise in other sections of the specifications. Employment of the laboratory shall in no way relieve the Contractor's obligations to perform the work of the contract.

1.11 Temporary Utilities

1.11.1 Temporary Electricity: The Contractor shall make all necessary arrangements for obtaining temporary electric power for construction purposes. No separate payment for electric power for construction purposes or testing other than the payment included in the contract lump sum or unit prices will be allowed.

1.11.2 Temporary Water: The Contractor may use the Town's potable water during construction free of charge. The Contractor must provide an appropriate air gap to prevent cross contamination in the Town's water system. Coordinate and schedule potable water usage with Town personnel prior to construction activities.

1.11.3 Temporary Sanitary Facilities: The Contractor shall provide and maintain in a neat and sanitary condition such accommodations for the use of his employees as will comply with laws and regulations.

1.12 Temporary Controls

1.12.1 Construction Cleaning: The Contractor shall clean daily all areas under construction to ensure minimum interference with roads, streets, sidewalks, and access of adjacent property owners.

1.12.2 Erosion and Sediment Control: These controls shall be in coordination with the appropriate drawings and any requirements of the local authority.

1.12.3 Dust Control: Contractor shall ensure that dust is held to a minimum throughout the length of the project through the application of moisture where applicable.

1.13 Vehicular Access and Parking

1.13.1 Parking and Laydown Areas: The location of Contractor parking and laydown areas shall be as agreed upon by the Owner and the Engineer.

Provide gravel in the laydown area and comply with the latest edition of the Virginia Erosion and Sediment Control Handbook.

1.13.2 Maintenance and Access Roads

1.13.2.1 All maintenance and access roads used by the Contractor shall be surfaced with 6 inches of VDOT No. 21A coarse aggregate. This work shall be progressively performed prior to use of any unsurfaced areas by the Contractor where construction will cause muddy and erodible conditions.

1.13.2.2 The Contractor shall maintain and supplement coarse aggregate and perform routine maintenance as required for all maintenance and access roads during construction. The Contractor shall develop suitable subgrade and provide 6 inches of VDOT No. 21A coarse aggregate as finished road course at the end of construction at no additional cost to the Owner.

1.14 Laydown Area

1.14.1 Laydown area shall be on the east side of the railroad tracks as indicated on the drawings. The Contractor shall repair and restore to preconstruction condition the designated laydown area and access area from East Spencer Street.

1.15 E-Mail Address: The Contractor shall provide an e-mail address to allow the Owner and the Engineer to correspond with the Contractor's project manager during the construction period.

1.16 Product Requirements

1.16.1 Quality of Material and Equipment Incorporated into the Work:

1.16.1.1 Design, fabricate and assemble in accordance with the best engineering and shop practices.

1.16.1.2 Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.

1.16.1.3 Two or more items of the same kind shall be identical, by the same manufacturer.

1.16.1.4 Products shall be suitable for services conditions.

1.16.1.5 Equipment capacities, sizes, and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.

1.16.2 Except as specifically indicated or specified, materials and equipment removed from the existing structure shall not be used in the completed work.

1.16.3 For material and equipment specifically indicated or specified to be reused in the work:

1.16.3.1 Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed work.

1.16.3.2 Arrange for transportation, storage, and handling of products, which require off-site storage, restoration, or renovation. Pay all costs for such work.

1.16.4 Manufacturer's Instructions

1.16.4.1 When contract documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to WW Associates, Inc.

1.16.4.2 Maintain one set of complete instructions at the job site during installation and until completion.

1.16.4.3 Handle, install, connect, clean, condition, and adjust products in accordance with such instructions and in conformity with specified requirements.

1.16.5 Transportation and Handling of Materials

1.16.5.1 Arrange deliveries of products in accordance with construction schedules. Coordinate to avoid conflict with work and conditions at the site.

1.16.5.2 Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

1.16.5.3 Immediately on delivery, inspect shipments to assure compliance with requirements of contract documents and approved submittals, and that products are properly protected and undamaged.

1.16.6 Storage and Protection

1.16.6.1 Store products in accordance with manufacturer's instructions, with seals and labels intact and legible.

1.16.6.2 Store products subject to damage by the elements in weathertight enclosures.

1.16.6.3 Maintain temperature and humidity within the ranges required by manufacturer's instructions.

1.16.6.4 Exterior Storage

1.16.6.4.1 Store fabricated products above the ground, on blocking or skids; prevent soiling or staining; cover products, which are subject to deterioration with impervious sheet coverings; and provide adequate ventilation to avoid condensation.

1.16.6.4.2 Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

1.16.6.4.3 Protection after Installation: Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove when no longer needed.

1.17 Lines and Grades

1.1.1 The Contractor shall include $12,000.00 in the Total Base Bid to be provided as payment for the initial construction stakeout provided by WW Associates, Inc. Certified Land Surveyor. Should the Contractor disturb the initial stakeout, restaking will be provided on an hourly rate to the Contractor by WW Associates, Inc. Stakeout fees are not subject to retainage. Stakeout will include the location and elevation data to construct structures, pavements, piping, and other improvements associated with this project. Stakeout services for the project will be as follows:

- Flag property limits
- Stake limits of towers
- Stake corners of fencing
- Stake utilities
- Stake restroom
- Stake hardscape features

1.18 Starting of Systems

1.18.1 The Contractor shall initially start up and place all equipment (including elevators) installed by the Contractor into successful operation according to manufacturers' written instructions and as instructed by manufacturers' representatives.

1.18.2 Provide all materials, labor, tools, equipment and expendables required.

1.18.3 Coordinate schedule for start-up of various equipment and systems. Notify the Engineer at least seven days prior to start-up of each item. The Owner's operator and the Engineer will be present during start-up.

1.18.4 When required in individual Specification Sections, the manufacturer shall provide an authorized representative to be present at the site to inspect, check, and approve equipment or system installation, and to supervise placing equipment or system into operation.

1.18.5 Submit a written report that each equipment item or system has been properly installed and is functioning correctly.

1.18.6 General activities include the following:

1.18.6.1 Cleaning.

1.18.6.2 Removing temporary protective coverings.

1.18.6.3 Flushing and replacing greases and lubricants, where required by manufacturer.

1.18.6.4 Lubrication.

1.18.6.5 Check shaft and coupling alignments and reset where needed.

1.18.6.6 Check and set motor, pump and other equipment, rotation, safety interlocks, and belt tensions.

1.18.6.7 Check and correct, if necessary, leveling plates, grout, bearing plates, anchor bolts, fasteners, and alignment of piping which may put stress on equipment connected to it.

1.18.6.8 Test all equipment and systems at normal operating conditions and through the normal operating range.

1.18.6.9 Make all adjustments and balances required

1.18.7 Minimum Start-Up Procedures

1.18.7.1 Motors: Measure amperage of each motor and compare to nameplate value. Correct conditions which produce excessive current flow, and which exist due to equipment malfunction.

1.18.7.2 Pumps: Check glands and seals for cleanliness and adjustment before operating pump. Inspect shaft sleeves for scoring. Inspect mechanical faces, chambers, and seal rings, and replace, if defective. Verify that piping system is free of debris before circulating liquid through pump. Pump startup shall be performed in accordance with the manufacturer's written recommendations

under the supervision of the manufacturer's representatives, and as specified in the technical specifications of this document.

1.18.7.3 Valves: Inspect all valves, clean bonnets and stems. Inspect packing glands to assure no leakage, and tighten or replace as necessary. Verify that control valve seats are free from foreign material and are properly positioned for service.

1.18.7.4 Pipe Joints: Inspect all joints for leakage, and tighten, remake, or replace as necessary.

1.18.7.5 Pipe Supports: Inspect all piping supports to assure adequate restraint to prevent displacement, vibration, or failure of piping and fittings, while allowing for expansion and contraction. Modify and adjust as necessary.

1.18.7.6 Electrical Circuits: Check each electrical control circuit to assure operation complies with specifications and requirements to provide desired performance.

1.18.7.7 Instruments: Test, adjust, and calibrate as required.

1.19 Demonstration and Instructions

1.19.1 Prior to final inspection, demonstrate operation of each system to the Engineer and the Owner.

1.19.2 Instruct the Owner's personnel in operation, adjustment, and maintenance of equipment and systems, using the operation and maintenance manuals as a basis for instruction. Review the contents of all manuals with the Owner's personnel in detail to explain all aspects of operation and maintenance.

1.20 Acceptance for Operation

1.20.1 As soon as the unit, equipment, or system has been properly prepared for operation and it is necessary to be placed into service, bring it on-line; then make an on-line performance test by operating it under approximately normal conditions for a period of 5 consecutive days to demonstrate that all materials and components are in proper working order and free from defects. During this time, the Owner will receive specified instruction on the unit or system by qualified personnel, and be furnished all appropriate operation and maintenance manuals. In event of failure to demonstrate successful performance on the first or any subsequent attempt, make all alternations, adjustments, repairs, and replacements that may be needed; and, if it becomes necessary to shut down the unit or system, or any portion thereof before the on-line test is satisfactorily completed, provide all appropriate measures to resume operations without the unit or system. When the unit or system is again ready for operation, bring it on-line and start a new on-line test. This procedure shall be repeated as often as necessary until the unit or

system shall have operated continuously to the satisfaction of the Owner, for a test period duration of 5 consecutive days. The Owner will furnish all operating personnel (other than vendor's or subcontractor's service engineers) needed to operate equipment during the on-line test period; however, said personnel will perform their duties under the Contractor's direction and supervision. Until performance tests are completed and units and systems are accepted by the Owner for operation, the Contractor shall be fully responsible for supervising their operation.

1.20.2 When the on-line test has been completed, the Owner will notify the Contractor to this effect in writing and will then take over the unit or system for purpose of operation. Neither this notice nor the act of taking over any item for operation shall relieve the Contractor from his obligations to complete the facility or perform any other obligations or responsibilities, which extend beyond the completion of the on-line tests.

1.20.3 The Contractor shall maintain full responsibility for the maintenance of all units and systems placed on-line until they have been determined substantially complete. No warranties shall begin prior to the date of substantial completion.

1.20.4 Acceptance Requirements: All equipment shall pass the specified performance testing prior to substantial completion certifications. Partial acceptance of equipment will not be allowed.

1.21 Cleaning

1.21.1 Periodically clean premises of accumulated construction debris.

1.21.2 Prior to final completion, thoroughly remove from premises any debris remaining from construction activities, and properly dispose. Leave premises in a clean, neat, orderly and safe condition.

1.22 Contract Closeout Procedures

1.22.1 Punch List: Correct All Punch List Items.

1.22.2 Operations and Maintenance Data: Obtain, assemble, and submit to WW Associates, Inc. three manuals containing comprehensive operating and maintenance instructions and parts lists. Each manual shall be self-contained and include information for efficient servicing of equipment supplied and installed under the contract.

1.22.2.1 Operating instructions shall explain maintenance procedures, methods of checking the systems for safe and normal operation, and recommended procedure for safely stopping and starting the equipment and systems.

1.22.2.2 These requirements shall be fulfilled before any guarantee periods become effective so as to limit the possibility of claims arising from the absence of pertinent information.

1.22.3 Guarantees, Warranties, and Bonds: Submit all required guarantees, warranties and bonds.

1.22.4 Project Record Documents

1.22.4.1 Provide one complete set of drawings and project manual recording all changes to work to indicate actual installation. Changes shall be noted in legible red letters at least ⅛-inch high. These changes shall include, but are not limited to, the following:

1.22.4.1.1 Size, depth or position of foundations.

1.22.4.1.2 Exact location and elevation of all underground utility services.

1.22.4.1.3 Changes in general construction, mechanical, or electrical work above or below ground.

1.22.4.2 These records are a specific contract requirement, and final payment will not be made until these drawings and project manual have been submitted in an acceptable form.

1.22.5 Spare parts and maintenance materials required by these contract documents shall be delivered to the Owner as directed by the Owner.

1.22.6 List of Manufacturers and Suppliers: At the conclusion of the project, the Contractor shall furnish WW Associates, Inc. with a complete list of subcontractors, manufacturers, and suppliers who participated in the construction or who furnished materials or equipment. The address of each firm shall be included, together with types of materials or work performed.

1.22.7 Affidavit of Payment of Debts and Claims

1.22.8 Affidavit of Release of Liens

End of Section

Section 01500
Supplementary Conditions

1 Supplements

1.1 These supplementary conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC Document C-700, 2007 edition, and other provisions of the contract documents to the extent indicated. All provisions that are not so amended or supplemented remain in full force and effect.

2 Definitions

2.1 The terms used in these supplementary conditions that are defined in the Standard General Conditions of the Construction Contract (EJCDC Document C-700, 2007 edition) have the meanings assigned to them in the general conditions.

2.2 The terms "Town" and "Town of Culpeper" refer to the Owner.

3 Preliminary Matters

3.1 Delete Paragraph 2.01 and substitute the following revised Paragraph 2.01 in its place:

"*Conditions Precedent to Formation:*

Before any Contract between the Owner and the Contractor is effective, the following conditions precedent must be satisfied. Satisfaction of these conditions is the responsibility of the Contractor. If, after performance under the Contract, the Owner learns that a condition precedent has not been met, the Owner may, if permitted by law, ratify the Contract by affirmative recorded vote or may disclaim it, in its sole discretion.

1. Insurance: If insurance is required under the Contract, the Contractor must provide proof of insurance in the amounts required by the Contract with an insurance company licensed to do business in the Commonwealth of Virginia.

2. Bonds: If payment and/or performance bonds are required under the Contract, then bonds with surety satisfactory to the attorney for the Owner shall be submitted to the Owner for approval.

3. Permits and Licenses: The Contractor shall obtain all licenses and permits required to perform the Work under the Contract.

4. Payment of Debts: The Contractor must pay all amounts shown as due to the Owner on the Owner's accounts, even if a dispute exists as to the debt's validity or enforceability."

3.2 The Copies of Documents: Modify Article 2.02 as follows: For construction purposes the Contractor will be issued, free of charge, the following documents:

A PDF of the "Issued for Construction" documents.

4 Bonds

4.1 Add the following to Article 5, Paragraph 5.01.

"The Contractor shall secure and provide all bonds, called for in the General Conditions and Instructions to Bidders. All bonds shall be written by sureties or insurance companies licensed to do business in the Commonwealth of Virginia."

5 Insurance: The Contractor shall purchase and maintain the insurance, required by Article 5 of the General Conditions, in at least the following coverage amounts. A sample Certificate of Insurance is included at the end of this Section for use as a template by your agent.

Workers Compensation	Statutory
Employer's Liability-	
Each Accident:	$100,000
Disease, Each Employee:	$100,000
Disease, Policy Limit:	$500,000
General Liability-	
Each Occurrence:	$1,000,000
Personal & Advertising Injury:	$1,000,000
Products Completed Operations Aggregate:	$2,000,000
General Aggregate:	$2,000,000
Excess or Umbrella Liability-	
Each Occurrence:	$2,000,000
General Aggregate:	$2,000,000
Automobile Liability-	
Combined Single Limit	
Each Accident:	$1,000,000
Installation Floater:	Coverage Equal to Value of Materials

5.1 Contractor's workers compensation insurance as required by Federal, State, and Municipal laws for the protection of all Contractors' employees working on or in connection with the project, including broad form all states and voluntary compensation coverages and employers' liability coverage.

5.2 Contractor's general liability insurance shall include the following coverages: premises and operations, explosion, collapse and underground, products completed operations, contractual liability, and personal and advertising injury.

5.3 The Automobile Liability Insurance shall include coverage for owned, non-owned and hired autos.

5.4 All insurance shall be written by insurance companies licensed to do business in the Commonwealth of Virginia.

5.5 The Town of Culpeper and WW Associates, Inc. shall be listed as an additional insured on all policies except workers compensation.

5.6 A waiver of subrogation shall apply in favor of the Town of Culpeper and WW Associates, Inc. on all policies as permitted by law.

5.7 Certificate Holder: Town of Culpeper
400 South Main Street
Culpeper, VA 22701

6 Contractor's Responsibilities

6.1 Labor, Materials, and Equipment: Add the following to Paragraph 6.03

"All material incorporated in the work of this contract shall be free of asbestos and other hazardous materials."

6.2 Delete Subparagraph 6.06(B) and substitute the following revised Subparagraph 6.06(B) in its place:

"Contractor may not subcontract any of the work under this Contract without the prior, written approval of the Town, which will not be unreasonably withheld. The Contractor will, as soon as practicable after award of the Contract, give the Town a written list of each proposed subcontractor and the work to be done by that subcontractor. The Town shall, after reasonable investigation, promptly inform the Contractor if it objects to a particular subcontractor. If the Town objects, the Contractor will not use that subcontractor for any part of the work and will promptly submit in writing for the Town's approval the name of another subcontractor (or propose to use the Contractor's own forces) to perform those portions of the work. The Contractor will not change a subcontractor without giving the Town written notice of the proposed new Subcontractor and receiving the Town's approval after reasonable investigation. If the Town objects, the Contractor will either retain the existing subcontractor or propose a different subcontractor to the Town for approval. It is the Contractor's responsibility to obtain subcontractors whom the Town approves, and no delay due to the Town's objection to a subcontractor will authorize any change in the time required to perform the work. No acceptance by Owner of any such subcontractor, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work."

6.3 Add new Subparagraph 6.06(H) as follows:

"1. Within seven days after receipt of amounts paid to the Contractor by the Owner for satisfactorily completed performance, the prime contractor agrees to:

a. Pay the subcontractor for the proportionate share of the total payment received from the Owner attributable to the work performed by the subcontractor under that contract; or

b. Notify the Owner and subcontractor, in writing, of his intention to withhold all or a part of the subcontractor's payment with the reason for nonpayment.

2. If the Contractor after having received payment for the Owner fails to pay each subcontractor its proportionate share of the total payment, the Contractor shall be obligated to pay interest to each subcontractor on all amounts that remain unpaid after the seven days following receipt by the Contractor of payment from the Owner. Under no circumstances will the Town pay or reimburse this interest payment.

3. Unless otherwise provided under the terms of this Contract or by statute, interest shall accrue at a rate of one percent per month against the Contractor on any unpaid amounts owed to each subcontractor.

4. The Contractor shall include in each of its subcontracts a provision requiring each subcontractor to include or otherwise be subject to the same payment and interest requirements with respect to each lower-tier subcontractor."

6.4 Delete Subparagraph 6.07(B).

6.5 Laws and Regulations: Add the following to Subparagraph 6.09 D.:

"The Contractor shall be licensed in the Commonwealth of Virginia in accordance with Title 54.1, Chapter 11, Code of Virginia (1950) as Amended."

6.6 Permits

6.6.1 The Contractor shall obtain all required permits for this project at no additional cost to the Owner. The Contractor shall pay any associated fees and post any associated sureties for required permits. Required permits shall include, but not be limited to, the following:

6.6.1.1 Town of Culpeper Business Registration: Submit a Business Registration Form to Ashley Clatterbuck. Telephone: (540) 829-8240, E-Mail: aclatterbuck@culpeperva.gov.

6.6.1.2 Culpeper County Building Permit: The Contractor shall apply for and obtain the building permit. Comply with all County requirements and provide all required Special Inspections for building construction. Contact the County Building Department for additional information. Telephone: (540) 727-3405, Fax: (540) 727-3461, E-Mail: kkendall@culpepercounty.gov.

6.6.1.3 Town of Culpeper Land Disturbance Permit: Contact Gary Cole. Telephone: (540) 829-8260, E-Mail: gcole@culpeperva.gov.

6.7 OSHA Requirements: The Contractor shall be responsible for all safety at the job site and shall comply with OSHA Regulations for all work associates with this project.

6.8 Delete Subparagraph 6.20(A) and substitute the following revised Subparagraph 6.20(A) in its place:

"1. To the fullest extent permitted by law, the Contractor shall indemnify, defend, and hold harmless the Town and its officers, agents, employees, community representatives, volunteers or others working on behalf of the Town, including the Engineer, from any and all claims, judgments, suits, losses, damages, payments, costs, fines and/or fees levied against the Owner and expenses of every nature and description, including attorney's fees, arising out of, connected or associated with or resulting from the lack of performance or the negligent performance of work as described in this Contract, Contract Documents or any agreement that results from this Contract. Further, if the Contractor subcontracts for work, it will require in its subcontracts that each subcontractor indemnify, defend, and hold harmless the Town and its officers, agents, employees and community representatives, from any and all claims and losses accruing or resulting from the negligent performance of work as described in any agreement that results from this Contract.

2. To the fullest extent permitted by law, the Contractor shall also indemnify, defend, and hold harmless the Town and its officers, agents, employees, community representatives, volunteers or others working on behalf of the Town, including the Engineer, against all costs, including reasonable attorney's fees, arising from liens encumbering the Town's Property filed by subcontractors, sub-subcontractors, material suppliers, and all other persons and entities acting for and under the Contractor, and the Contractor shall immediately discharge or bond such liens off.

3. Virginia is a Dillon Rule state. Unless specifically permitted by statute, indemnification or any attempt to have the Town hold others harmless is invalid and unenforceable as an impermissible waiver of the Town's sovereign immunity which may create potential future debt in violation of Virginia Constitutional and statutory requirements. The Town cannot waive its sovereign immunity. Subparagraph 4.06(g) is hereby deleted."

7 Project Representative

7.1 Add the following to Paragraph 8.01:

"B. The Town Manager will designate a person to serve as the Contract Administrator. The initial Contract Administrator is WW Associates, Inc., but

the Town Manager may designate a new Contract Administrator by notice to the Contractor."

7.2 Revise the first sentence in Paragraph 9.03(A) as follows: "As requested by Owner, Engineer or Owner will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work."

In addition, add the following to Paragraph 9.03:

"B. The Resident Project Representative will serve as the Engineer's liaison with the Contractor, working principally through the Contractor's superintendent to assist him in understanding the intent of the Contract Documents.

C. The Resident Project Representative shall conduct on-site observations of the work in progress to confirm that the work is proceeding in accordance with the Contract Documents. He will verify that tests, equipment and systems start-ups and operating and maintenance instructions are conducted as required by the Contract Documents. He will have the authority to disapprove or reject defective work in accordance with Article 13."

7.3. Add the following to Paragraph 9.09:

"F. Except upon written instructions of the Engineer, the Resident Project Representative:

1. Shall not authorize any deviation from the Contract Documents or approve any substitute materials or equipment.

2. Shall not exceed limitations of Engineer's authority as set forth in the Contract Documents.

3. Shall not undertake any of the responsibilities of Contractor, Subcontractors, or Contractor's superintendent, or expedite the Work.

4. Shall not advise on or issue directions related to any aspect of the means, methods, techniques, sequences or procedures of construction unless such is specifically called for in the Contract.

5. Shall not advise on or issue directions as to safety precautions and programs in connection with the Work."

8 Change in Contract Times

8.1 Add new Subparagraph 12.02(C) as follows:

"This Contract may be extended as provided in the Solicitation or by Change Order or amendment. If this is a fixed price contract, however, no extension may increase the price by more than twenty-five percent of the amount of the Contract or

$50,000, whichever is greater, without a recorded affirmative vote of the Town Council. The Town may extend the term of this contract for services to allow completion of work undertaken but not completed under its original term."

8.2. Add new Subparagraph 12.03(F) as follows:

"Time shall be of the essence to this Contract.

1. If the Contractor at any time finds that the schedule will not be met for any reason, the Contractor shall so notify the Town in writing.

2. Where Contractor is prevented from completing any part of the Work within the Contract Period due to abnormal weather conditions the Contract Period will be extended in an amount calculated as stated in Paragraph 12.03 F.4. below if a Claim is made therefor in writing and provided to the Town within the time frame and in the manner prescribed and if the performance of the Work is not, was not, or would not have been delayed by any other cause for which the Contractor is not entitled to an extension of the Contract Period under the Contract Documents.

3. Contractor acknowledges and agrees that adjustments in the Contract Period will be permitted for a delay only to the extent such delay (i) is not caused, or could not have been anticipated, by Contractor; (ii) could not be limited or avoided by the Contractor's timely notice to the Town of the delay or reasonable likelihood that a delay will occur; and (iii) is of a duration not less than one day. Such an adjustment of time shall be Contractor's sole and exclusive remedy for the delays described in this Section. Any time extensions for changes in the work will depend upon the extent, if any, by which the changes cause delay in the completion of the various elements of this Contract. The change order granting the time extension may provide that the completion date will be extended only for those specific elements so delayed and that the remaining completion dates for all other portions of the work will not be altered and may further provide for an equitable readjustment of liquidated damages under the new completion schedule.

4. Actual adverse weather delay days must prevent work on critical activities outdoors for fifty percent (50%) or more of Contractor's scheduled workday in order to be counted. The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in a previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. Where Contractor is prevented from completing any part of the Work within the Contract Period due to abnormal weather conditions, the Contract Period will be extended in an amount equal to the time lost due to such delay if a Claim is made therefore as provided herein. Abnormal weather conditions occur only if the total number of actual adverse weather days exceeds the standard for that month as shown in the following table:

Month	Number of Days
January	7
February	7
March	8
April	7
May	8
June	7
July	8
August	8
September	6
October	6
November	6
December	6

5. Upon commencement of on-site activities and continuing throughout construction, Contractor shall record daily the occurrence of adverse weather and resultant impact to normally scheduled work and within 30 days of the last day of any month (hereinafter referred to as the "Reporting Month"), Contractor shall submit a written adverse weather report, including copies of Contractor's daily weather reports and applicable climatological data from the National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location, unless the Town allows, in writing, an additional period of time for the submission of said report. Notwithstanding any other provisions, failure to submit the required written report within the time specified above shall be deemed to be and shall constitute a waiver by Contractor of any and all claims for delay due to adverse weather conditions occurring during said Reporting Month.

6. The Town shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of Engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

7. Contractor shall not be entitled to an adjustment in Contract Price or Contract Period for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor."

9 Payments to Contractor

9.1 Add to end of Subparagraph 14.02(D)(1)(c) the following: ", including, but not limited to, the Town may offset any payment due to Contractor by any debt shown on the Town's accounts, even if a dispute exists as to the debt's validity or enforceability;"

9.2 Delete Subparagraph 14.02(C) and substitute the following revised Subparagraph 14.02(C) in its place:

"Thirty (30) days after presentation of the Application of Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Subparagraph 14.02(D) and to Subparagraph 15.03(B) relating to 'Non-appropriation of Funds) become due, and when due will be paid by Owner to Contractor."

10 Suspension of Work and Termination

10.1 Delete Paragraph 15.03 and substitute the following revised Paragraph 15.03 in its place:

"A. Termination for Convenience

1. The Town may terminate this Contract or any work or delivery required hereunder from time-to-time either in whole or in part, whenever the Contract Administrator, with the concurrence of the Town Manager, determines that such termination in the best interest of the Town.

2. Termination may occur in whole or as to any discrete part of the Contract. A partial termination shall set forth the portions of the Contract which are terminated.

3. The effective date of the termination shall be three days after issuance of a Notice of Termination signed by the Contract Administrator and Town Manager and its mailing or delivery to the Contractor, or any later date specifically set forth in the Notice of Termination.

B. Termination for Non-Appropriation

1. If funds are not appropriated for purposes of this Contract for any succeeding fiscal year subsequent to the one in which this Contract is entered into, then the Town may terminate this Contract upon thirty (30) days written notice to the Contractor. The notice shall set forth the grounds for termination and its effective date.

2. If the Town terminates for non-appropriation, the Town shall be liable only for payments due through the effective date of termination.

3. Until the effective date of the termination, the Contractor shall continue to perform its duties under the Contract and is not excused from any portion of the Contract.

C. Claims Upon Termination

1. Upon receipt of a Notice of Termination, the Contractor shall:

   a. Cease any further deliveries or work due under this Contract, on the date, and to the extent, which may be specified in the Notice;

b. Place no further orders with any subcontractors except as may be necessary to perform any portion of the Contract not subject to the Notice (in the case of partial termination);

c. Terminate all subcontractors except to the extent necessary to complete work which was not subject to the Notice (in the case of partial termination);

d. Settle all outstanding liabilities and claims which may arise out of such termination, with the ratification of the Contract Administrator; and

e. Use its best efforts to mitigate any damages which may be sustained by the Contractor or any of its subcontractors as a consequence of termination under this clause.

2. After complying with the foregoing provisions, the Contractor shall submit a termination claim within thirty days unless an extension is granted by the Contract Administrator. This termination claim shall document all amounts due under this provision.

a. Upon receipt of the Contractor's termination claim, the Town, with the approval of the Town Manager, shall pay from the Using Department's budget the reasonable costs of termination, including a reasonable amount for profit on services delivered or completed. In no event shall this amount be greater than the original contract price, reduced by any payments made prior to Notice of Termination, and further reduced by the price of the goods or services not delivered, or those goods or services not provided. The calculation of the amount to be paid the Contractor shall be documented and made a part of the Contract file.

b. If the parties cannot agree on the whole amount to be paid to the Contractor by reason of termination under this clause, the Town shall pay the Contractor from the Using Department's budget the amounts determined as follows, without duplicating any amount which may have already been paid under the preceding paragraph of this clause:

i. With respect to all Contract performance prior to the effective date of Notice of Termination, the total of:

- Cost of the goods delivered or work performed; and
- The cost of settling and paying any reasonable claims as provided above; and
- A sum as profit on work performed determined by the Town Procurement Officer to be fair and reasonable.

ii. The total sum to be paid shall not exceed the Contract price, as reduced by the amount of payments otherwise made, and as further reduced by the Contract price of goods or services not terminated.

c. If the Contractor is not satisfied with any payments which the Contract Administrator determines to be due under this provision, the Contractor may appeal any claim accordance with the provisions of Paragraph 10.05 and Article 16, Dispute Resolution.

3. The Contractor shall include similar provisions for termination in any subcontractors and shall require subcontractors to make reasonable efforts to mitigate damages if the Contract is terminated. Failure to include such provisions shall bar the Contractor from any recovery from the Town whatsoever for loss or damage sustained by a subcontractor as a consequence of termination."

10.2 In Subparagraph 15.04(A), the seven (7) days written notice to Owner and Engineer is changed to ten (10) business days written notice to Owner and Engineer.

11 Dispute Resolution

11.1 Add the following new Subparagraph 16.01(D):

"Before the Contractor may exercise any legal remedy it may have in relation to rights arising out of this Contract, it must comply fully and strictly with each of the applicable conditions below. Failure to comply fully and strictly with an applicable condition precedent bars the Contractor from exercising any legal remedies it may otherwise have in relation to this Contract until it complies with the condition precedent or the Town knowingly and intentionally waives the condition precedent.

1. Submission of Disputes: A Contractor must submit any dispute arising out of this Contract to the Town for adjustment. In doing so, it shall provide all relevant evidence that bears on the Town's liability for the amount claimed or responsibility to grant any non-monetary relief requested.

2. Disputes by the Contractor with respect to this Contract shall be decided within fifteen (15) days from submission by the Town Manager's designee, who shall reduce his/her decision to writing, and mail or otherwise furnish a copy thereof to the Contractor. This decision shall be final and binding unless within five (5) days from the date of such decision the Contractor mails or otherwise furnishes the Town Manager a written appeal addressed to the Town Council. The Town Council shall consider the appeal and render its written decision within forty (40) days. The decision of the Town Council shall be final and binding unless set aside by a court of competent jurisdiction as fraudulent, capricious, arbitrary, or so grossly erroneous as necessarily to imply bad faith, or as not supported by any evidence. Pending a final determination of a properly appealed decision of the Town Manager's designee, the Contractor shall proceed diligently with the performance of the Contract in accordance with that decision."

11.2 Add the following new Subparagraph 16.01(E):

"Any action brought under this Contract must be brought in the state courts for the County of Culpeper and may not be removed to the Federal Court system."

11.3 Add the following new Subparagraph 16.01(F):

"Any action brought under this Contract, except an action for breach of warranty, shall be brought within the shorter of the statutory limitations period and the period of three years from the date of final payment without any tolling of this statutory limitations period for any reason whatsoever."

11.4 Add the following new Subparagraph 16.01(G):

"In any action brought under this Contract, the parties expressly waive their right to trial by jury and agree to submit all questions of fact to the judge as trier of fact."

12 Miscellaneous

12.1 Delete Paragraph 17.05 and substitute the following revised Paragraph 17.05 in its place:

"This Contract is governed by the law of the Commonwealth of Virginia, including but not limited to the Virginia Public Procurement Act (VPPA), Sections 2.2-4300 et seq. of the Code of Virginia (1950), as amended. This Contract is also governed by the applicable Town Policies."

12.2 Add the following new Paragraph 17.07:

"In all contracts, regardless of contract amount, the Contractor will abide by the provisions of the Americans with Disabilities Act, and will require each sub-contractor to do so. If this Contract is for a consideration in excess of Ten Thousand Dollars ($10,000.00), then during the performance of this Contract, the Contractor agrees as follows:

a. The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or other basis prohibited by state law relating to discrimination in employment, except where there is a bona fide occupational qualification reasonably necessary to the normal operation of the Contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this non-discrimination clause.

b. The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, will state that such Contractor is an equal opportunity employer.

c. Notices, advertisements, and solicitations placed in accordance with Federal law, rule, or regulation shall be deemed sufficient for the purpose of meeting the requirements of this paragraph.

d. The Contractor will include the provisions of this Contract paragraph in every subcontract or purchase order over $10,000, so that the provisions will be binding upon each subcontractor or vendor."

12.3 Add the following new Paragraph 17.08:

"The provisions contained in Chapter 43, Article 6, Sections 2.2-4367 through 2.2-4377 of the Virginia Public Procurement Act, as set forth in the 1950 Code of Virginia, as amended, apply to this contract. The provisions of Article 6 of Chapter 43 supplement, but do not supersede, other provisions of law including, but not limited to, the Virginia Conflict of Interest Act (§ 2.2-3100 et seq.), the Virginia Governmental Frauds Act (§ 18.2-498.1 et seq.) and Articles 2 and 3 of Chapter 10 of Title 18.2. The provisions apply notwithstanding the fact that the conduct described may not constitute a violation of the Virginia Conflict of Interests Act."

12.4 Add the following new Paragraph 17.09:

"During the performance of this contract, the Contractor agrees to:

1. Provide a drug-free workplace for the Contractor's employees.

2. Post in conspicuous places, available to employees and applicants for employment a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition.

3. State in all solicitations or advertisement for employees placed by or on behalf of the contractor that the contractor maintains a drug-free workplace.

4. Include the provisions of the foregoing clauses in every subcontract or purchase order of over $10,000.00, or so that the provisions will be binding upon each subcontractor or vendor."

12.5 Add the following new Paragraph 17.10:

"The Town of Culpeper in procuring goods and services, or in making disbursements pursuant to this section, shall not discriminate against a faith-based organization on the basis of the organization's religious character or impose conditions that restrict the religious character of the faith-based organization, except funds provided for expenditure pursuant to contracts with public bodies shall not be spent on religious worship, instruction, or proselytizing, or impair, diminish, or discourage the exercise of religious freedom by the recipients of such goods, services, or disbursement."

12.6 Add the following new Paragraph 17.11:

"Foreign and Domestic Businesses Authorized to Transact Business in the Commonwealth:

1. A Contractor organized as a stock or nonstock corporation, limited liability company, business trust, or limited partnership or registered as a registered limited liability partnership shall be authorized to transact business in the Commonwealth as a domestic or foreign business entity if so required by Title 13.1 or Title 50 or as otherwise required by law.

2. A Contractor organized as a stock or nonstock corporation, limited liability company, business trust, or limited partnership or registered as a registered limited liability partnership shall not allow its existence to lapse or its certificate of authority or registration to transact business in the Commonwealth, if so required under Title 13.1 or Title 50, to be revoked or cancelled at any time during the term of this contract. The Town may void any contract with a business entity if the business entity fails to remain in compliance with this provision."

12.7 Add the following new Paragraph 17.12:

"A. The Contractor agrees that the Town or any duly authorized representative of the Town may have access to and the right to examine and copy any directly pertinent books, documents, papers, and records of the Contractor involving transactions related to this Contract. This right shall expire on the third anniversary of the issuance of final payment under this Contract.

B. The Contractor further agrees to include in any subcontract for more than $10,000 entered into as a result of this Contract, a provision to the effect that the subcontractor agrees that the Town or any duly authorized representative may have access to and the right to examine and copy any directly pertinent books, documents, papers, and records of such subcontractor involved in transactions related to such subcontract, or this Contract. The term subcontract as used herein shall exclude subcontracts or purchase orders for public utility services at rates established for uniform applicability to the general public. This right expires on the third anniversary of the issuance of final payment to the subcontractor."

12.8 Add the following new Paragraph 17.13:

"The Contractor shall not be excused from performance under this Contract by failure to agree to a Change Order, and it is the express purpose of this provision to permit unilateral changes in the Contract by the Owner subject to the conditions and limitation herein. No claim for changes made by Change Order shall be considered if made after final payment in accordance with the Contract."

12.9 Add the following new Paragraph 17.14:

"This Contract, including its incorporated documents, contains the whole agreement between the parties as to its subject, and no prior or contemporaneous

communications, representations, or agreements, written or verbal, may alter, add to, or contradict any provision in it. There are no promises, terms, conditions, or obligations related to the subject of this Contract other than those contained herein. All modifications and changes to the Contract shall be in writing and signed by the party to be charged, or its authorized representative."

12.10 Add the following new Article 4.03B to the Agreement between the Owner and Contractor:

"Alternatively, if performance is so delayed, the Town may terminate this Contract in whole or in part under the Default clause in this Contract and in that event, the Contractor shall be liable for fixed, agreed and liquidated damages accruing until the time the Town may reasonably obtain performance of similar services. The liquidated damages shall be in addition to any increased costs occasioned the Town in completing the work."

End of Section

Section 01600
Standard Contract Forms

The following Engineers Joint Contract Documents Committee (EJCDC) and American Institute of Architects (AIA) documents will be incorporated in this project manual. All forms shall be utilized in accordance with applicable EJCDC and AIA regulations and modified as needed for this particular project:

Agreement

Completed EJCDC Document C-520 (2007) "Suggested Form of Agreement Between Owner and Contractor for Construction Contract", will be a part of this contract.

Performance Bond, and Payment Bond

Completed EJCDC Document C-610, (2007) and EJCDC Document C-615 (2007), will be a part of this contract.

Supplemental Attachment for Accord Certificate of Insurance

Completed AIA Document G715, (1991), will be a part of this contract.

Application and Certificate for Payment and Continuation Sheet

Completed EJCDC Document C-620, (2007), will be a part of this contract.

Affidavit of Payment of Debts and Claims, and Affidavit of Release of Liens

Completed AIA Documents G706 and G706A (1994), will be part of this contract.

Standard General Conditions of the Construction Contract

EJCDC Document C-700 (2007) "Standard General Conditions of the Construction Contract", modified as needed, will be a part of this contract.

EJCDC documents are available from the EJCDC online store at www.ejcdc.com.

AIA documents are available at www.AIA.org.

End of Section

Section 02050
Demolition

1 GENERAL

1.1 Description: This section specifies removal and offsite disposal or relocation of the following:

1.1.1 Existing equipment as indicated on the drawings.

1.1.2 Disconnecting, capping, or sealing and removal of existing utilities and site piping as indicated on the drawings.

1.2 Definitions

1.2.1 Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.

1.2.2 Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean and pack or crate items to protect against damage. Identify contents of containers and deliver to the Owner's designated storage area.

1.2.3 Remove and Reinstall: Remove items indicated; clean, service and otherwise prepare them for reuse; store and protect against damage. Reinstall items in locations indicated.

1.2.4 Existing to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by WW Associates, Inc. items may be removed to a suitable, protected storage location during demolition and then cleaned and reinstalled in their original location.

1.3 Materials Ownership

1.3.1 Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site and be disposed of by the Contractor.

1.3.2 Historical items, relics, and similar objects, which may be encountered during demolition, remain the Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Owner.

1.4 Quality Assurance

1.4.1 Regulatory Requirements: Comply with governing Environmental Protection Agency (EPA) notification regulations before starting demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.5 Project Conditions

1.5.1 The Owner assumes no responsibility for actual condition of structures to be demolished.

1.5.2 Storage or sale of removed items or materials onsite will not be permitted.

1.5.3 Asbestos: It is not expected that asbestos will be encountered in the course of this contract. If any materials suspected of containing asbestos are encountered, do not disturb the materials. Immediately notify WW Associates, Inc. and the Owner.

1.6 Scheduling

1.6.1 Arrange demolition schedule so as not to interfere with the Owner's onsite operations.

2 PRODUCTS

2.1 Flowable Backfill

2.1.1 Hydraulic cement, fly ash, water, aggregates, admixtures, and granulated iron blast furnace slag used in flowable backfill shall conform to the requirements of the latest edition of the Virginia Department of Transportation (VDOT) Road and Bridge Specifications.

2.1.2 Flowable backfill shall have a 28-day design compressive strength of 30 to 200 psi when tested in accordance with AASHTO T23. Mix design shall result in a fluid product having a slump of 8 to 48 inches at the time of placement.

2.1.3 Mixing, transporting, and placement of flowable backfill shall be performed in accordance with the latest edition of the VDOT Road and Bridge Specifications.

2.1.4 Temperature of flowable backfill shall be a minimum of 50°F at the time of placement. Material shall be protected from freezing for a minimum of 24 hours after placement.

3 EXECUTION

3.1 General

3.1.1 Work shall be performed in such manner as not to endanger the safety of the workmen or the public or cause damage to nearby structures.

3.1.2 Provide all barriers and precautionary measures in accordance with the Owner's requirements and other authorities having jurisdiction.

3.1.3 Prior to the execution of the work, the Contractor, Owner, and Engineer shall jointly survey the condition of the adjoining and/or nearby structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.

3.2 Disposal of Material

3.2.1 All debris resulting from the demolition and removal work shall be disposed of by the Contractor as part of the work of this contract. Material designated by the Engineer to be salvaged shall be stored on the construction site as directed. All other material shall be disposed of offsite by the Contractor at his expense in accordance with all federal, state, and local regulations.

3.2.2 Burning of any debris resulting from demolition activities will not be permitted at the site.

3.3 Utility Services

3.3.1 Utility Requirements: Locate, identify, disconnect, and seal or cap off utility services to be removed or abandoned in place as indicated on the drawings.

3.3.2 Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

3.3.2.1 Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

3.3.3 Storm culverts abandoned in place within VDOT right-of-way shall be completely backfilled with flowable backfill as specified herein and sealed with non-shrink grout at each pipe opening in accordance with the latest edition of the Virginia Department of Transportation Road and Bridge Standards.

3.4 Explosives: Explosives shall not be used for demolition activities.

3.5 Pollution Controls

3.5.1 Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.

3.5.1.1 Do not use water when it may create hazardous or objectionable conditions, such as ice, flooding, or pollution.

3.5.2 Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas. Keep pavement and area adjacent to the site clean and free of mud, dirt, and debris at all times.

3.5.3 Clean adjacent buildings and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to the condition existing before the start of demolition activities.

3.6 Remove above grade improvements such as posts, poles, fences, walls, and other items as specifically indicated or necessary to permit new construction.

3.7 Equipment Removal/Abandonment: Coordinate with the Owner prior to starting demolition activities. Remove and abandon equipment items in place as indicated on the drawings. Use such methods required to complete work within limitations of governing regulations and as follows:

3.7.1 Dispose of demolished items and materials promptly. On-site storage or sale of removed items will be prohibited.

3.7.2 Remove/drain water, sludge, and other organic residuals from structures prior to demolition and abandonment.

3.7.3 Promptly patch and repair holes and damaged surfaces caused to adjacent construction by demolition operations. Completely fill holes and depressions in existing concrete floor slabs and walls to remain with ASTM C 1107 nonshrink grout, applied according to the manufacturer's written recommendations.

3.7.4 Return elements of construction and surfaces to remain to condition existing before the start of demolition operations.

3.8 Filling Below Grade Areas: Completely fill below grade areas and voids resulting from demolition of structures, and pavements with soil materials in accordance with Section 02200 - Earthwork. Fill material shall be completely free of debris and rubbish.

3.8.1 Prior to placement of fill materials, ensure that areas to be filled are free of standing water, frost, frozen material, trash, and debris.

3.8.2 After fill placement and compaction, grade surface to meet adjacent contours and to provide flow to surface drainage structures.

3.9 Damages: Promptly repair damages to adjacent utilities or pavement caused by demolition activities.

3.10 Cleanup

3.10.1 Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site. If the Contractor fails to remove excess debris promptly, the Owner reserves the right to remove it at the Contractor's expense.

3.10.2 Remove promptly salvageable material that becomes property of the Contractor and is not to be reused in construction. Sale of material on the site will be prohibited.

3.10.3 Remove all tools, equipment, and materials from the demolition site, and all rubbish upon completion of the work.

3.10.4 Leave the site clean, neat, orderly, and in condition to begin new construction.

End of Section

Section 02055
Traffic Regulation

1 GENERAL

1.1 The Contractor shall perform all work occurring in rights-of-way in accordance with permits issued by the Virginia Department of Transportation (VDOT), as well as the latest edition of the following references:

1.1.1 VDOT Road and Bridge Standards

1.1.2 VDOT Road and Bridge Specifications

1.1.3 U.S. Department of Transportation (USDOT) Federal Highway Administration Manual of Uniform Traffic Control Devices (MUTCD)

1.1.4 Virginia Supplement to MUTCD

1.1.5 Virginia Work Area Protection Manual

1.2 Requirements

1.2.1 Description: This work shall cover all of the measures necessary to maintain and to protect traffic, to protect the work in progress, and to protect adjacent property from excessive dust generated by public traffic and Contractor's construction equipment on the public travel lane. The work shall include labor, materials, and equipment necessary to keep the traveled road smooth; the construction of temporary structures when required; the furnishing and applying of aggregate and dust palliatives; the furnishing and maintenance of signs, auxiliary barriers, channeling devices, hazard warning lights, barricades, and reflective markers and their prompt removal when the hazard is eliminated; the furnishing of pilot trucks and drivers when needed; and the furnishing of flagmen.

1.2.2 The Contractor shall conduct a preconstruction meeting with VDOT to obtain all traffic control requirements and discuss the required traffic control plan.

1.2.3 The Contractor shall maintain at least one lane open at all times during construction for two-way traffic.

1.2.4 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements:

1.2.4.1 Detailed traffic control plan and written description of proposed traffic control measures prior to the start of construction. The

Contractor shall submit a copy of the plan and proposed measures to VDOT for approval prior to construction.

1.2.5 Flagmen: The Contractor shall furnish all flagmen, and all flagging shall be his responsibility. Flagmen shall be provided at the ends of projects where one-way traffic is required, at limits of one-way traffic lanes, at locations where project construction equipment is required to cross public roads, and at any other locations necessary. Hand signaling devices, orange caps and vests shall be furnished by the Contractor for use by the Contractor's personnel assigned to traffic control responsibilities.

1.2.6 Warning Devices: Warnings devices, such as signs, auxiliary barriers, channeling devices, hazard warning lights, barricades, and reflective markers, shall be furnished, erected, and maintained by the Contractor for the protection and guidance of traffic. Devices shall be provided, erected, and maintained at the ends of the project and on roads intersecting the project. All devices shall be in place before work begins, be correctly maintained while in use, and be removed as soon as they are no longer necessary. If the devices do not apply to existing conditions during an intermediate period, they shall be removed or the face completely covered with an opaque weatherproof hood. All devices shall be moved as often as necessary to properly delineate the construction area.

1.2.7 Field Conditions: If actual field conditions are not illustrated on the drawings, engineering judgment and discretion shall be exercised to select devices that will be adaptable, but the general policies herein prescribed shall be adhered to. Final responsibility for the installation of adequate safety devices for the protection of the traveling public and workmen, as well as for the safeguard of the work in general, shall rest with the Contractor.

1.2.8 The Contractor shall notify VDOT a minimum of two weeks in advance of any road lane closures and specify the length of time of closure.

2 PRODUCTS: NOT USED

3 EXECUTION: NOT USED

End of Section

Section 02200
Earthwork

1 GENERAL

1.1 References: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1.1 American Society For Testing and Materials (ASTM)

1.1.1.1 ASTM C 136: Sieve analysis of fine and coarse aggregates.

1.1.1.2 ASTM D 698: Moisture-density relations of soils and soil-aggregate mixtures using 5.5-lb (2.49-kg) rammer and 12-inch (305-mm) drop.

1.1.1.3 ASTM D 1140: Amount of material in soils finer than the No. 200 (75-micrometer) sieve.

1.1.1.4 ASTM D 1556: Density of soil in place by the sand-cone method.

1.1.1.5 ASTM D 1557: Moisture-density relations of soils and soil-aggregate mixtures using 10-lb (4.54-kg) rammer and 18-inch (457-mm) drop.

1.1.1.6 ASTM D 2487: Classification of soils for engineering purposes.

1.1.1.7 ASTM D 2922: Density of soil and soil-aggregate in place by nuclear methods (shallow depth).

1.1.1.8 ASTM D 3017: Water content of soil and rock in place by nuclear methods (shallow depth).

1.1.1.9 ASTM D 4318: Liquid limit, plastic limit, and plasticity index of soils.

1.2 Definitions

1.2.1 Hard Materials: Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of “rock” but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.2 Rock: Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding ½ cubic yard in

volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.3 Cohesive Materials: Materials ASTM D 2487 classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

1.2.4 Cohesionless Materials: Materials ASTM D 2487 classified as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have plasticity index of zero.

1.3 Store and use explosives in accordance with federal, state, and local regulations. The Contractor shall be responsible for and shall satisfactorily correct all damage resulting from the use of explosives.

1.4 Submittals: Provide the following in a timely manner in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.4.1 Two copies of field test reports for fill and backfill tests, select materials tests, and density tests.

1.4.2 Two copies of a detailed blasting plan and schedule including procedures proposed, and qualifications and references of blasting personnel.

1.5 Delivery, Storage, and Handling: Perform in a manner to prevent contamination or segregation of materials.

1.6 Criteria for Bidding

1.6.1 Base bids on the elevations as indicated.

1.6.2 All earthwork excavation shall be unclassified, regardless of material encountered. All earthwork excavation shall be performed to the indicated elevations at no additional cost to the Owner.

1.6.3 Soil Borings were performed by Underhill Engineering in the vicinity of the new Pedestrian Bridge and Restroom Facility site. The geotechnical report, including the boring logs and addenda is included in Appendix A for reference only and is not a part of the contract documents. The Contractor is responsible for any conclusions made from the geotechnical report or boring logs.

1.6.4 Undercut 6.5 feet for tower construction and backfill with stone per geotechnical report.

1.6.5 Undercut 3 feet for restroom construction and backfill with stone per geotechnical report.

1.6.6 Remove material in an approved manner, and provide excavation support structures as required in accordance with the U.S. Army Corps of Engineers "Safety and Health Requirements Manual," EM-385-1-1, Sections 25 A through E.

1.7 Provide barricades, coverings, or other types of protection necessary to prevent damage to existing improvements not indicated to be removed, and improvements on adjoining properties.

1.7.1 Restore all improvements damaged by this work to their original condition, and acceptable to the Owner or other parties or authorities having jurisdiction, unless indicated otherwise.

1.8 Protect existing trees and other vegetation indicated to remain in place against cutting, breaking, or skinning of roots; skinning and bruising of bark; smothering of trees by stockpiling construction materials or excavated materials within drip line; excess foot or vehicular traffic; or parking of vehicles within drip line. Provide temporary fences, barricades, or guards as required to protect trees and vegetation to be left standing.

1.9 Burning of site clearing debris will not be allowed.

1.10 Utility Location: The Contractor shall provide the services of a pipe utility location firm to use nondestructive, air vacuum excavation methods to pothole existing underground utilities within the limits of disturbance on this project to avoid utility conflicts. Pothole excavations shall be performed every 50 linear feet along pipe lines, and at additional locations where requested by WW Associates, Inc. Resolution of utility conflicts is the responsibility of the Contractor at no additional cost to the Owner. Utilities shall be marked by the pipe utility location firm prior to construction.

2 PRODUCTS

2.1 Soil Materials: Free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen deleterious or objectionable materials. The maximum particle diameter shall be one-half the lift thickness at the specified location. The maximum particle diameter for pipe backfill material located less than 1-foot above the pipe crown shall be 1-inch.

2.1.1 Common Fill: Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.2 Backfill and Fill Material: ASTM D 2487, Classification GW, GP, GM, GC, SW, SP, SM, SC with a maximum ASTM D 4318 liquid limit of 35, maximum ASTM D 4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D 1140, No. 200 sieve.

2.1.3 Topsoil: Provide as specified in Section 02936 – Seeding.

2.1.4 Select Material: ASTM D 2487, Classification GW, GP, SW, SP with a maximum of 10 percent by weight passing ASTM D 1140, No. 200 sieve.

2.1.5 Pipe Bedding Material: As specified on Town of Culpeper details shown on the Drawings.

2.1.6 Aggregate Fill: VDOT No. 57 coarse aggregate.

2.2 Borrow: Obtain borrow materials required in excess of those furnished from excavations from sources off the Owner's property. Provide and submit soil classification testing to ensure borrow materials meet the requirements of this specification.

2.3 Geotextile fabric for riprap bedding material shall be woven polypropylene and shall have the following properties as a minimum:

Physical Property	Specification	Test Method
Apparent Opening Size	Equal to or greater than No. 50 sieve	ASTM D 4751
Grab Tensile Strength Warp/Fill	350 pounds/250 pounds	ASTM D 4632
Puncture Strength	140 pounds minimum	ASTM D 4833

2.3.1 Acceptable products are Erosion 1 as manufactured by Synthetic Industries, 4019 Industry Drive, Chattanooga, Tennessee 37416, Telephone: (615) 899-0444, and Amoco 1199 as manufactured by Amoco Fabrics and Fibers Company, 900 Circle 75 Parkway, Suite 300, Atlanta, Georgia 30339, Telephone: (404) 984-4444.

2.4 Geotextile fabric beneath access roads shall be woven polypropylene and shall have the following properties as a minimum:

Physical Property	Specification	Test Method
Apparent Opening Size	Equal to or greater than No. 40 sieve	ASTM D 4751
Grab Tensile Strength	315 pounds	ASTM D 4632
Grab Tensile Elongation	10%	ASTM D 4632
Mullen Burst Strength	650 psi	ASTM D 3786
Trapezoidal		

Tear Strength	120 pounds	ASTM D 4533
Puncture Strength	145 pounds minimum	ASTM D 4833
UV Resistance after 500 hours	70%	ASTM D 4355
Permittivity	0.05 sec^{-1}	ASTM D 4491

2.4.1 Acceptable products are Mirafi 600X as manufactured by Mirafi Construction Products, 365 South Holland Drive, Pendergrass, Georgia, 30567, Telephone: (706) 693-2226, or approved equal by Synthetic Industries, or Amoco Fabrics and Fibers Company.

3 EXECUTION

3.1 Clearing

3.1.1 Remove from the site trees, stumps, roots, brush, shrubs, down timber, rotten wood, rubbish, other vegetation, as well as fences and incidental structures necessary to allow for new construction.

3.1.2 Clearing work shall be restricted to area within "Construction Limits" specified in this Section and as indicated on the drawings.

3.1.3 Undisturbed stumps and roots, a minimum of 5 feet below finished grade and not located under or within 10 feet of any structure, may be left in place. Tops of stumps left in place shall not be more than 6 inches above original grade.

3.2 Existing Trees and Shrubs

3.2.1 Trees and shrubs that are to remain will be indicated on the drawings or conspicuously marked on site.

3.2.2 Ownership of Trees: Unless otherwise noted, trees removed to allow for new construction shall become the property of the Contractor and shall be removed from the site.

3.2.3 Provide protection for roots and branches over 1½ inches in diameter that are cut during construction operations. Coat the cut faces with an emulsified asphalt or other coating especially formulated for horticultural use on cut or damaged plant tissues. Temporarily cover all exposed roots with wet burlap to prevent roots from drying out. Provide earth cover as soon as possible.

3.3 Grubbing

3.3.1 Grub areas within and to a point 10 feet outside of all structures, areas to receive fill where finished grade will be less than 3 feet above existing grade, cut areas where finished grade will be less than 2 feet below existing

grade, transitional areas between cut and fill, and any area to receive control fill.

3.3.2 Remove from the ground to a depth of 24 inches all stumps, roots ½-inch diameter and larger, organic material, and debris.

3.3.3 Use only hand methods for grubbing inside the drip lines of trees that are to remain.

3.4 Land Disturbance and Construction Limit Criteria for Utility Construction

3.4.1 General Requirements Applying to all Areas

3.4.1.1 The Contractor shall plan construction to minimize disturbance to properties adjacent to the proposed utilities. The Contractor shall flag the proposed limits of construction and mark all proposed trees to be cut for review and approval by the Engineer prior to any clearing being performed.

3.4.1.2 The Engineer reserves the right to limit the width of land to be disturbed and to designate on the drawings or in the field certain areas or items within this width to be protected from damage.

3.4.1.3 The Contractor shall be responsible for damages to area or items designated by the Engineer to be protected. Repairs to, replacement of, or reparations for areas or items damaged shall be made to the satisfaction of the Engineer before acceptance of the completed project.

3.4.1.4 Unless otherwise noted on the contract drawings, all trees cut shall be removed from this project. Brush, laps, roots, and stumps from trees shall also be removed from the site.

3.4.1.5 All buildings or structures located along the line shall be protected by the Contractor. Hand trenching, shoring, or other methods may be required.

3.4.1.6 Any fences disturbed by the Contractor shall be repaired with new materials to a condition equal to or better than their original condition or to the satisfaction of the Engineer. Provide new fencing where indicated on the drawings.

3.4.1.7 The Contractor shall obtain written permission from property owners for use of any access points other than ones located within right-of-ways. Written permission shall contain conditions for use and restoration agreements between property owner and Contractor.

3.4.1.8 All areas disturbed shall be restored to a condition equal to or better than their original condition and shall be graded to drain.

3.4.1.9 The Contractor shall replace or repair all damaged or destroyed property corners.

3.4.1.10 All trees located beyond 10 feet of the utility centerline shall be protected unless the Contractor obtains written authorization from the Engineer to remove them. The Engineer reserves the right to designate other trees located closer to the centerline for protection where possible.

3.4.1.11 All shrubs, hedge, or other ornamental plantings located along the line shall be protected or moved and replanted by the Contractor.

3.4.1.12 The Contractor shall grub only brush, roots, and stumps of removed trees. Damage to lawns shall be kept to an absolute minimum necessary for construction.

3.4.1.13 Topsoil shall be removed from trench line to a depth of 6 inches and stockpiled for use in final restoration. Topsoil shall be replaced to the same depth.

3.4.1.14 Excavated or blasted rock shall be removed from the site unless otherwise ordered by the Engineer.

3.4.1.15 Restoration and fine grading shall follow within 1 week from the time an area is disturbed or within 500 feet from the immediate work site, whichever occurs first. Seeding shall follow as specified in Section 02936 – Seeding.

3.4.2 Construction Limits

3.4.2.1 The Contractor shall not disturb any areas outside the construction limits indicated on the drawings without express written permission from the Engineer. Construction limits are defined as the limits of clearing.

3.4.2.2 No clear-cutting of timber shall be permitted within the construction limits. The Contractor shall make select cutting of trees, taking the smallest trees first, that are mandatory for the construction of the utility line. The Engineer's decision shall be final on determination of which trees are to be cut.

3.5 Clean up debris resulting from site clearing operations continuously with the progress of the work.

3.6 Remove debris from the site in such a manner as to prevent spillage. Keep pavement and areas adjacent to site clean and free from mud, dirt, and debris at all times.

3.7 Surface Preparation

3.7.1 Stripping: Strip existing topsoil, when present, to a depth of 6 inches without contamination by subsoil material. Stockpile topsoil separately from other excavated material and locate convenient to finish grading area.

3.7.2 Unsuitable Material: Remove unsuitable soil materials, waste material, vegetation, debris, decayed vegetable matter, sod, and mulch from the construction site. Dispose of the unsuitable material off the Owner's property in accordance with all federal, state, and local regulations.

3.8 Protections

3.8.1 Protection Systems: Provide shoring, bracing, and sheeting as required in accordance with the U.S. Army Corps of Engineers "Safety and Health Requirements Manual," EM-385-1-1, Sections 25 A through E.

3.8.2 Site Drainage: Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.8.2.1 Surface Drainage: Completely drain the construction site during periods of construction to keep soil materials sufficiently dry. Provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified in this section at no additional cost to the Owner.

3.8.2.2 Subsurface Drainage: Consider site surface and subsurface conditions, available soil, and hydrological data. Remove water by benching, sump pumping, deep well pumping, or other methods to prevent softening of surfaces exposed by excavation. Use filters on dewatering devices to prevent removal of fines from soil. Provide erosion control at the outlet of piping to prevent erosion. Operate dewatering system continuously until construction work below existing water levels is complete.

3.8.3 Underground Utilities: Location of existing utilities indicated on the drawings is approximate. The Contractor shall physically verify the location and elevation of the existing utilities, whether indicated or not, prior to starting construction. The Contractor shall contact Miss Utility and respective utility owners for exact locations prior to any excavation near utilities.

3.8.4 Machinery and Equipment: Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged at no additional cost to the Owner.

3.8.5 Flotation: The Contractor shall take all necessary precautions to prevent the flotation of new piping and structures during installation and the period before the new piping and associated structures are backfilled and placed in service.

3.9 Excavation

3.9.1 Excavate to the elevations and dimensions indicated and as specified in this section. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. When soil not meeting the requirements specified in this section is encountered during excavation, remove the unsuitable soil material and replace with select material as specified in this section. Removal and disposal of unsuitable soil material and placement and compaction of select material shall be performed at no additional cost to the Owner.

3.9.2 Keep excavations free from water. Excavate soil disturbed or weakened by the Contractor's operations, and soils softened or made unsuitable for subsequent construction due to exposure to weather. Refill with select material and compact to 95% of ASTM D 698 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with select material and compact to 95% of ASTM D 698 maximum density. Side slopes when allowed shall be protected with 6-mil polyethylene sheeting.

3.9.3 Pipe Trenches: Excavate to the dimensions indicated and as specified herein. Trenches in public roadways shall be excavated in accordance with the latest edition of the VDOT Road and Bridge Specifications. Where rock is encountered, excavate and remove rock to a minimum depth of 6 inches below the pipe invert. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement.

3.9.4 Unsuitable Subgrade Soil Materials: Subgrades which are determined to be unsuitable for bearing new equipment, structures, or piping, shall have the unsuitable subgrade soil materials removed and disposed of, and replaced with select material at no additional cost to the Owner.

3.10 Filling and Backfilling: Fill and backfill to elevations and dimensions indicated. Compact each lift before placing overlaying lift.

3.10.1 Common Fill Placement: Provide for general site. Place in 6-inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Provide a smooth finish surface by blading, rolling with a smooth roller, or both.

3.10.2 Backfill and Fill Material Placement: Place in 6-inch lifts. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact

material to avoid loading upon or against structures. Place backfill and fill materials to 5 feet outside of structures.

3.10.3 Select Material Placement: Provide under all structures and concrete slabs. Select materials shall be provided from approved borrow areas. In addition, provide stone where indicated on the drawings. Place in 6-inch lifts. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structures.

3.10.4 Trench Backfilling: Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact initial backfill and backfill materials in 6-inch lifts to the top of the trench. Trenches in public roadways shall be backfilled and compacted in accordance with the latest edition of the VDOT Road and Bridge Specifications.

3.10.5 Bedding Requirements: Except as specified otherwise in the individual piping sections, provide bedding for buried piping as specified herein. Ductile iron piping shall be bedded in VDOT No. 57 coarse aggregate to a depth of ⅛ the outside pipe diameter (minimum depth of 6 inches) beneath the pipe invert in accordance with the Class C condition shown in the Town Standard Detail 20.1 entitled "Pipe Bedding Details."

3.11 Compaction: Expressed as a percentage of maximum density. Determine in-place density of the existing subgrade; if required density exists, no compaction of the existing subgrade will be required.

3.11.1 General Site: Compact underneath areas designated for vegetation and areas outside the 10-foot line of structures to 90% of ASTM D 698.

3.11.2 Concrete Slabs: Compact top 12 inches of subgrade to 98% of ASTM D 698. Compact fill, backfill, and select materials to 98% of ASTM D 698.

3.11.3 Pipe Trenches: Compact fill, backfill, and select materials placed in pipe trenches to 95% of ASTM D 698.

3.11.4 Adjacent Areas: Compact areas within 10 feet of structures to 95% of ASTM D 698.

3.11.5 Paved Areas: Compact top 12 inches of subgrade to 100% of ASTM D 698. Compact fill, backfill, and select materials to 100% of ASTM D 698. In addition to the specified compaction requirements, fill and backfill materials shall be compacted to develop a California Bearing Ratio (CBR) of 10.

3.12 Finish Operations

3.12.1 Grading: Finish grades as indicated within one-tenth of 1 foot. Grade areas to drain water away from structures. For existing grades that will remain but which were disturbed by the Contractor's operations, grade as directed.

3.12.2 Seeding: Provide as specified in Section 02936 – Seeding.

3.12.3 Protection of Surfaces: Comply with all local requirements and the latest edition of the Virginia Erosion and Sediment Control Handbook to control erosion and sedimentation. Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.12.3.1 No more than 100 feet of trench shall be open at any one time.

3.12.3.2 During pipe installation activities, the Contractor shall provide seeding and mulch restoration to ensure no more than 10,000 square feet of disturbed area remains unrestored at any given time.

3.12.3.3 Install silt fence on downhill side of pipe trenches and at other locations to prevent sediment from entering drainageways.

3.12.3.4 Apply permanent or temporary soil stabilization to denuded areas within 15 days after final grade is reached on any portion of the site. In addition, apply soil stabilization within 15 days to denuded areas which may not be at final grade but will remain dormant (undisturbed) for longer than 60 days. Soil stabilization practices include vegetative establishment, mulching, and the early application of gravel base on areas to be paved.

3.12.3.5 Install straw bale dam or silt fence around soil stockpiles and excavations.

3.12.3.6 Take all applicable erosion and siltation control measures prior to grading.

3.12.3.7 Protect and maintain storm sewer and culvert inlets with silt traps.

3.12.3.8 Inspect all erosion and sediment control devices at the close of each work day and after each rainstorm. Make necessary repairs or clean up immediately to maintain effectiveness of the device.

3.12.3.9 Where consistent with job safety requirements, easement conditions, and construction methods, place all excavated material on the uphill side of the trench. When the soil is placed on the downhill side of the trench, divert maximum drainage toward the trench.

3.12.3.10 Repair after cleanup: Upon completion of construction work and after spoils and debris have been removed, regrade any areas disturbed by the operations.

3.12.3.11 Water discharged from dewatering activities shall not be discharged directly to any stream or body of water. Comply with Specification 3.26, "Dewatering Structure," of the latest edition of the Virginia Erosion and Sediment Control Handbook.

3.13 Riprap: Riprap shall be installed in accordance with the latest edition of the VDOT Road and Bridge Specifications, Section 414, "Riprap." Geotextile fabric shall be placed under all riprap.

3.14 Geotextile Fabric: Geotextile fabric shall be installed in accordance with the latest edition of the Virginia Erosion and Sediment Control Handbook and the manufacturer's written recommendations.

3.15 Disposition of Surplus Material: Waste soil materials off the Owner's property as directed by the Owner and WW Associates, Inc. in accordance with federal, state, and local regulations.

3.16 Blasting is not permitted on this project.

3.17 Field Quality Control: The Contractor shall employ an independent testing firm to provide all soil testing required for this project.

3.17.1 Sampling: Take the number and size of samples required to perform the following tests.

3.17.2 Testing: Perform one of each of the required tests for each material used. Provide additional tests for each source change and as requested by WW Associates, Inc.

3.17.2.1 Fill and Backfill: Test fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 423 for liquid limit and ASTM D 424 for plastic limits; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.17.2.2 Select Material: Test select material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.17.2.3 Density Tests: Test soil density in accordance with ASTM D 698, or ASTM D 2922 and ASTM D 3017. When ASTM D 2922 and ASTM D 3017 density tests are used, verify density test results by performing an ASTM D 698 density test at a location already

ASTM D 2922 and ASTM D 3017 tested as specified herein. Perform an ASTM D 698 density test at the start of the project, and for every 10 ASTM D 2922 and ASTM D 3017 density tests thereafter. Test each lift at randomly selected locations every 500 square feet of existing grade in fills for structures and concrete slabs, every 500 square feet for other fill areas, every 1,000 square feet of subgrade in cut, and every 250 linear feet for pipe line installation (minimum one test per pipe line), and additional tests as requested by WW Associates, Inc.

End of Section

Section 02500
Paving and Surfacing

1 GENERAL

1.1 Reference specifications where applicable to work under this section are referred to by abbreviation as follows:

1.1.1 American Association of State Highway and Transportation Officials..... AASHTO

1.1.2 American Society for Testing and Materials..... ASTM

1.1.3 Virginia Department of Transportation..... VDOT

2 PRODUCTS

2.1 Aggregate base course for construction entrances shall be Size No. 1, graded aggregate base material as defined in VDOT Road and Bridge Specifications, Section 203, "Coarse Aggregate."

2.2 Aggregate base course for gravel access roads shall be Size No. 21A, graded aggregate base material as defined in VDOT Road and Bridge Specifications, Section 203, "Coarse Aggregate," and Section 208, "Subbase and Aggregate Base Material."

3 EXECUTION

3.1 Aggregate base course construction methods and equipment shall conform to requirements of Section 309, "Aggregate Base Course," of VDOT Road and Bridge Specifications.

3.2 Subgrade Preparation: Subgrade preparation shall consist of the final machining of the subgrade immediately prior to placing the aggregate base course. The surface shall be true to line and grade. Construction methods and equipment shall conform to applicable portions of Section 305, "Subgrade and Shoulders," of VDOT Road and Bridge Specifications.

3.3 Repairs

3.3.1 Contractor shall match the existing subgrade and base elevations when installing repairs. Repairs shall bring trench area to the same elevation as the surrounding area.

3.3.2 Where trenches cross a street, the Contractor shall disturb no more than one half of the street width at one time, and restore the first trench opening to satisfactory travelable condition before the second half is excavated. Avoid placement of excavated material on existing gravel drive wherever possible. Clean gravel driveways by an approved method. Any gravel driveways

damaged by equipment or Contractor's operation shall be repaired at the Owner's discretion at no additional cost. Alter normal traffic flow only with permission from the Owner.

3.3.3 Replace aggregate base course in layers not to exceed 6 inches in thickness to a depth of 1½ times the thickness of the original aggregate base. In no case shall the replaced base be less than 8 inches thick.

3.3.4 Restore private entrances to the original condition or provide no less than 6 inches of aggregate base course, whichever condition is better.

3.4 Temporary Repairs

3.4.1 Where it is not feasible to replace pavements in streets or private driveways immediately after completion of the excavation and backfill, furnish and place crushed stone or gravel as required to maintain traffic until the pavement can be restored. Continuously maintain the temporary crushed stone or gravel surfaces in a smooth condition, free of chuckholes or ruts, until the permanent pavement is restored. Keep dust to a minimum by applying water.

3.4.2 Restore permanent pavement within 30 days after the existing pavement has been cut.

3.5 All finished pavement edges shall be clean and straight. The final paving quality control shall be the responsibility of the Contractor and shall be acceptable to the Owner based on surface thickness and smoothness.

3.6 Do not block private entrances except for short periods, and maintain ingress and egress to adjacent property at all times.

3.7 Do not clog street drainage. Maintain shoulders, gutters, and ditches affected by trenching operations to carry drainage flows.

3.8 Upon completion of construction work and after spoils and debris have been removed, regrade any areas disturbed by the operations.

End of Section

Section 02660
Water Distribution System

1 GENERAL

1.1 Description: This section specifies all potable water distribution systems on this project.

1.2 Related Requirements: The following sections contain requirements that relate to this section.

1.2.1 Section 02300 – Boring/Tunneling

1.3 All water main accessories shall comply with the latest edition of the Town of Culpeper Water and Sanitary Sewer Construction Specifications and Standards.

1.4 Reference specifications are referred to by abbreviation as follows:

1.4.1 American Association of State Highway and Transportation Officials ..... AASHTO

1.4.2 American National Standards Institute ..... ANSI

1.4.3 American Society for Testing and Materials ..... ASTM

1.4.4 American Water Works Association ..... AWWA

1.4.5 Virginia Department of Health ..... VDH

1.5 All products in contact with drinking water shall meet NSF/ANSI Standard 61, and either NSF/ANSI 61, Annex G or NSF 372 for compliance with new “lead free” content requirements.

1.6 Project Conditions: Separation of Water Lines and Sanitary Sewers.

1.6.1 Follow VDH standards for separation of water mains and sewer lines.

1.6.2 Parallel Installation

1.6.2.1 Normal Conditions: Water lines shall be constructed at least 10 feet horizontally from a sewer or sewer manhole whenever possible, the distance shall be measured edge-to-edge.

1.6.2.2 Unusual Conditions: When local conditions prevent a horizontal separation of at least 10 feet, the water line may be laid closer to a sewer or sewer manhole provided that:

1.6.2.3 The bottom of the water line is at least 18 inches above the top of the sewer.

1.6.2.3.1 Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved water pipe pressure-tested in place to 50 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.

1.6.3 Crossing

1.6.3.1 Normal Conditions: Water lines crossing over sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water line and the top of the sewer whenever possible.

1.6.3.1.1 Unusual Conditions: When local conditions prevent a vertical separation described in crossing, normal conditions, paragraph above, the following construction shall be used.

1.6.3.1.2 Sewers passing over or under water lines shall be constructed of the materials described in parallel installation, unusual conditions, as specified above.

1.6.3.1.3 Water lines passing under sewers shall, in addition, be protected by providing:

A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water line,

Adequate structural support for the sewers to prevent excessive deflection of the joints and settling on and breaking water line,

That the length of the water line be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.

1.6.4 Sanitary Sewers or Sewer Manholes: No water pipes shall pass through or come in contact with any part of a sewer or sewer manhole.

1.7 Submittals: Provide the following shop drawings in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.7.1 Pipe and Fittings: Catalog cuts and certificates of compliance for pipe, fittings, linings, and materials for approval. Certificates shall state that materials furnished comply with the standards specified in this section.

1.7.2 Pipe Restraint Devices

1.7.3 Valves: Catalog cuts and certificates of compliance for valves.

1.7.4 Air Release Valves

1.7.5 Fire Hydrants

1.7.6 Valve Boxes

1.7.7 Water Piping Field Test Certification Reports

1.7.8 Bacteriological Test Reports (Submit to Owner)

1.8 NSF Compliance

1.8.1 All products in contact with potable water shall be certified compliant with NSF 61-G, and shall bear the NSF-61-G certification mark.

2 PRODUCTS

2.1 Piping Application

2.1.1 The following piping systems, 4 inches and larger in diameter, shall be constructed of push-on joint Special Thickness Class 52 ductile iron pipe unless otherwise indicated:

2.1.1.1 Below grade finished water main and drain piping, including inlet/outlet piping. Pipe restraint shall be provided as specified herein unless otherwise indicated.

2.1.2 The following piping systems, 4 inches and larger in diameter, shall be constructed of restrained joint Special Thickness Class 52 ductile iron pipe. All pipe joints for these sections of piping shall be restrained:

2.1.2.1 Below grade water piping beneath structures

2.1.2.2 Below grade water piping in casing pipe at bored road crossings

2.1.2.3 Below grade overflow and drain piping

2.1.2.4 Below grade water piping not otherwise specified

2.1.3 The following piping systems, 4 inches and larger in diameter, shall be constructed of butt-welded standard weight carbon steel pipe and flanged joint Special Thickness Class 53 ductile iron pipe unless otherwise indicated:

2.1.3.1 Above grade piping not otherwise specified

2.1.4 The following piping systems, 2 inches and smaller in diameter, shall be constructed of ASTM B 88 Type K flexible copper pipe unless otherwise indicated:

2.1.4.1 Water piping not otherwise specified

2.1.5 Accessories: Provide flanges, joint restraints, connecting pieces, transition glands, transition sleeves, tapping saddles, and other adapters as required for complete and operable piping systems for the service indicated. Provide restrained joints where indicated on the drawings and as specified in this section.

2.1.6 The Contractor shall be responsible for the removal, disposal, and replacement of any existing concrete thrust blocking on existing water lines for connection of new water lines and appurtenances at no additional cost to the Owner.

2.2 Pipe

2.2.1 Ductile Iron Pipe

2.2.1.1 Ductile iron pipe shall be Special Thickness Class 52 unless otherwise indicated and shall meet requirements of ANSI/AWWA C150 and C151. Flanged pipe shall be Special Thickness Class 53 unless otherwise indicated and shall meet requirements of ANSI/AWWA C115.

2.2.1.2 Fittings shall meet requirements of ANSI/AWWA C110 and C153 with pressure rating not less than that of the pipe.

2.2.1.3 Provide mechanical joints or push-on joints for underground piping. Jointing materials shall meet requirements of ANSI/AWWA C111.

2.2.1.4 Mechanical joint retainer glands shall be ductile iron and shall be manufactured by EBAA Iron, Inc, or approved equal by American Cast Iron Pipe Company, Ford Meter Box Company, or Romac Industries, Inc.

2.2.1.5 Restrained joints shall be “FLEX-RING” as manufactured by American Cast Iron Pipe Company, “TR FLEX” as manufactured by U.S. Pipe and Foundry Company, “SNAP-LOK” as manufactured by Griffin Pipe Products Company, or approved equal. Jointing materials shall meet requirements of ANSI/AWWA C111.

2.2.1.6 Push-on joint and rubber gasket shall meet requirements of ANSI/AWWA C111. Restrained push-on joints may be used where restrained joints are required. "FIELD-LOK" push-on gaskets or similar products will not be allowed as the sole method of joint restraint.

2.2.1.7 Provide flanged joints for all aboveground piping and as indicated on the drawings. Flanges shall meet requirements of Class 125 ANSI B16.1.

2.2.1.8 Flanged joint gaskets shall be full face, made of rubber, and shall meet requirements of ANSI/AWWA C111/A21.11.

2.2.1.9 Cement mortar lining with bituminous seal coat for ductile iron pipe and cast iron fittings shall meet requirements of ANSI/AWWA C104. Cement mortar lining shall be standard thickness.

2.2.1.10 Exterior, bituminous coating shall meet requirements of ANSI/AWWA C110, C115, C151, and C153, as applicable.

2.2.2 Copper Tubing

2.2.2.1 Copper tubing and associated fittings shall be ASTM B 88, Type K flexible.

2.2.2.2 Fittings shall be wrought copper or cast bronze of the flared joint type in sizes to 1-inch diameter, and of the compression joint type in sizes above 1-inch diameter. Fittings shall be manufactured by Ford Meter Box Company, Inc.

2.3 Flexible couplings for connecting pipes of dissimilar materials shall be as manufactured by Fernco of Davison, Michigan.

2.4 Pipe Labeling

2.4.1 Above grade piping 1-inch in diameter and larger shall be labeled. Provide labeling every 15 linear feet of pipe and spell out the pipe system. Labels shall be either black for light colored piping or white for dark colored piping.

2.4.2 Detectable tape shall be provided for all below grade piping systems and shall have a metallic core protected by a plastic jacket. The tape shall be continuously marked indicating that a water main is buried beneath the tape.

2.5 Valves: <u>Valve leakage will not be allowed.</u>

2.5.1 Gate Valves

2.5.1.1 Nonrising stem gate valves 3 inches and larger shall meet requirements of AWWA C500 "AWWA Standard for Gate Valves for Water and Sewerage Systems," or valves 3 inches through 12 inches shall meet requirements of AWWA C509 "AWWA Standard for Resilient Seated Gate Valves for Water and Sewerage Service." Working pressure shall be at least 200 psi for valve sizes 3 through 12 inches, or at the pressure rating specified for adjacent piping, whichever is greater. Valve ends shall be compatible with piping systems in which valves are installed. Valve shall be cast iron body, bronze mounted. Valves shall have o-ring seals and shall open counterclockwise. Asbestos packing will not be acceptable.

2.5.1.2 Valves listed above shall be manufactured by Mueller Company, Kennedy Valve Manufacturing Company, Inc., or American Flow Control.

2.5.2 Ball Valves: Ball valves shall be Class 150, meeting requirements of ANSI B16.34. Valves shall have ANSI carbon steel bodies and balls. Valves shall have stainless steel stems and trim, and Viton or Teflon seats, body seals, and stem seals. Valves shall be lever operated. Valves shall be manufactured by ITT-Grinnell, Worchester, Inc., or approved equal.

2.5.3 Air Release Valves – Water

2.5.3.1 Air release valves shall be APCO Model 145C combination air valves as manufactured by DeZurik, or approved equal by Cla-Val Company (Series 36) or ARI USA, Inc. (Model D-040). Valves shall have the following dimensions:

2.5.3.1.1 Inlet Diameter: 2-inch NPT

2.5.3.1.2 Outlet Diameter: 2-inch NPT

2.5.3.1.3 Large Orifice Diameter: 2-inch

2.5.3.1.4 Small Orifice Diameter: 3/32-inch

2.5.3.2 Valves shall have ASTM A126 Grade B cast iron body, cover, and lever frame, ASTM B124 bronze plug, Buna-N needle and seat, and ASTM A240 stainless steel float.

2.6 Corporation stops shall be one-piece bronze body with integral wrench flats, CC inlet taper threads, o-ring sealed, balanced pressure, ball type valve, having a

round, full open unobstructed flow way and meeting requirements of AWWA C800, "Underground Service Line Valves and Fittings." Corporation stops shall be manufactured by Mueller Company, Ford Meter Box Company, or A.Y. McDonald.

2.7 Valve boxes shall be adjustable, traffic rated, cast iron valve boxes of the two-piece screw-type. Base shall be proper type and size for the valve with which it is used. The word "WATER" shall be cast or embossed on the valve box lid in letters not less than 1-inch high. Valve boxes shall be manufactured by Mueller Company, Dewey Brothers, Tyler, or Bingham-Taylor.

2.8 Fire hydrants shall be the safety flange, breakaway top type, meeting requirements of AWWA C502, "AWWA Standard for Dry-Barrel Fire Hydrants." Hydrants shall be designed for a minimum working pressure of 150 psi. Hydrants shall have a 6-inch mechanical joint connection to the water main, a barrel diameter of no smaller than 7 inches, a hydrant valve diameter no smaller than 5¼ inches, and shall be equipped with two 2½-inch hose nozzles and one 4½-inch pumper connection. Connection caps shall be fitted with chains. Hose and pumper outlet threads shall conform to the National Standard and match local fire department equipment. Hydrants shall be equipped with a National Standard pentagon operating nut, opening counterclockwise. Hydrants shall be Kennedy Guardian or Mueller Company Model A-423.

3 EXECUTION

3.1 Pipe Laying

3.1.1 Take all precautions necessary to insure that pipe, valves, fittings, and other accessories are not damaged in unloading, handling, and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.

3.1.2 Exercise care to keep foreign material and dirt from entering pipe during storage, handling, and placing in trench. Close ends of in-place pipe at the end of any work period to preclude the entry of animals and foreign material.

3.1.3 Bedding of pipe shall be as specified in Section 02200 – Earthwork.

3.1.4 Do not lay pipe when trench bottom is muddy or frozen, or has standing water.

3.1.5 Use only those tools specifically intended for cutting the size and material and type pipe involved. Make cut to prevent damage to pipe or lining and to leave a smooth end at right angles to the axis of the pipe.

3.2 Lay water main piping with bell ends facing the direction of laying. Where grade is 10 percent or greater, pipe shall be laid uphill with bell ends upgrade. Lay water main piping with a minimum cover of 36 inches unless otherwise indicated.

3.3 Join mechanical joint pipe as follows:

3.3.1 Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter from the joint. Paint the bell and the spigot with soap solution. Slip cast-iron gland on spigot end with lip extension of gland toward end of pipe. Paint rubber gasket with or dip into soap solution and place on spigot end with thick edge toward gland.

3.3.2 Push the spigot end forward to seat in the bell. Then carefully press the gasket into the bell so that it is located evenly around the joint. Move the gland into position, insert bolts, and screw nuts up finger tight. Then tighten all nuts to torque listed below.

Bolts Size – Inches	Torque Feet – Pounds
⅝	40-60
¾	60-90
1	70-100
1¼	90-120

3.3.3 Tighten nuts on alternate sides of the gland until pressure on the gland is equally distributed.

3.3.4 Permissible deflection of mechanical joint pipe shall not be greater than listed in AWWA C600.

3.4 Lay overflow/drain piping so as to maintain a true alignment and grade as indicated on the drawings. After completion, the pipe shall exhibit a full circle of light when lighted at one manhole and viewed from the next.

3.4.1 Commence laying piping at the lowest point on a section of line and lay pipe upgrade with bell or groove ends upstream.

3.4.2 Pipe Joint: Preparatory to making pipe joints, clean and dry all surfaces of joint pipe and jointing material. Use lubricants, primers, adhesives, and similar materials as recommended by the manufacturers. Place, fit, join, and adjust jointing materials or factory fabricated joints as recommended by the manufacturer to obtain the degree of water tightness required. As soon as possible after the joint is made, place sufficient backfill material, as specified in Section 02200 – Earthwork, along each side of pipe to resist forces that might tend to move the pipe off line and grade.

3.4.3 Backfill as specified in Section 02200 – Earthwork. Place backfill over the pipe immediately after the pipe has been laid.

3.5 Join push-on joint pipe as follows:

3.5.1 Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter. Flex rubber gasket and insert in the gasket recess of the bell socket. Apply a thin film of gasket lubricant supplied by pipe manufacturer to either the gasket or the spigot end of the joining pipe.

3.5.2 Start spigot end of pipe into socket with care. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack type device. Field cut pipe shall have the end filed to match the manufactured spigot end.

3.5.3 Join restrained push-on joints according to the manufacturer's recommendations.

3.5.4 Permissible deflection of push-on joint pipe shall not be greater than listed in AWWA C600.

3.5.5 Permissible deflection in restrained push-on joint pipe shall be as recommended in writing by the manufacturer.

3.6 Install and test butt-welded, standard weight carbon steel pipe in accordance with ASME B31.1, "Power Piping."

3.7 Welded, soldered, or brazed joints between sections of copper pipe and between pipe and fittings shall be in compliance with ANSI B31.1. Make joints in piping system tight and leakproof against the design pressure. Peening of welded joints to correct leaks will not be permitted. Brazed or soldered joints that leak shall be disassembled, cleaned, and made again.

3.8 Join pipe of dissimilar materials by using Fernco couplings in accordance with the manufacturer's written recommendations.

3.9 Install detectable tape in trench above all pipe per the manufacturer's written recommendations.

3.10 Provide marker posts above non-metallic pipe systems at all changes in direction and where shown on the contract drawings. Space marker posts as recommended by the manufacturer.

3.11 Set Valves and Valve Boxes as follows:

3.11.1 Equip all underground valve operators with valve boxes. Set box in alignment with valve stem centered on valve nut. Set valve box to prevent transmitting shock or stress to the valve. Set box cover flush with the finished ground surface or pavement.

3.11.2 The Contractor shall operate new gate valves during preliminary flushing activities.

3.12 Installation of Tapping Sleeves and Tapping Valves

3.12.1 All tapping sleeves shall be set to avoid interference with existing pipe joints.

3.12.2 After all tapping sleeves and valves have been set in place, a 150-psi pressure test shall be performed to insure that there are no leaks around the sleeve or through the valve prior to tapping. All leakage shall be corrected.

3.12.3 Actual taps shall be made in the presence of the Owner's representative. The Owner shall be given a minimum of 48 hours notice before tapping operations commence.

3.13 For buried pressure piping, provide retainer gland type devices, restraining devices, or restrained joint type pipe at all changes in direction of pressure piping, at dead ends, and as shown on the drawings. Concrete reaction anchors will not be allowed as a means of joint restraint.

3.13.1 Restrain all joints with retainer glands/devices in accordance with the written recommendations of the retainer gland/device manufacturer. All pipe joints shall be restrained with retainer glands/devices a minimum of 60 feet each side of a fitting or valve.

3.13.2 Where retainer glands/devices are used, extreme care shall be taken so that each set screw is tightened as recommended by the manufacturer before the pipe is backfilled and tested.

3.13.3 Hydrants shall be tied to the pipe with suitable metal tie rods, clamps, or restrained joints as shown on the drawings. Tie rods, clips, or other components of dissimilar metal shall be protected against corrosion by hand application of a bituminous coating or by encasement of the entire assembly with 8-mil thick, loose polyethylene film in accordance with AWWA C105.

3.14 Install air release valves, manholes, and fire hydrant assemblies as indicated on the drawings and in accordance with the latest edition of the Town of Culpeper Water and Sanitary Sewer Construction Specifications and Standards.

3.15 Locate fire hydrants at such a distance from the curb or edge of pavement to provide ready access and minimize the possibility of damage from vehicles. Locate fire hydrants in dry, stable areas outside of high groundwater tables to prevent potential cross connection. Orient the hydrant so that the pumper nozzle faces the road. Set hydrant plumb and with the bury line on the hydrant at grade. Provide anchorage and at least 7 cubic feet of crushed stone under the base to allow drainage from the hydrant drain valve, as indicated on the drawings.

3.16 Install combination air valves at locations indicated on the drawings and at all high points on pressure piping in accordance with the manufacturer's written recommendations. Install gate valve between piping and air valve. Use tap, tapping saddle, tee, or other fittings as required for complete and operable installation.

3.17 Construct manholes using precast reinforced concrete manhole sections except as otherwise noted. Install manhole frames and covers and manhole steps using materials specified under products.

3.18 Construct inlets, endwalls, and other storm drainage items as detailed in the latest edition of the VDOT Road and Bridge Standards or on the drawings, as applicable.

3.19 Construct concrete cap or cradle in accordance with the latest edition of the VDOT Road and Bridge Standards at locations where the vertical separation between the new water main piping and adjacent utilities is less than 6 inches.

3.20 Use sleeves where pipes, valves, stem extensions, or equipment parts pass through concrete or masonry walls or slabs. Sleeves shall be or sufficient size to allow sealing around pipes and clearance for valve stem or equipment. Extend vertical sleeves through slabs 1-inch above top surface.

3.20.1 Use cast iron or steel sleeves with intermediate collars to anchor and provide water stops on sleeves that pass through exterior walls below grade. Seal around pipes using grouting compound or "Link-Seal" pipe to wall closures manufactured by Thunderline Corporation, Wayne, Michigan. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to fill annular space between pipe and wall opening and shall provide watertight seal between pipe and wall opening. Grouting compound shall be mixed and placed in accordance with the recommendations of the manufacturer. Mechanical pipe to wall seal shall be installed in accordance with the written recommendations of the manufacturer.

3.21 Acceptance Tests

3.21.1 After the line has been backfilled, subject the line or any valved section of the line to a hydrostatic pressure test. Fill the system with water at velocity

of approximately 1 foot per second while necessary measures are taken to eliminate all air. After the system has been filled, raise the pressure by pump to 150 psi, or 1.5 times the working pressure, whichever is greater. Measure pressure at the low point on the system compensating for gage elevation. Maintain this pressure for 2 hours. If pressure cannot be maintained, determine cause, repair, and repeat the test until successful.

3.21.2 A leakage test shall be conducted concurrently with the pressure test. Leakage shall be determined with a calibrated test meter furnished by the contractor. Leakage will be defined as the quantity of water required to maintain a pressure within 5 psi of the specified test pressure, after air has been expelled, and the pipe filled with water. Leakage shall not exceed that quantity obtained by the formula below. If leakage exceeds that determined by the formula, find and repair the leaks and repeat the test until successful. The leakage formula shall be as follows:

$$L = SD(\sqrt{P})/148{,}000$$

Where L = Allowable leakage, in gallons/hour
S = Length of pipeline tested, in feet
D = Nominal diameter of the pipe, in inches
P = Average test pressure during leakage test, in psig

3.21.3 All visible leaks shall be repaired regardless of the amount of leakage.

3.22 Disinfect and test water mains and accessories in accordance with AWWA standards and as specified herein.

3.22.1 Preliminary Flushing: The main shall be flushed prior to disinfection, except when the tablet method is used. Flushing shall be at a velocity of not less than 3.0 feet per second. Adequate provisions shall be made for drainage of flushing water.

3.22.2 Form of Chlorine for Disinfection

3.22.2.1 Liquid chlorine shall be used only when suitable equipment is available and only under the direct supervision of a person familiar with the physiological, chemical, and physical properties of this element and who is properly trained and equipped to handle any emergency that may arise. Introduction of chlorine-gas directly from the supply cylinder is unsafe and shall not be permitted.

3.22.2.2 Calcium hypochlorite contains 70% available chlorine by weight. It shall be either granular or tabular in form. The tablets, six to eight to the ounce, are designed to dissolve slowly in water. A chlorine-water solution shall be prepared by dissolving the

granules or tablets in water in the proportion requisite for the desired concentration.

3.22.2.3 Sodium hypochlorite is supplied in strengths from 5.25% to 16% available chlorine. The chlorine-water solution shall be prepared by adding hypochlorite to water.

3.22.2.4 Application: The hypochlorite solutions shall be applied to the water main with a gasoline or electrically powered chemical feed pump designed for feeding chlorine solutions. For small applications, the solutions may be fed with a hand pump; for example, a hydraulic test pump. Feed lines shall be of such material and strength as to withstand safely the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the hypochlorite solution is applied to the main.

3.22.3 Methods of Chlorine Application

3.22.3.1 Continuous Feed Method: Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 50 mg/L available chlorine. To assure that this concentration is maintained, the chlorine shall be measured at intervals not exceeding 1,200 feet in accordance with the procedures described in the current edition of "Standard Methods" and AWWA M12 – "Simplified Procedures for Water Examination." In the absence of a meter, the rate may be determined either by placing a pitot gage at the discharge or by measuring the time to fill a container of known volume.

During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24-hour period, the treated water shall contain no less than 25 mg/L chlorine throughout the length of the main.

3.22.3.2 Tablet Method: Use only when allowed by the Engineer. Do not use this method if trench water or foreign material has entered the main or if the water is below 41°F (5°C). This method may

be used for mains up to 12 inches in diameter, and where the total length of the main is less than 2,500 feet.

Place tablets in each section of pipe and also in hydrants, hydrant branches, and other appurtenances. Enough tablets shall be used to ensure that a chlorine concentration of 25 mg/L is provided in the water. Attach tablets using Permatex No. 1 adhesive or other approved adhesive, except for the tablets placed in hydrants and in the joints between the pipe sections. Tablets shall be free of adhesive except on the one broad side to be attached. Place all tablets at the top of the main. If the tablets are attached before the pipe section is placed in the trench, mark the position of the tablet in the pipe and assure that the pipe is placed with the tablet at the top.

When installation is completed, fill the main with water at a velocity of less than 1 foot per second. The water shall remain in the pipe for at least 24 hours. Operate valves so that the strong chlorine solution will not flow back into the line supplying the water.

3.22.4 Final Flushing: After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 mg/L. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipeline. Contractor shall provide dechlorination of all flushed water prior to discharge.

3.22.5 Bacteriologic Tests

3.22.5.1 After final flushing and before the water main is placed in service, samples shall be collected and tested for bacteriologic quality and shall show the absence of coliform organisms. Samples shall be collected at intervals not exceeding 1,200 feet, and tested by a VDH-approved laboratory and results submitted to the Owner. In addition, collect and test one sample at the end of the piping, and at least one sample from each branch greater than one pipe length.

3.22.5.2 Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate. If laboratory results indicate the presence of coliform bacteria, the samples are unsatisfactory, and disinfection shall be repeated until the samples are satisfactory.

3.22.5.3 A sampling tap consisting of a corporation cock with metal pipe shall be installed within 2 feet of valves. The corporation stop inlet shall be male, 1-inch in size, and the outlet shall have 1-inch I.P. threads and a cap.

3.22.6 Cleaning, disinfection, and testing will be the responsibility of the Contractor. The Contractor shall furnish the water required for these operations at his own cost and expense. No separate payment, other than that included in the contract lump sum, will be allowed.

3.22.7 Testing and disinfection of the completed sections shall not relieve the Contractor of his responsibility to repair or replace any cracked or defective pipe. All work necessary to secure a tight line shall be done at the Contractor's expense.

3.22.8 The Contractor has the following options for bacteriological testing for total coliform analysis:

3.22.8.1 Option A: Before approving a main for release, take an initial set of samples and then resample again after a minimum of 16 hours using the sampling site procedures outlined. Both set of samples must pass for the main to be approved for release.

3.22.8.2 Option B: Before approving a main for release, let it sit for a minimum of 16 hours without any water use. Then collect, using the sampling site procedures outlined and without flushing the main, two sets of samples a minimum of 15 minutes apart while the sampling taps are left running. Both sets of samples must pass for the main to be approved for release.

End of Section

Section 02720
Drainage Piping Systems

1 GENERAL

1.1 System Description: Work in this section includes drainage piping system work on this project, including foundation drains, yard drains, and roof drain leaders.

1.2 Reference specifications are referred to by abbreviation as follows:

1.2.1 American Association of State Highway and Transportation Officials ..... AASHTO

1.2.2 American National Standards Institute ..... ANSI

1.2.3 American Society for Testing and Materials ..... ASTM

1.2.4 Virginia Department of Transportation ..... VDOT

1.2.5 United States Bureau of Reclamation ..... USBR

1.3 Submittals: Provide the following in timely manner.

1.4 Shop Drawings of the following:

1.4.1 Pipe

1.4.2 Drainage Structures

2 PRODUCTS:

2.1 Piping Application

2.1.1 Roof Drain Leader

2.1.1.1 Roof Drain Leader piping 4” to 6” in diameter, shall be constructed of solvent welded schedule 40 polyvinyl chloride (PVC) pipe and fittings.

2.1.2 Yard Drains

2.1.2.1 Yard Drain piping 4” to 6” in diameter, shall be constructed of solvent welded schedule 40 polyvinyl chloride (PVC) pipe and fittings.

2.1.2.2 Yard Drain piping 8” and larger in diameter, shall be constructed of SDR-35 PVC push-on joint pipe, unless otherwise noted

2.1.3 Accessories: Provide flanges, connecting pieces, transition glands, transition sleeves, and other adapters as required for complete and operable piping systems for the service indicated.

2.2 Pipe

2.2.1 PVC Pipe and Fittings

2.2.1.1 Schedule 40 PVC

2.2.1.1.1 Pipe: PVC Compound Cell Classification 12454-B polyvinyl chloride meeting ASTM D1784. Schedule 40 for gravity applications meeting ASTM D1785. Joints shall be solvent welded, meeting requirements of ASTM D 2855.

2.2.1.1.2 Fittings

2.2.1.1.2.1 Socket: Solvent-welded meeting ASTM D2466.

2.2.1.1.2.2 Threaded: Taper pipe threads meeting ASTM D2464.

2.2.1.1.2.3 Flanged: One-piece solid design; compatible with ANSI B16.5, Class 150 metal flanges.

2.2.1.2 SDR 35 PVC

2.2.1.2.1 Pipe: Polyvinyl chloride (PVC) plastic gravity sewer piping shall meet requirements of ASTM D 3034 and be integral bell, gasketed joint pipe with dimension ratio (DR) of 35 and minimum pipe stiffness (PS) of 46 psi. Pipe joint shall meet requirement of ASTM D 3212. Rubber gaskets shall meet physical requirements specified in ASTM F 477 in all respects.

2.3 Yard Drain Structures

2.3.1 Yard Drain Structures shall include the drain basin type as indicated on the contract drawings and referenced within the contract specifications. The ductile iron grates for each of these fittings are to be considered an integral part of the surface drainage inlet and shall be furnished by the same manufacturer. The surface drainage inlets shall be as manufactured by Nyloplast a division of Advanced Drainage Systems, Inc., or approved equal.

2.3.2 Materials

2.3.2.1 The drain basins required for this contract shall be manufactured from PVC pipe stock, utilizing a thermoforming process to reform the pipe stock to the specified configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. This joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The flexible elastomeric seals shall conform to ASTM F477. The pipe bell spigot shall be joined to the main body of the drain basin or catch basin. The raw material used to manufacture the pipe stock that is used to manufacture the main body and pipe stubs of the surface drainage inlets shall conform to ASTM D1784 cell class 12454. The grates and frames furnished for all surface drainage inlets shall be ductile iron and shall be made specifically for each basin so as to provide a round bottom flange that closely matches the diameter of the surface drainage inlet. Grates for drain basins shall be capable of supporting various wheel loads as specified by Nyloplast. Ductile iron used in the manufacture of the castings shall conform to ASTM A536 grade 70-50-05. Grates and covers shall be provided painted black.

2.4 Slot Drains

2.4.1 Slot drains shall be Duraslot pipe, as manufactured and distributed by ADS, Inc. and shall have a smooth interior and annual exterior corrugations with an aluminum slot grate frame mounted longitudinally along the length of the pipe to accept the grate while maintaining the original pipe diameter.

2.4.1.1 4-through 10-inch (100 to 250mm) pipe shall meet AASHTO M252, Type S.

2.4.1.2 12-through 36-inch (300 to 900mm) pipe shall meet AASHTO M294, Type S or ASTM F2306.

2.4.1.3 Manning's "n' value for use in design shall be 0.012.

2.4.2 The aluminum slot grate frame shall be manufactured from 0.063" tempered commercial aluminum meeting the requirements of ASTM B209, consisting of two parallel plates separated by spacers spanning the slot on 6" centers. The grate shall be ½ - #13 galvanized steel. The grate shall have a diamond-shaped opening and be ADA compliant. The flange at the bottom of the aluminum slot grate frame shall be riveted to the pipe with a minimum of two rivets per linear foot. The Inlet capacity shall be 0.046 cfs per linear foot.

2.4.3 Fittings – Duraslot fittings shall be modified from fittings which conform to AASHTO M252, AASHTO M294. Or ASTM F2306.

2.5 Flexible couplings for connecting pipes of dissimilar materials shall be as manufactured by Fernco of Davison, Michigan.

2.6 Downspout Connectors shall be Universal Downspout Connectors as manufactured by Fernco of Davison, Michigan. Connectors shall be cut to provide a tight fit around downspout and roof drain leader piping.

3 EXECUTION

3.1 Maintain drainage on site to prevent erosion, damaging water, and standing water during all phases of construction.

3.2 Keep excavations clear of water while work is being installed. Control subsurface water in accordance with Section 02200 - Earthwork.

3.3 Take all precautions necessary to insure that pipe, fittings, and related items are not damaged in unloading, handling, and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.

3.4 Do not lay pipe or concrete when trench conditions or weather are unsuitable for such work. Keep pipe interior clean and free from dirt or waste materials.

3.5 Lay pipe so as to maintain a true alignment and grade as indicated on drawings. After completion, the pipe shall exhibit a full circle of light when lighted at one manhole and viewed from the next.

3.5.1 Commence laying piping at the lowest point on a section of line and lay pipe upgrade with bell or groove ends upstream.

3.5.2 Pipe Joint: Preparatory to making pipe joints, clean and dry all surfaces of joint pipe and jointing material. Use lubricants, primers, adhesives, and similar materials as recommended by the manufacturers. Place, fit, join, and adjust the jointing materials or factory fabricated joints as recommended by manufacturer to obtain the degree of water tightness required. As soon as possible after the joint is made, place sufficient backfill material, as specified in Section 02200 – Earthwork, along each side of pipe to resist forces that might tend to move pipe off line and grade.

3.5.3 Backfill as specified in Section 02200 – Earthwork. Place backfill over the pipe immediately after the pipe has been laid.

3.6 Join corrugated high density polyethylene (HDPE) pipe in accordance with the manufacture’s written recommendations.

3.7 Join solvent welded polyvinyl chloride (PVC) pipe in accordance with the manufacture's written recommendations.

3.8 As each joint is laid, visually inspect to be certain that no jointing compound, gasket, or trash is protruding from the joint or lying inside the pipe.

3.9 Downspout Connectors

3.9.1 Install new downspout connectors on each gutter downspout connection to a roof drain leader. Connector shall provide a tight seal around downspout and roof drain leader piping to prevent debris from entering the drainage piping system.

3.10 Yard Drainage Structures

3.10.1 Yard Drainage Structures shall be installed in accordance with the manufacturers written instructions. Bedding and backfill for surface drainage inlets shall be well placed and compacted uniformly in accordance with Section 02200 - Earthwork. The drain basin body will be cut at the time of the final grade is achieved. No brick, stone or concrete block will be allowed to set the grate to the final grade height. For load rated installations, a concrete slab shall be poured under and around the grate and frame. The concrete slab must be designed taking into consideration local soil conditions, traffic loading, and other applicable design factors.

3.11 Slot Drain

3.11.1 Install slot drain in accordance with manufacturer's written instructions and recommendations.

End of Section

Section 02730
Sanitary Sewer Piping

1 GENERAL

1.1 Description: This section specifies all sanitary sewer piping on this project:

1.1.1 All other wastewater treatment plant piping unless otherwise noted

1.1.2 Equalization Flow Distribution Box

1.2 Reference specifications are referred to by abbreviation as follows:

1.2.1 American National Standards Institute ..... ANSI

1.2.2 American Society for Testing and Materials ..... ASTM

1.2.3 American Water Works Association ..... AWWA

1.2.4 Uni-Bell PVC Pipe Association..... UNI-B

1.2.5 Virginia Department of Health .....VDH

1.2.6 Virginia Department of Transportation ..... VDOT

1.4 Project Conditions: Separation of Water Lines and Sanitary Sewers

1.4.1 Follow VDH standards for the separation of sanitary sewer and water distribution systems.

1.4.2 Parallel Installation

1.4.2.1 Normal Conditions: Sewer lines and manholes shall be constructed at least 10 feet horizontally from a water line whenever possible. The distance shall be measured edge-to-edge.

1.4.2.2 Unusual Conditions: When local conditions prevent a horizontal separation of at least 10 feet, then maximum horizontal separation shall be provided with vertical separation of bottom of water line at least 18 inches above top of sewer. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved water pipe pressure-tested in place to 50 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.

1.4.3 Crossing

1.4.3.1 Normal Conditions: Sewers crossing under water lines shall be laid to provide a separation of at least 18 inches between the bottom of water line and the top of the sewer whenever possible.

1.4.3.2 Unusual Conditions: When local conditions prevent a vertical separation described in "Crossing, Normal Conditions," paragraph above, the following construction shall be used.

1.4.3.2.1 Sewers passing over water lines shall be laid to provide:

1.4.3.2.1.1 Vertical separation of at least 18 inches between bottom of sewer and top of water line,

1.4.3.2.1.2 Adequate structural support for the sewers to prevent excessive deflection of the joints and settling on and breaking the water line,

1.4.3.2.1.3 Maximum separation of water and sewer line joints,

1.4.3.2.1.4 Sewers passing over or under water lines shall be constructed of cast or ductile iron with mechanical joints as described in "Parallel Installation, Unusual Conditions," paragraph above.

1.4.4 Sanitary Sewers or Sewer Manholes: No water pipes shall pass through or come in contact with any part of a sewer or sewer manhole.

1.5 Quality Assurance

1.5.1 Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic sanitary piping specialty components.

1.6 Submittals: Provide the following in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements.

1.6.1 Pipe and Fittings: Catalog cuts and certificates of compliance for pipe, fittings, linings, and materials for approval. Certificates shall state that materials furnished comply with the standards specified in this section.

1.6.2 Pipe Restraint Devices

1.6.3 Flexible Couplings

1.6.4 Precast Concrete Manholes

1.6.5 Pipe to Manhole Connection Details

2 PRODUCTS

2.1 Piping Application

2.1.1 All below grade gravity sewer wastewater treatment plant piping, 4 inches and larger in diameter, shall be constructed of push-on joint SDR 35 solid wall polyvinyl chloride (PVC) gravity sewer pipe unless otherwise indicated.

2.1.2 Accessories: Provide flanges, connecting pieces, transition glands, transition sleeves, and other adapters as required for complete and operable piping systems for service indicated. Provide restrained joints where indicated on the drawings and as specified in this section.

2.2 Pipe

2.2.1 Polyvinyl chloride (PVC) plastic gravity sewer piping shall meet requirements of ASTM D 3034 and be integral bell, gasketed joint pipe with dimension ratio (DR) of 35 and minimum pipe stiffness (PS) of 46 psi.

2.2.1.1 Pipe joint shall meet requirement of ASTM D 3212.

2.2.1.2 Rubber gaskets shall meet physical requirements specified in ASTM F 477 in all respects.

2.3 Pipe Labeling

2.3.1 Detectable tape shall be provided for all below grade piping systems and shall have a metallic core protected by a plastic jacket. The tape shall be continuously marked indicating that a sewer line is buried beneath the tape. In addition, a continuous No. 14 gauge copper wire with protective coating shall be provided for all below grade piping systems as indicated on the drawings.

2.4 Manholes

2.4.1 Precast Reinforced Concrete Manhole Section

2.4.1.1 Precast reinforced concrete manhole sections shall meet requirements of ASTM C 478. Section ends shall have o-ring gasket groove provided during manufacturing process. Gaskets for section joints shall meet requirements of ASTM C 443. Joints may also be sealed with flexible butyl resin sealant as manufactured by Concrete Sealants, Inc. Sealant shall be installed in accordance with the manufacturer's written recommendations. Top sections for all manholes shall be designed to withstand HS-20 traffic loading.

2.4.1.2 Protective coating for concrete manhole section interior shall be two coats of coal tar solution such as International protective coat "Intertuf 100" or Pittsburgh Paint "Coal Cat 97-640/97-641" or manufactured with calcareous aggregate so that the finished product shall have an AZ factor equal to 90.

2.4.2 Manhole frames and covers shall be gray iron castings meeting requirements of ASTM A 48, Class 30, and have 24-inch diameter clear openings such as Neenah Foundry Company Type R-1642 with Type "C" cover and bolt holes for four anchor bolts or approved equal by U.S. Foundry or East Jordan Iron Works. Frames shall be provided with holes for bolting it down to manhole riser section. Each cover shall have cast or embossed on it in letters not less than 1-inch high "SANITARY SEWER."

2.4.3 Manhole frames shall be anchored to the top of the manhole riser sections with ¾-inch expansion bolts. Two passes of "ConSeal" bitumastic sealant in 1-inch rope form shall be used to provide watertight seal between frame and manhole riser section. Clean manhole riser and frame thoroughly prior to installation.

2.4.4 Manhole steps shall be "Surefoot" step constructed of a No. 4 steel reinforcing rod encased in corrosion-resistant rubber by Oliver Tire & Rubber Company.

2.4.5 Pipe to manhole connection shall be sealed with a flexible boot, gasket, sleeve, or as detailed on drawings and meet requirements of ASTM C 923.

2.4.5.1 When the boot is used, the port shall be cored to the size, shape, surface finish, and location required and not cast in the manhole. Angular adjustments through 20º shall be allowed. The flexible boot shall be a ⅜-inch thick neoprene compound meeting ASTM C 443 specifications. The boot shall be secured to the port with an internal aluminum expanding band and to the pipe with a nonmagnetic corrosion resistant steel external band. Boot seal shall be "Kor-N-Seal" as manufactured by National Pollution Control Systems, Inc.

2.4.5.2 When gasket is used, the gasket shall be a rubber pressed wedge gasket cast into the manhole with a maximum deflection of 15º as manufactured by Press-Seal Gasket Corporation.

2.4.5.3 When sleeve is used, the sleeve shall be a flexible rubber sleeve cast into the manhole complete with stainless steel strap as manufactured by Interpace Corporation.

2.5 Sleeves through concrete or masonry walls or slabs shall be cast iron or Schedule 40 steel. Provide sleeves through walls, floors, and ceilings for all pipe penetrations except where wall pipes are indicated.

2.6 Pipe to sleeve sealant shall be grouting compound. Grouting compound shall be as manufactured by 3M Company or be an equivalent product having tensile strength of 80 psi and elongation property of 700% in accordance with ASTM D 3574 Test E, and linear dimension change shall not exceed 18% when subject to wet and dry cycles in accordance with ASTM D 756, Procedure G and ASTM D 1042.

2.7 Mechanical Type Pipe to Wall Sleeve Seals: Mechanical type pipe to wall sleeve seals shall be "Link-Seal" pipe to wall closures manufactured by Thunderline Corporation, Wayne, Michigan. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to fill annular space between pipe and wall opening and shall provide watertight seal between pipe and wall opening.

3 EXECUTION

3.1 Inspection and Preparation: Prior to all piping work, carefully inspect the installed work or excavation by other trades and verify that all such work is complete to the point where the piping may be installed in accordance with these documents. Follow the drawings in laying out work and check drawings of other trades to verify sufficient space to install piping. Undimensioned drawings are intended to indicate the general arrangement of piping systems and are not intended to convey precise locational information. Coordinate with other trades to permit all phases of the work to be installed. Offsets, fittings, and extra pipe, necessary to avoid interference or provide maximum headroom and space shall be furnished and installed without additional expense to the Owner. If the piping is installed without coordinating with other phases of the work and so as to cause interference, the necessary changes shall be made at no additional cost to the Owner.

3.2 Installation: Run piping concealed in finished areas unless otherwise indicated. Run piping exposed in equipment rooms, service areas, or areas with no means or need for concealment. Excessive cutting and similar operations likely to weaken a building structure to facilitate the piping installation will not be permitted. Implement suitable measures throughout the construction period to prevent trash and dirt from entering pipes, before, during, and after installation. Unless otherwise indicated, run piping parallel to the walls of the building. Erect vertical piping straight and plumb, with risers centered in pipe sleeves. Offsets shall conform to offsets in the building construction. Coordinate the work to insure that sleeves and inserts are positioned accurately along with other built-in items, before concrete pouring takes place, and before walls, partitions, and ceilings or roofs are erected so as to reduce to an absolute minimum the necessity for cutting or patching at a later stage.

3.3 Take all precautions necessary to insure that pipe, valves, fittings, and related items are not damaged in unloading, handling, and placing in trench. Examine each piece of material just prior to installation to determine that no damage has

occurred. Remove any damaged material from the site and replace with undamaged material.

3.3.1 Keep pipe clean. Exercise care to keep foreign material and dirt from entering pipe during storage, handling, and placing. Close ends of in-place pipe at the end of any work period to prevent entry of animals and foreign material.

3.3.2 Bed pipe in accordance with Section 02200 – Earthwork and as detailed on the drawings.

3.3.3 Do not lay pipe when weather or trench conditions are unsuitable.

3.4 Lay gravity sewers so as to maintain a true alignment and grade as indicated on drawings. After completion, the pipe shall exhibit a full circle of light when lighted at one manhole and viewed from the next.

3.4.1 Commence laying gravity sewers at the lowest point on a section of line and lay pipe with the bell ends uphill.

3.4.2 Pipe Joint: Preparatory to making pipe joints on gravity sewer lines, clean and dry all surfaces of joint pipe and jointing material. Use lubricants, primers, adhesives, and similar materials as recommended by the manufacturers. Place, fit, join, and adjust the jointing materials or factory fabricated joints as recommended by manufacturer to obtain the degree of watertightness required. As soon as possible after the joint is made, place sufficient backfill material, as specified in Section 02200 – Earthwork, along each side of pipe to resist forces that might tend to move pipe off line and grade.

3.4.3 Backfill as specified in Section 02200 - Earthwork. Place backfill over the pipe immediately after the pipe has been laid.

3.5 Join polyvinyl chloride (PVC) pipe using rubber ring gaskets in ball joints as recommended in writing by manufacturer.

3.6 Join and assemble solvent welded PVC pipe joints in accordance with requirements of ASTM D 2855.

3.7 Join pipe of different materials by using Fernco couplings in accordance with the manufacturer’s written recommendations.

3.8 Construct manholes using precast reinforced concrete manhole sections except as otherwise noted. Install manhole frames and covers and manhole steps using materials specified under products.

3.9 Construct manhole channel with smooth semicircular bottoms matching inside diameters of the connecting sewers. Change directions of flow with a smooth curve of as large a radius as the manhole size will permit. Change size and grade

of channels gradually and evenly. Channels may be formed directly in the concrete manhole bottom, made of channel pipe, laid in concrete, or constructed by laying full section sewer pipe through the manhole and breaking out the top half when the surrounding concrete has hardened. Manhole floors outside the channels shall be smooth and shall have slope between 2 and 4 inches per foot toward the channels.

3.10 Install precast equalization flow distribution box in accordance with the manufacturer's written recommendations.

3.11 Construct concrete cap or cradle in accordance with the latest edition of the VDOT Road and Bridge Standards at locations where the vertical separation between the new sanitary sewer and adjacent utilities is less than 6 inches.

3.12 Use wall pipes or sleeves where pipes, valves, stem extensions, or equipment parts pass through concrete or masonry walls or slabs. Sleeves shall be or sufficient size to allow sealing around pipes and clearance for valve stem or equipment. Extend vertical sleeves through slabs 1-inch above top surface.

3.12.1 Use cast iron or steel sleeves with intermediate collars to anchor and provide water stops on sleeves that pass through exterior walls below grade. Seal around pipes using grouting compound or "Link-Seal" pipe to wall closures manufactured by Thunderline Corporation, Wayne, Michigan. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to fill annular space between pipe and wall opening and shall provide watertight seal between pipe and wall opening. Grouting compound shall be mixed and placed in accordance with the recommendations of the manufacturer. Mechanical pipe to wall seal shall be installed in accordance with the written recommendations of the manufacturer.

3.13 Install detectable tape in trench above all pipe per the manufacturer's written recommendations. Install continuous copper wire in trench above all pipe as indicated on the drawings.

3.14 Testing Gravity Sewer Lines

3.14.1 Low pressure air testing in accordance with UNI-B-6 may be used on polyvinyl chloride (PVC) sanitary sewer lines. Low pressure air testing in accordance with ASTM C 924 may be used on all other sanitary sewer lines 24 inches or less in diameter. All manholes shall be tested using the infiltration method, exfiltration method, or vacuum testing. Tests shall be conducted on short sections of sewer line; i.e., between manholes, or at the end of each day's work. Installation of sewers will not be permitted at a point more than 2,000 feet ahead of any section of sewer or any manhole which has not been given the final test and accepted. The Contractor shall provide all labor, materials, tools, and equipment necessary to make the

tests. All monitoring gauges shall be subject to calibration, if deemed necessary. All sewer lines, regardless of size, that cross above or below streams shall be tested for and exhibit zero infiltration or exfiltration.

3.14.2 Low Pressure Air Test

3.14.2.1 Summary of Method: After the backfill has been placed and compacted to a minimum depth of 1 foot over the pipe, plug the section of the sewer line to be tested. Introduce low-pressure air into the plugged line.

3.14.2.2 Preparation of the Sewer Line: Flush and clean the sewer line prior to testing, thus serving to wet the pipe surface as well as clean out any debris. A wetted interior pipe surface will produce more consistent results. Plug all pipe outlets using approved pneumatic plugs with a sealing length equal to or greater than the diameter of the line being tested. Give special attention to laterals.

3.14.2.3 Groundwater Determination: Install a ½-inch capped galvanized pipe nipple, approximately 12 inches long, through the manhole. Immediately prior to the line test, the groundwater elevation shall be determined by removing the pipe cap and blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic hose to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in the plastic hose.

3.14.2.4 Procedures

3.14.2.4.1 Determine the test duration for the section under test by computation from the applicable formulas shown in ASTM C 924, or from the following "Air Test Table." The pressure-holding time is based on an average holding pressure of 3 psi (21 kPa) gauge or a drop from 3.5 psi (24 kPa) to 2.5 psi (17 kPa) gauge. The tests shall be conducted between two consecutive manholes or as directed.

3.14.2.4.2 The test section of the sewer line shall be plugged at each end. One of the plugs used at the manhole shall be tapped and equipped for the air inlet connection for filling the line from the air compressor.

3.14.2.4.3 All service laterals, stubs, and fittings into the sewer test section shall be properly plugged and carefully braced against the internal pressure to prevent air leakage by slippage and blowouts.

3.14.2.4.4 Connect air hose to tapped plug selected for the air inlet. Then connect the other end of the air hose to the portable air control equipment which consists of valves and pressure gages used to control the air entry rate to the sewer test section and the air pressure in the pipe line.

3.14.2.4.5 More specifically, the air control equipment shall include a shutoff valve, pressure regulating valve, pressure reduction valve, and a monitoring pressure gauge having a pressure range from 0 to 10 psi. The gauge shall have minimum divisions of 0.10 psi and an accuracy of plus or minus 0.04 psi.

3.14.2.4.6 Connect another air hose between the air compressor (or other source of compressed air) and the air control equipment. This completes the test equipment setup. Test operations may commence.

3.14.2.4.7 Supply air to the test section slowly, filling the pipe line until a constant pressure of 4.0 psig is maintained. The air pressure shall be regulated to prevent the pressure inside the pipe from exceeding 10.0 psig.

3.14.2.4.8 When constant pressure of 4.0 psig is reached, throttle the air supply to maintain the internal pressure above 3.5 psig for at least 5 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall. During this stabilization period, check all plugged fittings with a soap solution to detect any leakage at these connections. If leakage is detected at any plug, release the pressure in the line and tighten all leaky plugs. Then start the test operation again by supplying air. When it is necessary to bleed off the air to tighten or repair a faulty plug, a new 5-minute interval shall be allowed after the pipe line has been refilled.

3.14.2.4.9 After the stabilization period, shut off or disconnect the air supply. Before starting the test, the pressure may be allowed to drop to 3.5 psig. Record the drop in pressure

for the test period. If the pressure has dropped more than 1.0 psi (7 kPa) gauge during the test period, the line shall be presumed to have failed. The test may be discontinued when the prescribed test time has been completed even though the 1.0 psig drop has not occurred.

3.14.2.4.10 If the pipe to be tested is submerged in groundwater, the test pressure shall be increased 1.0 psi for every 2.31 feet the groundwater level is above the invert of the sewer. Example: If the vertical height of water from the sewer invert to the top of the water column measures 4.62 feet, the additional air pressure required would be 4.62 divided by 2.31 equals 2 psi. Therefore, the starting pressure of the test would be 3.5 plus 2 or 5.5 psig, and the 1.0 psig drop would be to 4.5 psig. There is no change in the allowable drop (1.0 psig) or in the time requirements established for the basic air test.

3.14.2.5 Safety: The air test may be dangerous if, because of lack of understanding or carelessness, a line is improperly prepared.

3.14.2.5.1 It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. A force of 250 pounds is exerted on an 8-inch (203 mm) plug by an internal pipe pressure of 5 psi (34 kPa), it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.

3.14.2.5.2 As a safety precaution, pressurizing equipment shall include a regulator or relief valve set at 10 psi (69 kPa) to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

3.14.2.6 Table: The air test table at the end of this section has been prepared utilizing applicable formulas from ASTM C 924.

3.15 Manhole Testing

3.15.1 All manholes shall be tested using the infiltration method, exfiltration method, or vacuum testing.

3.15.2 Infiltration or Exfiltration Method: All pipes leading to and from a manhole shall be plugged. Plugs shall be inserted into the pipes a distance greater than the length of the plugs used to test each respective section of sewer line to insure the manhole and sewer line tests overlap. Plugs shall be secured to the manhole structure. The manhole shall be filled with potable water to the top of frame and allowed to soak for a minimum of 2 hours and a maximum of 12 hours to permit the manhole to absorb water. The cover shall be on the manhole during the soaking period. At the end of the soaking period, potable water shall be added until the manhole overflows. After 30 minutes, check difference in level and convert to gallons. Manhole leakage shall not exceed ¼-gallon per hour. Upon completion of the test, the water shall be removed from the manhole.

3.15.3 Vacuum Testing: The vacuum test shall be made using an inflatable compression band, vacuum pump, and appurtenances specifically designed for vacuum testing manholes. Test procedures shall be in accordance with ASTM C 1244, except the more restrictive requirements specified herein. Equipment shall be manufactured by Peter A. Glazier, Inc., P.O. Box 1002, Worcester, Massachusetts 01613, Telephone: (508) 755-3849, Toll-Free: (800) 822-6488.

3.15.3.1 Manholes may be tested by vacuum test immediately after assembly of the manhole, frames, and connecting pipes and before any backfill is placed around the manholes. However, the final test and acceptance shall be based only upon a test after the manhole is backfilled and the cover frame castings are set in place.

3.15.3.2 All lift holes shall be plugged with nonshrink grout and all pipes shall be plugged, taking care to securely brace the plugs and pipe.

3.15.3.3 After the testing equipment is in place, a vacuum of 10 inches of mercury shall be drawn on the manhole. The manhole will be considered to have passed the test if the vacuum does not drop more than 1-inch of mercury within 60 seconds for manholes 7 feet in depth or less and 90 seconds for manholes over 7 feet deep.

3.15.3.4 If the manhole fails the initial test, the Contractor shall locate the leakage and make proper repairs, and retest until a satisfactory test result is obtained.

3.15.3.5 After the manholes have been backfilled and the cover frame casting sealed in place, and prior to final acceptance of the project, any signs of leaks or weeping visible from the inside of the manhole shall be repaired, and the manhole made watertight and tested.

3.16 Test for leakage of gravity sewers including manholes, using either the infiltration or exfiltration method. Maximum allowable leakage shall be limited to 2,400 gallons per day per mile or 100 gallons per day per inch diameter per mile, whichever is less.

3.16.1 Use infiltration test when groundwater is at least 4 feet above top of the pipe for the entire length of line to be tested. Plug the pipe at the upper manhole. Install suitable measuring device at the next lowest manhole. Measure the amount of water flowing through the measuring device over a 30-minute period. Sewer lines crossing under streams shall exhibit zero infiltration.

3.16.2 Use exfiltration test when groundwater is less than 4 feet above top of pipe. Plug the pipe at the lower manhole. Fill the line and manhole with potable water to 4 feet above top of pipe, or top of manhole whichever is less. Let the water stand until pipe has reached maximum absorption and until all trapped air has escaped, 12-hour minimum. After maximum absorption is reached, refill manhole to original level. After 30 minutes, record difference in level and convert to gallons.

3.16.3 Groundwater Determination: Use same procedure as “Low Pressure Air Test” above.

3.17 Repairs: If sewer lines or manholes fail to meet test requirements or if any leaks, crooked pipe, or other defects are visible by inspection, the Contractor shall repair or rebuild at his expense those portions of sewer lines which are faulty. The tests and repairs shall be continued until the sewer line is deemed acceptable.

Air Test Table
Based on Formulas from ASTM C 924

Minimum Test Time in Minutes: Seconds
For Pressure Drop from 3.5 to 2.5 psig

Line Length in Feet

Pipe Size Inches	10	50	100	150	200	250	300	350	400	450	500
4	0:02	0:09	0:18	0:27	0:36	0:45	0:54	1:03	1:12	1:21	1:30
6	0:04	0:21	0:42	1:03	1:24	1:45	2:06	2:27	2:48	3:09	3:30
8	0:07	0:36	1:12	1:48	2:24	3:00	3:36	4:12	4:48	5:24	6:00

End of Section

Section 02735
Pipe Supports and Anchors

1 GENERAL

1.1 Reference specifications are referred to by abbreviation as follows:

1.1.1 American National Standards Institute..... ANSI

1.1.2 American Society for Testing and Materials..... ASTM

1.1.3 Manufacturers Standardization Society of the Valve and Fittings Industry..... MSS

1.2 Piping systems shall be supported in accordance with ANSI B31.1 “Power Piping” so as to maintain required pitch of lines, prevent vibration, and provide for expansion and contraction movement. Provide hangers in accordance with MSS SP-58 and MSS SP-69.

1.3 Acceptable Manufacturer: Anvil, Elcen Metal Products, F&S Central, or Michigan Hanger Company. Anvil figure numbers establish the quality standard.

2 PRODUCTS

2.1 Hangers and Rigid Supports

2.1.1 Adjustable swivel split ring hanger shall be fabricated of black malleable iron and be approved by Factory Mutual and be UL listed. Hanger shall be Anvil Figure 104.

2.1.2 Adjustable clevis type hanger shall be black carbon steel and be approved by Factory Mutual and be UL listed. Hanger shall be Anvil Figure 260.

2.1.3 Pipe roll hangers shall consist of a cast iron roll and steel roll rod. Hanger shall be Anvil Figure 171.

2.1.4 Brackets shall be heavy welded carbon steel, of dimensions required to adequately support piping. Brackets shall be hot dipped galvanized after fabrication in accordance with ASTM A 123. Brackets shall be Anvil Figure 199.

2.1.5 U-bolts shall be standard weight, hot dipped galvanized carbon steel, furnished with four finished hex nuts. U-bolts shall be Anvil Figure 137.

2.1.6 Short strap shall be carbon steel, Anvil Figure 262. One-hole clamp shall be black finished malleable iron, Anvil Figure 126.

2.1.7 Adjustable pipe saddle support shall be cast iron saddle, locknut nipple, and cast iron reducer, factory assembled. Stantion type support shall allow

vertical adjustment by turning locknut nipple. Adjustable pipe saddle support shall be Anvil Figure 264. Adjustable pipe saddle support shall include pipe stand with base flange of suitable size to carry load. Provide expansion anchors for connecting base flange to finished floor, minimum four anchors required.

2.2 Hanger rods shall be ASTM A 575 or A 576 hot rolled carbon steel and meet mechanical property requirements of ASTM A 663.

2.3 Beam clamps shall be fabricated specifically for the structure to which the hanger rod is attached.

3 EXECUTION

3.1 Install rigid pipe hangers as follows:

3.1.1 Uninsulated pipe 2 inches and smaller – Anvil Figure 104

3.1.2 All piping 2½ inches and larger – Anvil Figure 260

3.2 Where necessary due to space limitations, provide pipe roll hanger equal to Anvil Figure 171 for piping 2½ inches and larger.

3.3 Space supports or hangers for horizontal piping as follows unless otherwise indicated on the drawings. Provide additional supports for concentrated loads at valves or specialties.

Nominal Pipe Size, Inches	Maximum Span in Feet Steel or Iron Pipe	Plastic Pipe
½-inch	4	2
¾-inch through 1½-inch	6	3
2-inch and 2½-inch	10	4
3-inch	12	5
4-inch and 5-inch	14	6
6-inch	16	6
8-inch and 10-inch	18	7
12-inch and 14-inch	22	8
16-inch and 18-inch	27	-
20-inch	30	-
24-inch	32	-

3.3.1 Provide pipe hanger or support within 18 inches or every change in direction for piping 1½ inches and below and within 3 feet of every change in

direction for piping 2 inches and larger. Horizontal "No-Hub" piping shall be supported at each joint.

3.3.2 Vertical Piping: Support metal piping at each floor, but at not more than 10-foot intervals. Support plastic at each floor and at midpoint between floors, but not at more than 5-foot intervals.

3.4 Support hangers for pipe by using malleable iron or galvanized steel concrete inserts, concrete anchor bolts, beam clamps with lock nuts or retaining straps, or other special fastening devices, as required, for the support of hangers. As an option where direct attachment to frame members is not possible, auxiliary frame members may be provided which shall span at least two structural frame members.

3.4.1 Where pipe cannot be suspended from overhead supports, use substantial cast iron or welded steel wall brackets to support the hangers, pipe seats, or roll stands, as conditions demand.

3.5 Use hot rolled steel hanger rods sized as follows:

3.5.1 For 2-inch pipe and smaller – ⅜-inch diameter

3.5.2 For 2½-inch through 3½-inch pipe – ½-inch diameter

3.5.3 For 4-inch and 5-inch pipe – ⅝-inch diameter

3.5.4 For 6-inch pipe – ¾-inch diameter

3.5.5 For 8-inch and larger – ⅞-inch diameter

End of Section

Section 02751
Stamped Concrete

1 GENERAL

1.1 Related Documents

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

1.2 Summary

1.2.1 This Section includes the following:

1.2.1.1 Concrete application where indicated on the drawing

1.2.1.2 Concrete coloring

1.2.1.3 Score Joint Patterns

1.2.2 Related Sections include the following:

1.2.2.1 Division 2 Section 02200 “Earthwork” for compacted subgrade and subbase course, if any under concrete slabs.

1.2.2.2 Division 3 Section 03300 “Cast-in-place Concrete”.

1.3 Submittals

1.3.1 Product Data: For the following:

1.3.1.1 Concrete Finish

1.3.1.2 Stamped Concrete

1.3.2 Samples for Verification: Full-size of specified pattern

1.3.2.1 Include Typical Concrete Mockup slab (90” x 90” x 5” depth) for finish and gridded score joints, showing technique and style for score joints.

1.3.2.2 Include Stamped and stained Concrete Mockup (60” x 60” x 5” thick) with complete sample of finished work, including texture and color.

1.4 Quality Assurance

1.4.1 Installer Qualifications: An experienced installer who has completed concrete installation similar in material, design, and extent to that indicated

for this Project and whose work has resulted in construction with a record of successful in-service performance.

1.4.2 Mockups: Before installing concrete grid pattern, build mockup to verify as required in Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work, including expansion joints, and contiguous brick work as indicated:

1.4.2.1 Build mockups in the location (near the work site but out of the way), as directed by WW Associates, Inc.

1.4.2.2 Notify WW Associates, Inc. seven days in advance of dates and times when mockups will be constructed.

1.4.2.3 Demonstrate the proposed range of aesthetic effects and workmanship.

1.4.2.4 Obtain WW Associates, Inc.'s approval of mockups before starting concrete grid pattern or stamped concrete Work.

1.4.2.5 Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

1.4.2.6 Demolish and remove mockups when directed.

1.5 Delivery, Storage and Handling

1.5.1 Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.5.2 Store liquids in tightly closed containers protected from freezing.

1.6 Project Conditions

1.6.1 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. Remove and replace Work damaged by frost or freezing.

1.6.2 Weather Limitations for joint fillers and sealants: Comply with the following requirements:

1.6.2.1 Take all applicable precautions to avoid damage to product and workmanship due to adverse weather conditions.

2 PRODUCTS

2.1 Manufacturers and Suppliers

2.1.1 Available Manufacturers: Provide a list of all concrete manufacturers of products used or incorporated into the Work.

2.1.2 The Stamped Concrete Pattern and Color shall match existing stamped concrete adjacent to the West Tower.

2.2 Colors and Textures

2.2.1 Colors and Textures: Match existing stamped concrete adjacent to West Tower.

2.2.2 Stamped concrete shall be homogeneously colored.

3 EXECUTION

3.1 General

3.1.1 Proceed with and complete concrete work and finishing work.

3.1.1.1 Grid Pattern:

3.1.1.1.1 Control joints are intended to align with score joints wherever possible. Minor adjustments of control joints may be allowed, while adjustments to grid pattern are to be strictly adhered to in order to maintain integrity of the pattern.

3.1.2 Stamped Concrete Area:

3.1.2.1 Installation shall be per Manufacturer's recommendations.

3.1.2.2 Provide control joints to control cracking.

End of Section

Section 02831
Chain Link Fences and Gates

1 GENERAL

1.1 Scope: The work covered by this section consists of furnishing all labor, equipment, and materials necessary to install all required chain link fencing and gates for the work. The contract documents apply to this Section.

1.2 Reference specifications are referred to by abbreviation as follows:

1.2.1 American Society for Testing and Materials..... ASTM

1.2.2 Chain Link Fence Manufacturer's Institute..... CLFMI

1.3 Submittals

1.3.1 Submit shop drawings showing all details of the chain link fence and gates.

2 MATERIALS

2.1 Fence

2.1.1 All tubular members shall meet the requirements of ASTM F 1043 for weight and coating.

2.1.2 All structural shapes shall meet the requirements of ASTM A 123 and ASTM F 1083 for galvanized coatings.

2.1.3 End, corner, and pull posts shall be 2⅞-inch O.D. pipe weighing 5.79 pounds per linear foot.

2.1.4 Line posts shall be 2⅜-inch O.D. pipe weighing 3.65 pounds per linear foot.

2.1.5 Swing and horizontal slide gate posts shall be 4-inch O.D. pipe weighing 9.11 pounds per linear foot. Swing gate posts shall meet ASTM F 900 requirements; slide gate posts shall meet ASTM F 1184 requirements.

2.1.6 Fit top posts with galvanized malleable iron fittings designed to exclude water from the post interior. The top shall have provisions for accommodating a rail.

2.1.7 A No. 7 gauge coiled spring tension wire having a zinc coating of 1.6 ounces of zinc per square foot of surface shall be provided along the bottom of the fence.

2.2 Bracing and Tensioning

2.2.1 Bands shall be unclimbable, beveled edge type, secured with ⅜-inch diameter square shouldered aluminum carriage bolts, nonremovable from outside the fence enclosure.

2.2.2 All terminal posts shall have 1⅝-inch O.D. horizontal compressive member braces, securely attached to terminal and first line posts with malleable iron fittings and bevel edge bands. Provide ⅜-inch diameter rod and turnbuckle truss braces from first line post to bottom of terminal post.

2.2.3 Tension bars for attaching fence fabric to terminal posts shall be ¼-inch by ¾-inch high carbon steel, and shall be attached to terminal posts with of beveled edge bands.

2.3 Fabric

2.3.1 Fencing fabric shall meet ASTM A 392 and CLFMI CLF 2445 requirements, and consist of individual wire pickets, helically wound, and interwoven from 9 gauge copper bearing steel wire to form a continuous chain link fabric in 2-inch mesh. Top and bottom edges of the fabric shall have a twisted and barbed finish, and fabric height between top and bottom edges shall be as indicated on the drawings, exclusive of the barbed wire brackets.

2.3.2 Fence fabric edging shall be barbed top and bottom

2.3.3 The wire in the completed fabric shall have a tensile strength of not less 80,000 pounds per square inch.

2.3.4 All fencing fabric shall be ASTM F 668, Class 2a polyvinyl chloride coated material. Coating shall be black, complying with ASTM F 934.

2.4 Gates, Frames, and Hardware.

2.4.1 Gate frames shall be minimum 2 inches, O.D. standard weight steel pipe with interval bracing of 1⅝-inch O.D. standard weight steel pipe. Frame members shall be welded at all joints to insure a watertight construction.

2.4.2 Fabric for gates shall be as specified for fence.

2.4.3 Hinges shall be standard offset type that will allow gates to swing back parallel with line fence. Hinge material shall be malleable iron or steel forgings.

2.4.4 Double latches shall be drop-bar type, securely bolted to the gate frames and designed to engage heavy malleable iron gate stops anchored in concrete footings.

2.4.5 Single latches for gate frames up to and including 8 feet wide shall be malleable iron, gravity type, designed to automatically engage a pin welded to the gate frame and to be secured with an approved type padlock.

2.4.6 Gate shall be equipped with a gate keeper designed to engage with the gate when opened wide to secure it in this position.

2.4.7 The Owner will provide a padlock for all gates.

2.4.8 Provide diagonal cross-bracing consisting of a ⅜-inch diameter adjustable length truss rods on gates where necessary to provide frame rigidity without sag or twist.

2.5 All miscellaneous fence fittings shall be malleable iron, pressed steel, aluminum, or forgings. All miscellaneous ferrous metals shall be hot dipped galvanized.

2.6 Wire ties for tying fabric to post shall be minimum No. 9 gauge aluminum or steel for tubular posts. No. 9 gauge aluminum wire ties shall be used to tie fabric to rails and braces. No. 11 gauge pig rings shall be used to tie fabric to tension wire. Finish for coil wire, pig rings, and wire ties shall be the same as fencing fabric.

2.7 Polyvinyl Chloride (PVC) Finishes

2.7.1 Supplemental Color Coating: In addition to specified metallic coatings for steel, provide fence components with polyvinyl chloride (PVC) coating.

2.7.2 Metallic-Coated Steel Tension Wire: PVC-coated wire complying with ASTM F 1664, Class 2a.

2.7.3 Metallic-Coated Steel Framing, Fittings: Comply with ASTM F 626 and ASTM F 1043 for PVC coating applied to exterior surfaces and, except inside cap shapes, to exposed interior surfaces.

2.7.3.1 Polymer Coating: Not less than 10-mil-thick PVC finish.

2.7.4 Color: Black, complying with ASTM F 934.

3 EXECUTION

3.1 General

3.1.1 Install chain link fencing and gates in accordance with ASTM F567 requirements.

3.1.2 Space posts no more than 10 feet on center.

3.1.3 Encase post in concrete footings at least 3 feet in depth. There shall be a minimum of 6 inches of concrete below the post. Provide 10-inch diameter footings for line posts and 14-inch diameter footings for corner, end, and

gate posts. Extend footings 2 inches above the ground line and slope to drain away from posts.

3.1.4 Where rock is encountered, drill holes 3 feet deep and 2 inches greater than the outside diameter of the post. Then fill hole around the post with grout. The post shall be 6 inches off the bottom the hole.

3.1.5 Where the fence is located on concrete structures, cast or grout an 18-inch section of steel pipe with an inside diameter at least 2 inches larger than the post into the structure. Grout the fence post into the steel pipe.

3.1.6 Brace terminal posts with horizontal compressive member and truss braces and fittings.

3.1.7 Brace corner posts in each direction with the bracing specified for terminal posts.

3.1.8 Brace line fence at not more than 500 foot intervals and each vertical angle point of 15 degrees or more with the bracing specified for terminal posts.

3.1.9 Install corner posts at each horizontal angle point.

3.1.10 Install fence uniformly 2 inches above the ground.

3.1.11 Fasten fabric to top and bottom tension wire at intervals of 2 feet with pig rings.

3.1.12 Attach fabric to all posts at intervals of not more than 14 inches and on the outside of the post with relation to the enclosed area.

3.1.13 Bend ends of wire ties to minimize hazard to persons and clothing.

3.1.14 Attach stretcher bars to terminal posts with beveled edge band.

3.1.15 Install gates plumb, level and secure for full opening without interference. Install ground-set items in concrete as recommended by the manufacturer. Adjust and lubricate all hardware as required for smooth operation.

3.1.16 Install gate stops so that the plunger can be fully engaged.

3.1.17 Install nuts for tension band and hardware bolts on the inside of the fence.

End of Section

Section 02851
Prefabricated Pedestrian Bridge

1 GENERAL

1.1 Scope: The work covered in this section consists of furnishing and installing a fully engineered clear span pedestrian bridge as shown on the Contract Drawings and specified herein. Coordination with the site contractor is a salient feature of the contract. The bridge manufacturer shall install the bridge on the north and south towers/foundation.

1.2 Referenced specifications where applicable to work under this section are referred to by abbreviation as follows:

1.2.1 American Association of State Highway and Transportation Officials..... AASHTO

1.2.2 American Institute of Steel Construction ..... AISC

1.2.3 American National Standards Institute..... ANSI

1.3 Submittals:

1.3.1 Submittal Drawings

1.3.1.1 Schematic drawings and diagrams shall be submitted for review. Submittal drawings shall be unique drawings, prepared to illustrate the specific portion of the bridge(s) being fabricated. All relative design information such as member size, material specification, bridge reactions, dimensions, general notes, and required critical welds shall be clearly shown on the drawings. Drawings shall have cross referenced details and sheet numbers. All drawings shall be signed and sealed by a Professional Engineer registered in the Commonwealth of Virginia. A stamped electronic soft copy shall be provided.

1.3.1.2 At minimum the following criteria must be included for approval:

- All Relevant Bridge Dimensions
- Bridge Cross sections
- Sufficient Detailing
- Member Cross sections
- General Notes indicating material specifications
- Weld Details
- Detail of Bolted Splices (if applicable)
- Signature and Seal of PE licensed in accordance with this specification

- Concrete Deck – 2 stage
- Concrete Deck heating system
- Camber Details

1.3.2 Structural Calculations

1.3.2.1 Structural Calculations for the bridge superstructure shall be submitted by the bridge manufacturer. All calculations shall be signed and sealed by a Professional Engineer licensed in the Commonwealth of Virginia. The calculations shall include all design information necessary to determine the structural adequacy of the bridge. A stamped electronic soft copy shall be provided.

1.3.2.2 At minimum the following criteria must be included for approval:

- Applied loads and conditions for all load combinations
- All resistance checks for axial, bending, and shear in each critical member type (i.e., top chord, bottom chord, vertical, floor beam, etc.)
- Truss and Floor Deflection Checks
- FEA Boundary Conditions
- FEA Data Input
- FEA Results and Supplementary Calculations for all Stress & Deflection Analyses
- FEA Results for Frequency Analysis
- U-Frame Stiffness Checks
- Bolted Splice Connections (if applicable)
- Bearing Plate Analysis
- Critical weld connection check for each truss member type (i.e., vertical, diagonal)
- Welded Tubular Connections (see section 4.3.4 of this document for design check requirements)
- Bridge Reactions
- Expansion and Contraction Requirements and/or Induced Loads

1.4 Quality Assurance:

1.4.1 Prefabricated pedestrian bridges manufactured by Bridge Brothers Inc. shall be the design standard. A bridge manufactured by Contech Bridge Solutions Inc., that meets the requirements of these specifications, is an approved substitution. Other substitutions are not allowed.

1.4.2 Bridge supplier must have at least ten (10) years' experience designing and fabricating this type of pedestrian structures and a minimum of ten (10)

successful bridge projects, of similar construction, each of which has been in service at least three (3) years. The bridge supplier shall list the location, bridge size, owner, and a contact for reference for each project.

1.5 Warranty:

1.5.1 The manufacturer shall provide a warranty against defects in material and workmanship for a period of ten (10) years.

2 PRODUCTS

2.1 Unpainted Weathering Steel: Bridges shall be fabricated from high strength, low alloy, and atmospheric corrosion resistant ASTM A847 cold-formed welded square and rectangular tubing and/or ASTM A588, ASTM A242, or ASTM A606 plate and structural steel shapes. Steel shall have a minimum yield strength of 50ksi. The minimum corrosion index of atmospheric corrosion resistant steel, as determined in accordance with ASTM G101, shall be 6.0.

2.2 Bolts: Field splices shall be fully bolted with ASTM A325 high strength bolts in accordance with the AASHTO Specifications for Structural Joints. Type 3 hardware shall be used for weathering steel bridge.

2.3 Deck: Decking shall meet the following criteria:

2.3.1 Concrete: The bridge shall be furnished with a stay-in place galvanized steel form deck suitable for pouring a reinforced concrete slab. The form deck shall be designed to carry the dead load of the wet concrete, weight of form decking, plus a construction load of 20 psf or a 150 pound concentrated load on a 1'-0" wide section of deck.

2.3.2 Concrete decks shall be designed for concentrated load as specified in Section 4.1.3. The wheel loads used for deck design shall be distributed per AASHTO LRFD Bridge Design Specifications and using Steel Deck Institute C-2017 Standard for Composite Steel Floor Deck-Slabs. Concrete deck shall be poured in 2 stages to accommodate heating mats.

2.3.3 Concrete deck shall be reinforced concrete, minimum of 6 inches thick, cross sloped to eliminate potential for standing water.

2.3.4 Concrete deck shall be provided with embedded electrical heating system to eliminate potential for freezing. Heating system shall be Promelt Mat, as manufactured by Watts Radiant or approved equal. Provide wiring, junction boxes, control panel, circuit breaker panel, and sensors, as indicated on the electrical drawings and as recommended by the manufacturer.

2.3.5 Heating system shall be provided by the bridge manufacturer.

2.3.6 Install the heating mat in a 2 stage concrete slab in accordance with manufacturer's printed instructions. Embed matting in gravel and sand when transitioning out of concrete slab.

3 APPLICABLE CODES AND STANDARDS

3.1 Governing Codes and Standards: Bridges shall be designed in accordance with the AASHTO Guide Specification for the Design of Pedestrian Bridges, latest edition, where applicable and unless otherwise stated in the document.

3.2 Reference Codes and Standards:

- AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges, 2009
- AASHTO LRFD Bridge Design Specifications, latest edition
- AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, latest edition
- AASHTO Guide Specifications for LRFD Seismic Bridge Design, latest edition
- AASHTO M 133 Standard Specification for Preservatives and Pressure Treatment Processes for Timber, latest edition
- Steel Deck Institute (SDI), C-2017 Standard for Composite Steel Floor Deck-Slabs
- AISC Part 16.1-2010 Specification for Structural Steel Buildings
- AWS D1.1 Structural Welding Code – Steel, latest edition
- Guide to Stability Design Criteria for Metal Structures, latest edition
- National Design Specification for Wood Construction, ANSI NDS, latest edition
- American Wood Preservers Association Standards, latest edition

4 GENERAL DESIGN FEATURES

4.1 Span: The bridge span shall be 102 ft. The span shall be a straight line dimension measured from each end of the bridge structure.

4.2 Width: The bridge width shall be 10-foot wide, walking concrete deck. The width shall be the clear width to structural members or accoutrements to the structure as measured at deck level.

4.3 Truss Style: The bridge shall be designed as a Boxed Hhalf-Through Pratt truss with one (1) diagonal per panel and square ended vertical members. Provide arch above the box truss as indicated. All vertical members, unless specified otherwise, shall be plumb or perpendicular as determined during design.

4.3.1 Bridges may be designed utilizing an H-Section configuration where the floor beams are placed up inside the trusses or utilizing a U-Section

configuration where the floor beam is welded to the bottom of the bottom chord.

4.3.2 The distance from the top of the deck to the top and bottom truss members shall be determined by the bridge fabricator based upon structural and/or shipping requirements.

4.3.3 The top of the top chord shall not be less than forty-two inches (42") above the deck (measured from the high point of the walking surfaces).

4.4 Member Components: All members of the vertical trusses (top and bottom chords, verticals, and diagonals) shall be fabricated from square and/or rectangular structural steel tubing. Other structural members and bracing shall be fabricated from structural steel shapes or square and rectangular structural steel tubing.

4.5 Deck: Decking shall be VLI Prepped for concrete.

4.6 Attachments:

4.6.1 Safety Rails: Horizontal safety rails shall be placed on the structure up to a minimum height of forty-two inches (42") above the deck surfaces. Safety rails shall be placed so as to prevent a four-inch (4") sphere from passing through the truss. Safety rails shall be welded to the inside or outside of the structure. Safety rails shall have their ends sealed and ground smooth so as to produce no sharp edges if safety rails are placed on the inside of the structure. Additionally, the bridge will have 2" x 2" x 9 gauge weathered steel mesh on the sides and top of the truss. Provide viewing port as directed by the Town.

4.7 Camber: The bridge shall have a vertical camber dimension at midspan equal to one hundred percent (100%) of the full dead load deflection.

4.8 Elevation Difference: The bridge abutments shall be constructed at the same top elevation on both ends of the bridge.

5 ENGINEERING

5.1 Structural design of the bridge shall be performed by or under the direct supervision of a professional engineer licensed in the Commonwealth of Virginia, and in accordance with recognized engineering practices and principles.

5.2 Design Loads: In considering design and fabrication issues, this structure shall be assumed to be statically loaded. No dynamic analysis shall be required nor shall fabrication issues typically considered for dynamically loaded structures be considered for this bridge.

5.2.1 Dead Loads: The bridge structure shall be designed considering its own dead load (superstructure and original decking) only. No additional dead loading shall be considered.

5.2.2 Pedestrian Live Load

5.2.2.1 Main supporting members, including girders, trusses and arches shall be designed for a pedestrian live load of ninety pounds (90lbs) per square foot of bridge walkway area. The pedestrian live load shall be applied to those areas of the walkway so as to produce maximum stress in the member being designed. Pedestrian live loads shall NOT be reduced.

5.2.2.2 Secondary members such as bridge decks and supporting floor systems, including secondary stringers, floor beams, and their connections to main supporting members shall be designed for a live load of ninety pounds (90lbs) per square foot, with no reduction allowed.

5.2.3 Wind Load

5.2.3.1 Horizontal Forces: The bridge shall be designed for a wind load as specified by AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges, latest edition. The wind load shall be applied horizontally at right angles to the longitudinal axis of the structure.

5.2.3.1.1 The wind load shall be considered both in the design of the lateral load bracing system and in the design of the truss vertical members, floor beams, and their connections.

5.2.3.2 Overturning Forces: The effect of forces tending to overturn structures shall be calculated assuming that the wind direction is at right angles to the longitudinal axis of the structure. In addition, an upward force shall be applied at the windward quarter point of the transverse superstructure width. This force shall be twenty pounds (20lbs) per square foot of deck.

5.2.4 Top Chord Railing Loads: The top chord, truss verticals, and floor beams shall be designed for lateral wind loads, per Engineering – Horizontal Forces, herein and for any loads required to provide top chord stability as outlined in Engineering – Top Chord Stability herein. In no case shall the load be less than fifty pounds (50lbs) per lineal foot or a two hundred pound (200lb) point load, whichever produces greater stresses, applied in any direction at any point along the top chord, or at the top of the safety system (42” or 54” above the deck level) if higher than the top chord.

5.2.5 Safety Rails: The safety rail system shall be designed for all infill loading of two hundred pounds (200 lbs) applied horizontally at right angles, to a one (1) square foot area at any point in the system.

5.3 Design Limitations

5.3.1 Deflection

5.3.1.1 Vertical Deflection

5.3.1.1.1 The vertical deflection of the main trusses due to service pedestrian Live Load shall not exceed one three-sixtieth (1/360) of the span.

5.3.1.1.2 The vertical deflection of cantilever spans of the structure due to service pedestrian Live Load shall not exceed one two-twentieth (1/220) of the cantilever arm length.

5.3.1.1.3 The deflection of the floor beams due to service pedestrian Live Load shall not exceed one three-sixtieth (1/360) of its span.

5.3.1.1.4 The deflection of the deck and stringers due to service pedestrian Live Load or Vehicle Load shall not exceed one three-sixtieth (1/360) of their respective spans.

5.3.1.1.5 The service pedestrian Live Load shall NOT be reduced for deflection checks.

5.3.1.2 Horizontal Deflection

5.3.1.2.1 The horizontal deflection of the structure due to lateral wind loads shall not exceed one three-sixtieth (1/360) of the span.

5.3.2 Vibration: The fundamental frequency of the unloaded pedestrian bridge shall be no less than 3.0 Hz to avoid the first harmonic.

5.3.3 Minimum Thickness of Metal: The minimum thickness of all main structural steel members shall be one-quarter of an inch (1/4") nominal and be in accordance with the AISC Manual of Steel Constructions "Standard Mill Practice Guidelines". For ASTM A500 and ASTM A847 tubing, the section properties used for design shall be per the Steel Tube Institute of North America, Hollow Structural Sections, "Dimensions and Section Properties".

5.4 Analysis

5.4.1 Load Combinations: The loads listed herein shall be considered to act in the following combinations, whichever produce the most unfavorable effects on the bridge superstructure or structural member concerned. [DL = Dead Load, LL = Live Load, WL = Wind Load, VL = Vehicle Load].

- Strength I

- 1.25*DL+1.75*LL
- 1.25*DL+1.75*VL

- Strength III
  - 1.25*DL+WL+OW
- Service I
  - DL+LL+WL+OW
- Fatigue I
  - Fatigue WL Only

The foundation engineer will determine any additional loads (i.e., earth pressure, stream force on abutments, wind loads other than those applied perpendicular to the long axis of the bridge, etc.) and load combinations required for design of the abutments.

5.4.2 Frequency: Frequency analysis shall be completed to determine that the bridge frame is sufficient to avoid resonance due to frequencies likely encountered under normal use for the following load combinations and in accordance with section.

5.4.3 Top Chord Stability: The top chord of a half-through truss shall be considered as a column with elastic lateral supports at the panel points.

5.4.4 Welded Tubular Connections:

5.4.4.1 All welded tubular connections shall be checked, when within applicable limits, for the limiting failure modes outlined in the ANSI/AWS D1.1 Structural Welding Code.

5.4.4.2 When outside the "validity range" defined in these design guidelines, the following limit states or failure modes shall be checked:

- Chord Wall Plastification
- Shear Yielding (Punching)
- Local Yielding of Chord Sidewalls
- Local Crippling of Chord Sidewalls
- Local Yielding of Branch Due to Uneven Load Distribution

5.4.4.3 All tubular joints shall be plain unstiffened joints and fabricated without the use of reinforcing plates, except as follows:

5.4.4.3.1 Floor beams hung beneath the lower chord of the structure may be constructed with or without stiffener (or gusset) plates, as required by design.

5.4.4.3.2 Floor beams which frame directly into the truss verticals (H-Section bridges) may be designed with or without end stiffening plates as required by design.

5.4.4.3.3 Where chords, end floor beams and in high profiles the top end struts weld to the end verticals, the end verticals (or connections) may require stiffening to transfer the forces from these members into the end vertical.

5.4.4.3.4 Truss vertical to chord connections.

5.4.5 Bolted Splices: Bolted splice design shall be in accordance with Section 6.13 of the "AASHTO LRFD Bridge Design Specifications" latest edition and in accordance with section 1.4 of this document. Bolted field splices shall be located on the bridge so as to produce a structure which can be economically shipped and erected. Splices across the width of the bridge (in floor beams and wind braces) may be used, when necessary, to keep the overall structure width within reasonable limits for shipping.

6 WELDING

6.1 Welding: Welding and weld procedure qualification tests shall conform to the provisions of ANSI/AWS D1.1 "Structural Welding Code", latest edition. Filler metal shall comply with the applicable AWS Filler Metal Specification (i.e., AWS A 5.28 for the GMAW Process). For exposed, bare, unpainted applications of corrosion resistant steels (i.e., ASTM A588 and A847), the filler metal shall comply with AWS D1.1, Section 3.7.3.

6.2 Welders: Each welder shall be a properly accredited operator, and shall:

6.2.1 Submit certification of satisfactorily passing AWS standard qualification tests for all positions with unlimited thickness of base metal,

6.2.2 Have a minimum of six (6) months experience in welding tubular structures and,

6.2.3 Have demonstrated the ability to make uniform sound welds of the type required.

7 FABRICATIONS

7.1 General Requirements

7.1.1 Drain Holes: When the collection of water inside a structural tube is a possibility, either during construction or during service, the tube shall be provided with a drain hole at its lowest point to let water out.

7.1.2 Bolt Holes: Unless otherwise specified, standard holes shall be used in high-strength bolted connections. Oversize holes may be used in any or all plies of slip-critical connections. They shall not be used in bearing-type connections. Cut, drill, mechanically thermal cut, or punch bolt holes perpendicular to metal surfaces. Do not enlarge bolt holes by burning.

7.1.3 Bearing Holes/Slots: Cut, drill, mechanically thermal cut, or punch bearing holes/slots perpendicular to steel surfaces.

8 FINISHING

8.1 Blast Cleaning

8.1.1 All Blast Cleaning shall use Best Management Practices and exercise environmentally friendly blast media recovery systems.

8.1.2 To aid in providing a uniformly "weathered" appearance, all exposed surfaces of a weathering steel bridge shall be blast cleaned in accordance with Steel Structures Painting Council Surface Preparation Specifications No. 7 Brush-Off Blast Cleaning, SSPC-SP7 latest edition.

8.1.3 Exposed surfaces of steel shall be defined as those surfaces seen from the deck and from outside of the structures. Stringers, floor beams, lower brace diagonals and the inside face of the truss below deck and bottom face of the bottom chord shall not be blasted.

8.1.4 All finishing shall be completed in manufacturer's shop prior to shipping.

9 BEARING DEVICES

9.1 Bridge bearings shall consist of a setting or slide plate placed on the abutment or grout pad. The bridge bearing plate which is welded to the bridge structure shall bear on this setting plate. One end of the bridge will be fixed by fully tightening the nuts on the anchor bolts at that end. The opposite end will have finger tight only nuts to allow movement under thermal expansion or contraction.

9.2 Bridges in excess of 100 feet in length or bridges with dead load reactions of 15,000 pounds or more (at each bearing location) shall have Teflon coated steel setting plates. UHMW setting plates may be used if approved as an alternate.

10 FOUNDATIONS

10.1 Unless specified otherwise, the bridge manufacturer shall determine the number, diameter, minimum grade and finish of all anchor bolts. The anchor bolts shall be designed to resist all horizontal and uplift forces to be transferred by the superstructure to the supporting foundations. Engineering design of the bridge supporting foundations (abutment, pier, bracket and/or footings), including design of anchor bolt embedments, shall be the responsibility of the Bridge Manufacturer. The Contractor shall provide all materials for (including anchor bolts) and construction of the bridge supporting foundations. The contractor shall install the anchor bolts in accordance with the manufacturer's bridge bearing dimensions.

10.2 Minimum 28-day strength for the abutment concrete shall be 4,000 PSI. The bearing seat shall be a minimum of 16" wide. The step height (from bottom of bearing to top-of-deck) shall be determined by the bridge manufacturer.

10.3 Information as to bridge support reactions and anchor bolt locations will be furnished by the bridge manufacturer after receipt of order and after the bridge design is complete.

11 DELIVERY AND ERECTION

11.1 Bridges will be delivered by truck to a location nearest to the site accessible by roads. Hauling permits and freight charges are the responsibility of the manufacturer.

11.2 The manufacturer will notify the customer in advance of the expected arrival. Information regarding delays after the trucks depart the plant such as weather, delays in permits, re-routing by public agencies or other circumstances will be passed on to the customer as soon as possible but the expense of such unavoidable delays will not be accepted by the manufacturer.

11.3 The manufacturer will advise the customer of the actual lifting weights, attachment points and all necessary information to install the bridge. Lifting procedure submittals shall be the responsibility of the bridge erector. Unloading, splicing, bolting, and proper lifting equipment is the responsibility of others.

11.4 The bridge manufacturer shall provide written inspection and maintenance procedures to be followed by the bridge owner.

End of Section

Section 02936
Seeding

1 GENERAL

1.1 Related Requirements: The following sections contain requirements that relate to this section.

1.1.1 Section 01400 – General Requirements

1.1.2 Section 02200 - Earthwork

1.2 Submittals: Provide the following items in accordance with the approved submittals schedule as specified in Section 01400 – General Requirements:

1.2.1 Seed Test Report

1.2.2 Fertilizer Analysis

1.3 Reference specifications are referred to by abbreviation as follows:

1.3.1 American Society of Testing and Materials ..... ASTM

1.3.2 Virginia Department of Transportation ..... VDOT

2 PRODUCTS

2.1 Topsoil: Topsoil shall be the top 6 inches of original soil from the site. Topsoil obtained off-site shall be fertile, friable loam, containing not less than 2% by weight of finely divided, decomposed vegetation. Topsoil shall be free of subsoil, clay lumps, brush, weeds, roots larger than 1½-inch in diameter, stones larger than 1½-inch in diameter, and other material toxic or harmful to growth.

2.2 Fertilizer: Fertilizer shall meet requirements of Federal Specification O-F-241. Provide fertilizer that is complete, inorganic, uniform in composition, and suitable for application with approved equipment. Proportions of fertilizer nutrients shall be the following:

2.2.1 Permanent Seeding

2.2.1.1 5% total nitrogen

2.2.1.2 10% available phosphoric acid

2.2.1.3 5% soluble potash

2.2.2 Temporary Seeding

2.2.2.1 10% total nitrogen

2.2.2.2 20% available phosphoric acid

2.2.2.3 10% soluble potash

2.3 Grass Seed: Grass seed, tested within 6 months of sowing, shall have the following characteristics:

2.3.1 Permanent Seeding (for Residential Lawn Areas)

Species	%Weight	%Purity	%Germination
Kentucky 31 tall fescue	95-100	98	90
Perennial ryegrass	0-5	98	90
Kentucky bluegrass	0-5	98	90

2.3.2 Temporary Seeding

Seeding Date	Species	%Wgt.	%Purity	%Germ.	Seed Rate (lb/acre)
Sep. 1-Feb. 15	Rye/Oats	100	98	85	50-100
Feb. 16-Apr. 30	Rye	100	96	85	60-100
May. 1-Aug. 31	Millet	100	98	80	50

2.4 Lime: Lime shall be ground agriculture grade limestone containing not less than 85% calcium and magnesium carbonates. Fineness shall be such that 100% will pass a No. 20 sieve, and not less than 50% will pass a No. 100 sieve. Burnt lime or hydrated lime may be substituted in equivalent carbonates, if requested.

2.5 Mulch: Type II mulch composed of threshed straw of cereal grain, pine needles or wood fiber which shall be free of objectionable weed seeds or other harmful material.

2.6 Asphalt Adhesive: Asphalt adhesive for use with Type II mulch shall be emulsified asphalt meeting requirements of ASTM D 977, Grade SS-1.

2.7 Mulch Binder: Synthetic mulch binder for use with Type II mulch shall be Curasol, DCA-70 Petroset, or Terra Tack.

2.8 Jute Mesh (VDOT EC-2 Soil Stabilization Blanket): Jute mesh shall be as defined in the VDOT Road and Bridge Specifications, Section 244, "Roadside Development Materials." Installation locations shall be as specified herein.

2.9 VDOT EC-3 Soil Stabilization Matting: C 125 Erosion Control Blanket manufactured by North American Green, 14649 Highway 41 North, Evansville,

Indiana 47711, Telephone: (800) 772-2040, or Curlex III High Velocity Blanket manufactured by American Excelsior Company, 850 Avenue H East, Arlington, Texas, 76011, Telephone: (800) 777-7645. Installation locations shall be as specified herein.

3 EXECUTION

3.1 General

3.1.1 Before seeding, 4 inches of topsoil shall be spread in areas to be seeded. In general, the topsoil shall come from the stockpiles created during the initial clearing of the site. If there is insufficient topsoil in the stockpiles, the Contractor shall provide topsoil from an offsite source at no additional cost to the Owner.

3.1.2 Material shall be delivered in unbroken containers, clearly marked by the manufacturer as to their contents. Seed, limestone, and fertilizer shall be labeled as to proportions, analysis, and quality. Store all materials in a manner affording protection from damage by weather or vandalism.

3.1.3 Seed only when the wind velocity is less than 15 miles per hour.

3.1.4 All areas disturbed by excavation, grading, or other construction operations, except areas to be paved or otherwise permanently stabilized, shall be seeded as specified for permanent seeding. Temporary seeding shall be provided when required at no additional cost to the Owner.

3.1.5 Remove all soiling or staining off finished structures or pavements resulting from seeding work. Maintain paved areas in clean condition.

3.2 Temporary Seeding

3.2.1 Use in areas when final grading has not been completed, when permanent seeding cannot be performed due to the specified permanent seeding dates, or when required for erosion control.

3.2.2 Apply fertilizer at a rate of 10 pounds per 1,000 square feet (450 pounds per acre) or equivalent. Apply lime at a rate of 90 pounds per 1,000 square feet.

3.2.3 For loose soil, work lime and fertilizer into soil and then seed. For packed or hard soil, loosen top layer while working lime and fertilizer into soil and then seed at the rate specified for the temporary seeding species.

3.2.4 Seed only between the application dates mentioned above and in “Table 3.31-B: Temporary Seeding Specifications” as shown on design drawing C-8.

3.3 Permanent Seeding

3.3.1 For all areas to receive permanent seeding, apply fertilizer at the rate of 50 pounds per 1,000 square feet and apply lime at the rate of 100 pounds. per 1,000 square feet.

3.3.2 Apply fertilizer and lime uniformly and mix well into the top 4 inches of the seedbed.

3.3.3 Prepare soil for permanent seeding by tillage of topsoil in place to loosen thoroughly and break up all clods to a depth of 6 inches. Remove all stumps and roots, coarse vegetation, stones larger than 1½ inches, and all construction debris. Soil shall be worked by suitable agricultural equipment to a depth of not less than 4 inches. Surface shall be uniform, smooth, and drainable. A firm and compact seedbed is required.

3.3.4 Sow permanent grass seed between dates of March 1 and April 15 or September 1 and November 15.

3.3.5 Sow seed by mechanical seeder as follows:

3.3.5.1 Mix seed thoroughly with clean dry sawdust and broadcast at rate of 6 pounds of seed per 1,000 square feet for permanent seeding or as specified elsewhere for temporary seeding.

3.3.5.2 Apply Type II mulch uniformly to depth of approximately 1¼ inches.

3.3.5.3 Anchor Type II mulch by the following methods:

3.3.5.3.1 Apply light tack coat of asphalt emulsion or synthetic mulch binder.

3.3.5.3.2 On slopes steeper than 4(H):1(V), anchor with VDOT EC-2 jute mesh fastened to wooden stakes.

3.3.5.3.3 On slopes steeper than 2(H):1(V), anchor with VDOT EC-3 soil stabilization matting fastened in accordance with the manufacturer's written recommendations.

3.3.6 Sow seed by hydraulic seeder as follows:

3.3.6.1 Prepare homogeneous slurry equal to the seed mixture used for mechanical seeding as specified in this section.

3.3.6.2 Distribute slurry uniformly at rate equal to the rate specified for mechanical seeding.

3.3.6.3 Apply mulch, jute mesh, and soil stabilization blankets as specified for sowing by mechanical seeder.

3.3.7 Coordinate permanent seeding with the requirements presented in "Table 3.32-D: Site Specific Seeding Mixtures for Piedmont Area" as shown on design drawing C-8.

3.4 Maintenance of Seeded Areas

3.4.1 The Contractor is advised that final payment for the project will not be received until a uniform stand of grass acceptable to the Engineer has been established.

3.4.2 Reseed and mulch spots larger than one square foot without uniform stand of grass. In areas where jute mesh or soil stabilization blankets have been applied, the mesh or blanket shall be removed prior to reseeding, and reapplied after reseeding activities are complete. Reseeding shall include application of fertilizer, lime, and seed in accordance with the agronomic loading rates specified herein. Reseeding shall be performed multiple times during the course of a planting season and over the course of multiple planting seasons until a uniform stand of grass is established.

3.4.3 Maintain all seeded areas until uniform stand of grass is acceptable to the Engineer.

3.4.4 In the event that growth is not established by the final project inspection, continue the specified attention until the stand is accepted by the Engineer.

3.4.5 Correct or repair all undue settling for a period of one year after final inspection.

3.4.6 Water as necessary.

3.4.7 Mowing: Maintain grass height between 2 and 4 inches.

End of Section

Section 032000
Concrete Reinforcing

1 GENERAL

1.1 Summary

1.1.1 Section Includes:

1.1.1.1 Steel reinforcement bars.

1.1.1.2 Welded-wire reinforcement.

1.2 Action Submittals

1.2.1 Product Data: For the following:

1.2.1.1 Each type of steel reinforcement.

1.2.1.2 Bar supports.

1.2.1.3 Mechanical splice couplers.

1.2.2 Shop Drawings: Comply with ACI SP-066:

1.2.2.1 Include placing drawings that detail fabrication, bending, and placement.

1.2.2.2 Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.2.3 Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1.2.3.1 Location of construction joints is subject to approval of the Architect.

2 PRODUCTS

2.1 Steel Reinforcement

2.1.1 Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

2.1.2 Headed-Steel Reinforcing Bars: ASTM A970/A970M.

2.1.3 Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.1.4 Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.2 Reinforcement Accessories

2.2.1 Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

2.2.1.1 Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

2.2.1.1.1 For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

2.2.2 Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

2.2.2.1 Finish: Plain

2.3 Fabricating Reinforcement

2.3.1 Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

3 EXECUTION

3.1 Preparation

3.1.1 Protection of In-Place Conditions:

3.1.1.1 Do not cut or puncture vapor retarder.

3.1.1.2 Repair damage and reseal vapor retarder before placing concrete.

3.1.2 Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 Installation of Steel Reinforcement

3.2.1 Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

3.2.2 Accurately position, support, and secure reinforcement against displacement.

3.2.2.1 Locate and support reinforcement with bar supports to maintain minimum concrete cover.

3.2.3 Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

3.2.4 Provide concrete coverage in accordance with ACI 318.

3.2.5 Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.2.6 Splices: Lap splices as indicated on Drawings.

3.2.6.1 Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.

3.2.6.2 Stagger splices in accordance with ACI 318.

3.2.7 Install welded-wire reinforcement in longest practicable lengths.

3.2.7.1 Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

3.2.7.1.1 For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.

3.2.7.2 Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.

3.2.7.3 Offset laps of adjoining sheet widths to prevent continuous laps in either direction.

3.2.7.4 Lace overlaps with wire.

3.3 Joints

3.3.1 Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.3.1.1 Place joints perpendicular to main reinforcement.

3.3.1.2 Continue reinforcement across construction joints unless otherwise indicated.

3.4 Installation Tolerances

3.4.1 Comply with ACI 117.

3.5 Field Quality Control

3.5.1 Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare test reports.

3.5.2 Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

3.5.3 Inspections:

3.5.3.1 Steel-reinforcement placement.

End of Section

Section 033000
Cast-In-Place Concrete

1 GENERAL

1.1 Summary

1.1.1 Section Includes:

1.1.1.1 Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

1.1.2 Related Requirements:

1.1.2.1 Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

1.2 Definitions

1.2.1 Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, and other pozzolans materials subject to compliance with requirements.

1.2.2 Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 Action Submittals

1.3.1 Product Data: For each of the following:

1.3.1.1 Portland cement.

1.3.1.2 Fly ash.

1.3.1.3 Slag cement.

1.3.1.4 Aggregates.

1.3.1.5 Admixtures:

1.3.1.5.1 Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

1.3.1.6 Vapor retarders.

1.3.1.7 Liquid floor treatments.

1.3.1.8 Curing materials.

1.3.1.9 Joint fillers.

1.3.2 Design Mixtures: For each concrete mixture, include the following:

1.3.2.1 Mixture identification.

1.3.2.2 Minimum 28-day compressive strength.

1.3.2.3 Durability exposure class.

1.3.2.4 Maximum w/cm.

1.3.2.5 Calculated equilibrium unit weight, for lightweight concrete.

1.3.2.6 Slump limit.

1.3.2.7 Air content.

1.3.2.8 Nominal maximum aggregate size.

1.3.2.9 Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.

1.3.2.10 Intended placement method.

1.3.2.11 Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.3.3 Shop Drawings:

1.3.3.1 Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1.3.3.1.1 Location of construction joints is subject to approval of the Architect.

1.3.4 Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1.3.4.1 Concrete Class designation.

1.3.4.2 Location within Project.

1.3.4.3 Exposure Class designation.

1.3.4.4 Formed Surface Finish designation and final finish.

1.3.4.5 Final finish for floors.

1.3.4.6 Curing process.

1.3.4.7 Floor treatment if any.

1.4 Informational Submittals

1.4.1 Material Certificates: For each of the following, signed by manufacturers:

1.4.1.1 Curing compounds.

1.4.1.2 Vapor retarders.

1.4.1.3 Joint-filler strips.

1.4.2 Material Test Reports: For the following, from a qualified testing agency:

1.4.2.1 Portland Cement.

1.4.2.2 Fly Ash.

1.4.2.3 Slag Cement

1.4.2.4 Aggregates.

1.4.2.5 Admixtures:

1.4.3 Research Reports: For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.

1.4.4 Preconstruction Test Reports: For each mix design.

1.5 Quality Assurance

1.5.1. Ready-Mixed 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.

1.5.1.1 Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

1.6 Preconstruction Testing

1.6.1 Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1.6.1.1 Include the following information in each test report:

1.6.1.1.1 Admixture dosage rates.

1.6.1.1.2 Slump.

1.6.1.1.3 Air content.

1.6.1.1.4 Seven-day compressive strength.

1.6.1.1.5 28-day compressive strength.

1.7 Delivery, Storage, And Handling

1.7.1 Comply with ASTM C94/C94M and ACI 301.

1.8 Field Conditions

1.8.1 Cold-Weather Placement: Comply with ACI 301 and ACI 306.1.

1.8.2 Hot-Weather Placement: Comply with ACI 301 and ACI 305.1.

2 PRODUCTS

2.1 Concrete, General

2.1.1 ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 Concrete Materials

2.2.1 Cementitious Materials:

2.2.1.1 Portland Cement: ASTM C150/C150M, Type I/II, gray.

2.2.1.2 Fly Ash: ASTM C618, Class C or F.

2.2.1.3 Slag Cement: ASTM C989/C989M, Grade 100 or 120.

2.2.2 Normal-Weight Aggregates: ASTM C33/C33M, [Class 4M] coarse aggregate or better, graded. Provide aggregates from a single source.

2.2.2.1 Maximum Coarse-Aggregate Size: 3/4 inch nominal.

2.2.2.2 Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

2.2.3 Air-Entraining Admixture: ASTM C260/C260M.

2.2.4 Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium.

2.2.4.1 Water-Reducing Admixture: ASTM C494/C494M, Type A.

2.2.4.2 Retarding Admixture: ASTM C494/C494M, Type B.

2.2.4.3 Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.

2.2.4.4 High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

2.2.4.5 High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.

2.2.4.6 Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

2.2.5 Water and Water Used to Make Ice: ASTM C94/C94M, potable.

2.3 Vapor Retarders

2.3.1 Sheet Vapor Retarder, Class A: ASTM E1745, Class A not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.4 Curing Materials

2.4.1 Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

2.4.2 Water: Potable or complying with ASTM C1602/C1602M.

2.4.3 Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

2.5 Related Materials

2.5.1 Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated

cellulosic fiber or ASTM D1752, cork or self-expanding cork.

Concrete Mixtures, General

2.5.2 Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

2.5.2.1 Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

2.5.3 Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

2.5.2.1 Fly Ash or Other Pozzolans: 25 percent by mass.

2.5.2.2 Slag Cement: 50 percent by mass.

2.5.2.3 Total of Fly Ash or Other Pozzolans, Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.

2.5.2.4 Total of Fly Ash or Other Pozzolans: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass.

2.5.4 Admixtures: Use admixtures in accordance with manufacturer's written instructions.

2.5.4.1 Use high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.

2.5.4.2 Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.5.4.3 Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.

2.6 Concrete Mixtures

2.6.1 Class A: Normal-weight concrete used for footings, grade beams, and foundation walls.

2.6.1.1 Exposure Class: ACI 318 F0.

2.6.1.2 Minimum Compressive Strength: 4000 psi at 28 days.

2.6.1.3 Maximum w/cm: 0.45.

2.6.1.4 Slump Limit: 8 inches, plus or minus 1 inch for concrete with verified

slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.

2.6.2 Class B: Normal-weight concrete used for slabs on grade and elevated slabs.

2.6.2.1 Exposure Class: ACI 318 F2.

2.6.2.2 Minimum Compressive Strength: 4000 psi at 28 days.

2.6.2.3 Maximum w/cm: 0.45.

2.6.2.4 Slump Limit: 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.

2.6.2.5 Air Content:

2.6.2.5.1 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.

2.7 Concrete Mixing

2.7.1 Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M , and furnish batch ticket information.

3 EXECUTION

3.1 Installation Of Embedded Items

3.1.1 Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

3.1.1.1 Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.1.1.2 Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.1.1.3 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.

3.2 Installation Of Vapor Retarder

3.2.1 Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

3.2.1.1 Install vapor retarder with longest dimension parallel with direction of concrete pour.

3.2.1.2 Face laps away from exposed direction of concrete pour.

3.2.1.3 Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.

3.2.1.4 Lap joints 6 inches and seal with manufacturer's recommended tape.

3.2.1.5 Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.

3.2.1.6 Seal penetrations in accordance with vapor retarder manufacturer's instructions.

3.2.1.7 Protect vapor retarder during placement of reinforcement and concrete.

3.2.1.7.1 Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.3 Joints

3.3.1 Construct joints true to line, with faces perpendicular to surface plane of concrete.

3.3.2 Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

3.3.2.1 Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.

3.3.2.2 Place joints perpendicular to main reinforcement.

3.3.2.2.1 Continue reinforcement across construction joints unless otherwise indicated.

3.3.2.2.2 Do not continue reinforcement through sides of strip placements of floors and slabs.

3.3.2.3 Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.

3.2.2.4 Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

3.2.2.5 Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

3.3.3 Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

3.3.3.1 Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

3.3.3.2 Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

3.3.4 Isolation Joints in Slabs-on-Ground: 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.

3.3.4.1 Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.

3.3.4.2 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 Section 079200 "Joint Sealants," are indicated.

3.3.4.3 Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.3.5 Doweled Joints:

3.3.5.1 Install dowel bars and support assemblies at joints where indicated on Drawings.

3.3.5.2 Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.3.6 Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.4 Concrete Placement

3.4.1 Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are

completed.

3.4.1.1 Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.

3.4.1.2 Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

3.4.2 Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

3.4.3 Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.

3.4.3.1 Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

3.4.4 Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

3.4.4.1 Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

3.4.5 Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

3.4.5.1 If a section cannot be placed continuously, provide construction joints as indicated.

3.4.5.2 Deposit concrete to avoid segregation.

3.4.5.3 Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.

3.4.5.4 Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

3.4.5.4.1 Do not use vibrators to transport concrete inside forms.

3.4.5.4.2 Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.

3.4.5.4.3 Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.

3.4.5.4.4 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.

3.4.6 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.

3.4.6.1 Do not place concrete floors and slabs in a checkerboard sequence.

3.4.6.2 Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

3.4.6.3 Maintain reinforcement in position on chairs during concrete placement.

3.4.6.4 Screed slab surfaces with a straightedge and strike off to correct elevations.

3.4.6.5 Level concrete, cut high areas, and fill low areas.

3.4.6.6 Slope surfaces uniformly to drains where required.

3.4.6.7 Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.

3.4.6.8 Do not further disturb slab surfaces before starting finishing operations.

3.5 Finishing Formed Surfaces

3.5.1 As-Cast Surface Finishes:

3.5.1.1 ACI 301Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

3.5.1.1.1 Patch voids larger than 3/4 inch wide or 1/2 inch deep.

3.5.1.1.2 Remove projections larger than 1/4 inch.

3.5.1.1.3 Patch tie holes.

3.5.1.1.4 Surface Tolerance: ACI 117 Class B.

3.5.1.1.5 Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

3.5.2 Related Unformed Surfaces:

3.5.2.1 At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.

3.5.2.2 Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.6 Finishing Floors And Slabs

3.6.1 Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

3.6.2 Float Finish:

3.6.2.1 When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.

3.6.2.2 Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.

3.6.2.3 Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

3.6.3 Trowel Finish:

3.6.3.1 After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.

3.6.3.2 Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.

3.6.3.3 Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

3.6.3.4 Do not add water to concrete surface.

3.6.3.5 Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.

3.6.3.6 Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

3.6.3.7 Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

3.6.4 Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

3.6.4.1 Coordinate required final finish with Architect before application.

3.6.4.2 Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

3.6.5 Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

3.6.5.1 Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.6.5.2 Coordinate required final finish with Architect before application.

3.7 Installation Of Miscellaneous Concrete Items

3.7.1 Filling In:

3.7.1.1 Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.

3.7.1.2 Mix, place, and cure concrete, as specified, to blend with in-place construction.

3.7.1.3 Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.7.2 Curbs: 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.

3.8 Concrete Curing

3.8.1 Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

3.8.1.1 Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.

3.8.1.2 Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.

3.8.1.3 Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

3.8.2 Curing Formed Surfaces: Comply with ACI 308.1 as follows:

3.8.1.1 Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.

3.8.1.2 Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.

3.8.1.3 If forms remain during curing period, moist cure after loosening forms.

3.8.1.4 If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

3.8.1.4.1 Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.

3.8.1.4.2 Continuous Sprinkling: Maintain concrete surface continuously wet.

3.8.1.4.3 Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.

3.8.1.4.4 Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.

3.8.1.4.5 Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

3.8.1.4.5.1 Recoat areas subject to heavy rainfall within three hours after initial application.

3.8.1.4.5.2 Maintain continuity of coating and repair damage during curing period.

3.8.3 Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

3.8.3.1 Begin curing immediately after finishing concrete.

3.8.3.2 Interior Concrete Floors:

3.8.3.2.1 Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

3.8.3.2.1.1 Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

3.8.3.2.1.1.1 Lap edges and ends of absorptive cover not less than 12-inches.

3.8.3.2.1.1.2 Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

3.8.3.2.1.2 Moisture-Retaining-Cover Curing: 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.

3.8.3.2.1.2.1 Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3.8.3.2.1.2.2 Cure for not less than seven days.

3.8.3.2.1.3 Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

3.8.3.2.1.3.1 Water.

3.8.3.2.1.3.2 Continuous water-fog spray.

3.8.3.2.2 Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

3.8.3.2.2.1 Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface,

install prewetted absorptive cover over entire area of floor.

3.8.3.2.2.1.1 Lap edges and ends of absorptive cover not less than 12 inches.

3.8.3.2.2.1.2 Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

3.8.3.2.2.2 Moisture-Retaining-Cover Curing: 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.

3.8.3.2.2.2.1 Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3.8.3.2.2.2.2 Cure for not less than seven days.

3.8.3.2.2.3 Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

3.8.3.2.2.3.1 Water.

3.8.3.2.2.3.2 Continuous water-fog spray.

3.8.3.2.3 Floors to Receive Chemical Stain:

3.8.3.2.3.1 As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.

3.8.3.2.3.2 Install curing paper square to building lines, without wrinkles, and in a single length without end joints.

3.8.3.2.3.3 Butt sides of curing paper tight; do not overlap sides of curing paper.

3.8.3.2.3.4 Leave curing paper in place for duration of curing period, but not less than 28 days.

3.8.3.2.4 Floors to Receive Urethane Flooring:

3.8.3.2.4.1 As soon as concrete has sufficient set to permit application

without marring concrete surface, install prewetted absorptive cover over entire area of floor.

3.8.3.2.4.2 Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.

3.8.3.2.4.3 Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.

3.8.3.2.4.4 Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.

3.8.3.2.5 Floors to Receive Curing Compound:

3.8.3.2.5.1 Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

3.8.3.2.5.2 Recoat areas subjected to heavy rainfall within three hours after initial application.

3.8.3.2.5.3 Maintain continuity of coating, and repair damage during curing period.

3.8.3.2.5.4 Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

3.8.3.2.6 Floors to Receive Curing and Sealing Compound:

3.8.3.2.6.1 Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.

3.8.3.2.6.2 Recoat areas subjected to heavy rainfall within three hours after initial application.

3.8.3.2.6.3 Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.9 Tolerances

3.9.1 Conform to ACI 117.

3.10 Field Quality Control

3.10.1 Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

3.10.2 Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

3.10.2.1 Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.

3.10.2.2 Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.

3.10.2.3 Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

3.10.2.3.1 Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

3.10.2.3.1.1 Project name.

3.10.2.3.1.2 Name of testing agency.

3.10.2.3.1.3 Names and certification numbers of field and laboratory technicians performing inspections and testing.

3.10.2.3.1.4 Name of concrete manufacturer.

3.10.2.3.1.5 Date and time of inspection, sampling, and field testing.

3.10.2.3.1.6 Date and time of concrete placement.

3.10.2.3.1.7 Location in Work of concrete represented by samples.

3.10.2.3.1.8 Date and time sample was obtained.

3.10.2.3.1.9 Truck and batch ticket numbers.

3.10.2.3.1.10 Design compressive strength at 28 days.

3.10.2.3.1.11 Concrete mixture designation, proportions, and materials.

3.10.2.3.1.12 Field test results.

3.10.2.3.1.13 Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.

3.10.2.3.1.14 Type of fracture and compressive break strengths at seven days and 28 days.

3.10.3 Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

3.10.4 Inspections:

3.10.4.1 Headed bolts and studs.

3.10.4.2 Verification of use of required design mixture.

3.10.4.3 Concrete placement, including conveying and depositing.

3.10.4.4 Curing procedures and maintenance of curing temperature.

3.10.4.5 Verification of concrete strength before removal of shores and forms from beams and slabs.

3.10.4.6 Batch Plant Inspections: On a random basis, as determined by Architect.

3.10.5 Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

3.10.5.1 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.

3.10.5.1.1 When frequency of testing provides 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.

3.10.5.2 Slump: ASTM C143/C143M:

3.10.5.2.1 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.

3.10.5.2.2 Perform additional tests when concrete consistency appears to change.

3.10.5.3 Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;

3.10.5.3.1 One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

3.10.5.4 Concrete Temperature: ASTM C1064/C1064M:

3.10.5.4.1 One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

3.10.5.5 Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.

3.10.5.5.1 One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

3.10.5.6 Compression Test Specimens: ASTM C31/C31M:

3.10.5.6.1 Cast and laboratory cure two sets of three 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.

3.10.5.7 Compressive-Strength Tests: ASTM C39/C39M.

3.10.5.7.1 Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.

3.10.5.7.2 A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

3.10.5.8 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.

3.10.5.9 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 if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.

3.10.5.10 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.

3.10.5.11 Additional Tests:

3.10.5.11.1 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 Architect.

3.10.5.11.2 Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

3.10.5.11.2.1 Acceptance criteria for concrete strength shall be in accordance with ACI 301 section 1.6.6.3.

3.10.5.12 Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10.5.13 Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.10.6 Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 48 hours of completion of floor finishing and promptly report test results to Architect.

3.11 Protection

3.11.1 Protect concrete surfaces as follows:

3.11.1.1 Protect from petroleum stains.

3.11.1.2 Diaper hydraulic equipment used over concrete surfaces.

3.11.1.3 Prohibit vehicles from interior concrete slabs.

3.11.1.4 Prohibit use of pipe-cutting machinery over concrete surfaces.

3.11.1.5 Prohibit placement of steel items on concrete surfaces.

3.11.1.6 Prohibit use of acids or acidic detergents over concrete surfaces.

3.11.1.7 Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

3.11.1.8 Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

End Of Section 033000

Section 04100
Mortar and Grout

1 GENERAL

1.1 Related Documents:

1.1.1 The General Conditions of the Construction Contract and Division 1, General Requirements are a part of this Section.

1.2 Submittals:

1.2.1 Color Selection Sample: Submit a sample mortar strip for each type of colored masonry mortar. Project Engineer review will be for color only.

1.2.2 Product Data: Submit mix designs of mortar and grout types.

1.3 Handling and Storage:

1.3.1 Deliver all materials in usable condition.

1.3.2 Store off the ground in a dry location and covered with tarpaulins or polyethylene sheets to prevent wetting by capillary action, rain and snow.

2 PRODUCTS

2.1 Materials:

2.1.1 Portland Cement: ASTM C150 Type I, non-staining without air entrainment and of natural color or white to produce the required mortar color.

2.1.1.1 Use Type III when temperatures drop below 40°F or when high early strength is desired.

2.1.1.2 The use of prepackaged masonry cement is not permitted.

2.1.2 Hydrated Lime: ASTM C207, Type S.

2.1.3 Aggregate: ASTM C144 natural or manufactured sand.

2.1.3.1 For joints less than ¼-inch use aggregate graded with 100 percent passing a No. 16 sieve.

2.1.3.2 For all other joints grading shall comply with the following limits:

Sieve Size	Percent Passing
No. 4 (4.76 mm)	100
No. 8 (2.38 mm)	95 to 100

No. 16 (1.19 mm)	60 to 100
No. 30 (595 um)	35 to 70
No. 50 (297 um)	15 to 35
No. 100 (149 um)	2 to 15
No. 200 (74 um)	0 to 2

2.1.4 Water: Clean, fresh, potable, and free of deleterious amounts of acids, alkalis, salts or organic materials.

2.1.5 The use of anti-freeze admixtures is prohibited.

2.2 Mortar Uses and Color:

2.2.1 Mortar - ASTM C270:

2.2.1.1 Exposed masonry above grade and interior walls and partitions below grade: Type S.

2.2.1.2 Walls below grade and in contact with earth: Type M.

2.2.1.3 Colored mortar: Mortar exposed to view in the finished state shall be the color produced by the colored mortar, for standard color specified.

2.2.1.4 All other mortar may be natural color.

2.2.2 Grout: ASTM C476.

2.2.2.1 For reinforced masonry. Minimum strength 2000 PSI at 28 days.

2.2.2.2 For grout where indicated or required for stiffening, sound deadening, or filling of hidden voids. Use fine aggregate only in spaces less than 4 inches in one direction.

2.3 Mortar Types and Proportions:

2.3.1 Type M: Not more than ¼ part lime per part of Portland cement.

2.3.2 Type S: Not more than ½ part lime per part of Portland cement.

2.3.3 Type N: Not more than 1 part lime per part of Portland cement.

2.3.4 For all mortar types, aggregate (when measured in a damp loose condition) shall be not less than 2 1/4 or more than 3 times the sum of the volumes of the cement and lime used.

3 EXECUTION

3.1 General Requirements:

3.1.1 Mix cementitious materials and aggregate in a mechanical batch mixer for a minimum of 7 minutes with the maximum amounts of water to produce a workable consistency.

3.1.2 Mortars that have stiffened because of evaporation of water may be tempered by adding water as frequently as needed to restore the required consistency. Mortars shall be used and placed in final position within 2 hours after mixing. Retempering of mortar by remixing with new batches will not be permitted.

3.2 Cold Weather Requirements:

3.2.1 Air Temperature 40°F to 32°F: sand or mixing water shall be heated to produce mortar temperatures between 40°F and 120°F.

3.2.2 Air Temperature 32°F to 25°F: Sand and mixing water shall be heated to product mortar temperatures between 40°F and 120°F. Maintain temperatures of mortar on boards above freezing. See Section 04200 – Unit Masonry.

3.2.3 Air Temperature 25°F to 20°F: Sand and mixing water shall be heated to produce mortar temperatures between 40°F and 120°F. Maintain mortar temperatures on boards above freezing. Salamanders or other sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph. See Section 04200 – Unit Masonry.

3.2.4 Air Temperature 20°F and Below: Sand and mixing water shall be heated to provide mortar temperatures between 40° F and 120°F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32°F. Temperature of units when laid shall be not less than 20°F. See Section 04200 – Unit Masonry.

3.2.5 The use of anti-freezing agents is prohibited.

3.3 For Hot Weather Requirements See Masonry Council Recommendations.

End of Section

Section 04200
Unit Masonry

1 GENERAL

1.1 Related Documents:

1.1.1 The General Conditions of the Contract and Division 1, General Requirements are a part of this section.

1.2 Quality Assurance:

1.2.1 Fire Performance Characteristics: Where fire-resistance ratings are indicated for unit masonry work, provide materials and construction which are identical to those of assemblies whose fire endurance has been determined by testing in compliance with ASTM E119 by a recognized testing and inspecting organization or by another means, as acceptable to authority having jurisdiction.

1.3 Coordination:

1.3.1 Cooperate with other trades in setting built-in items in masonry walls.

1.4 Submittals:

1.4.1 Product Data: Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products.

1.4.2 Certificate of Compliance: Submit for each type of masonry and reinforcement.

1.5 Product Delivery, storage and Handling:

1.5.1 Deliver and stack unit masonry on wood pallet platforms. Cover with tarpaulins which are not vapor retarders and store in manner to provide protection from contact with soil. Exercise care in handling masonry units to avoid chipping, breakage.

2 PRODUCTS

2.1 Concrete Masonry Units (CMU):

2.1.1 CMU: Provide CMU fabricated from lightweight concrete aggregate, complying with ASTM C331, free of combustible matter and organic impurities that would cause rusting, staining, pop-out to walls.

2.1.2 CMU Types:

2.1.2.1 75 percent solid and solid load-bearing units: ASTM C145 Grade N-1.

2.1.2.2 Hollow load bearing units: ASTM C90 Grade N-1.

2.1.2.3 Hollow non-load bearing units: ASTM C129 Type I.

2.1.2.4 UL Classification C-3: Units for fire resistant partitions shall have fire resistance ratings as indicated and in compliance with the requirements established by the American Insurance Association and other governing authorities. Units shall be the rated product of a manufacturer listed in the current building material list published by the Underwriters' Laboratories, Inc. in lieu of the above, units may be furnished on the basis of examination and certified report by a recognized testing laboratory indicating that the units are equivalent in fire resistance to those furnished by UL listed producers. Examination shall cover width, height and length of block, shell web thickness, maximum equivalent thickness, compressive strength and type of aggregate.

2.1.2.5 Provide sash type units at all control joints.

2.1.3 Curing Method:

2.1.3.1 Cure units in a moisture-controlled atmosphere or in an autoclave at normal pressure and temperature to comply with ASTM C90, Type I.

2.1.3.1.1 Limit moisture absorption during delivery and until time of installation to the maximum percentage specified for Type I units for the average annual relative humidity as reported by the U.S. Weather Bureau station nearest the project site.

2.1.4 Acceptable Manufacturers:

2.1.4.1 Solite; PO Box 27211, Richmond, VA 23261 (T. 804-329-8135).

2.1.4.2 Adams Products Company; PO Box 2655, Durham, NC 27705 (T. 800-922-6330).

2.1.4.3 Smithtown Concrete Products Corporation; PO Box 612, Middle Country Road and Arthur Drive, Smithtown, NY 11787 (T. 631-265-1815).

2.1.4.4 Approved equal or as specified

2.1.5 Veneer Brick: As selected and approved by ARB. See plans.

2.2 Reinforcing:

2.2.1 Horizontal Joint Reinforcing:

2.2.1.1 Provide welded wire units prefabricated in straight lengths of not less than 10 feet, with matching corner ("L") and intersection ("T") units. Fabricate from cold-drawn steel wire complying with ASTM A82, with deformed or embossed continuous side rods and plain cross-rods, crimped for cavity wall construction (if any), with unit width of 1- ½ inches to 2 inches less than thickness of wall or partition.

2.2.1.2 For single wythe masonry walls provide ladder type fabricated with single pair of side rods and perpendicular cross-rods spaced not more than 16 inches O.C. or truss type fabricated with single pair of side rods and continuous diagonal cross-rods spaced not more than 16 inches O.C.

2.2.1.3 Wire: Fabricate with 9-gauge side and cross-rods, unless otherwise indicated.

2.2.1.4 Corrosion Protection:

2.2.1.4.1 For use in exterior cavity walls, hot-dip with 1.5 oz. per sq. ft. in accordance with ASTM A153, Class B02.

2.2.1.4.2 For use in interior partition walls, fabricate from mill galvanized wire.

2.2.1.5 Manufacturers offering products to comply with the requirements include the following:

2.2.1.5.1 AA Wire Products.

2.2.1.5.2 Dur-O-Wal.

2.2.1.5.3 Approved equal.

2.2.1.6 Hohmann and Barnard.

2.2.2 Anchoring Devices for Masonry:

2.2.2.1 Provide straps, bars, bolts and rods of the type and size shown, but fabricated from not less than 16-gauge sheet metal or 3/16-inch diameter rod stock, unless otherwise shown, and as follows:

2.2.2.2 Flexible anchors: where masonry is shown or specified to be anchored to structural framework with flexible anchors, provide anchors which will permit horizontal and vertical movement of masonry but will provide lateral restraint, and as follows:

2.2.2.2.1 For anchorage to concrete framework, provide 2-piece anchors with sheet metal dovetail section and rectangular

or vee-shaped 3/16-inch wire tie section sized to extend to within 1 inch of face of masonry.

2.2.2.2.2 For anchorage to steel framework, provide 2-piece anchors with crimped ¼ inch bar for welding to steel and rectangular or vee-shaped 3/16-inch wire tie sections sized to extend within 1 inch of face of masonry abutting flanges or between 1-½ inches and 2 inches less than width of masonry abutting web.

2.2.3 Masonry Inserts in Concrete:

2.2.3.1 Unit Type: Furnish cast iron or malleable iron inserts of the type and size shown, or fabricated from not less than 16-gauge steel, hot-dip galvanized after fabrication with 1.5 oz. zinc coating complying with ASTM A153, Class B2.

2.2.3.2 For installation of concrete inserts, see Division 3 Sections of these Specifications. Advise concrete installer of specific requirements regarding placement of inserts which are to be used by the masonry installer for anchoring of masonry work.

2.2.3.3 Dovetail slots: Furnish 24-gauge galvanized steel dovetail slots with filler strips, where shown.

2.2.4 Vertical reinforcing:

2.2.4.1 Comply with ASTM A615, Grade 60.

2.2.4.2 Refer to structural drawings for size and spacing of vertical reinforcement.

2.3 Wall Flashing:

2.3.1 Provide concealed flashing, shown to be built into masonry.

2.3.1.1 Metal flashing: Fabricate wall flashings using metal with deformations in both directions for integral mechanical mortar bond.

2.3.1.1.1 Copper: ASTM B370, soft temper, 10 oz. uncoated.

2.3.1.2 Vinyl sheet flashing:

2.3.1.2.1 Virgin polyvinyl chloride with plasticizers and other modifiers, formed into uniform flexible sheets not less than 30-mils thick, unless otherwise shown, and black in color.

2.3.2 Sealing Material:

2.3.2.1 Sealing material for vinyl sheet flashing shall be an adhesive approved by the manufacturer of the vinyl sheet flashing.

2.4 Control Joint:

2.4.1 Provide pre-molded control joint strips of PVC or neoprene with a Shore A durometer hardness of 60 to 80 and designed fit standard sash block and maintain lateral stability in the masonry wall.

3 EXECUTION

3.1 General Requirements:

3.1.1 Do not erect masonry when air temperature is below or expected to go below 40°F except when permitted by Project Engineer. When masonry work is authorized during temperatures below 40°F, make provisions for heating, drying materials. Protect completed work in accordance with BIA Technical Notes, Volume 1, No. 1. Do not build upon frozen work. Do not lay masonry units having water film or frost on its surface.

3.1.2 Build in required items as erection of masonry progresses.

3.1.3 Erect masonry within the following construction tolerances:

3.1.3.1 Variation from plumb: For lines and surfaces of columns, walls and arrises do not exceed ¼ in. in 10 ft., or 3/8 in. in a story height or 20 ft. maximum, nor ½ in. in 40 ft. or more.

3.1.3.2 Variation from level: For lines of exposed sills, lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed ¼ in. in any bay or 20 ft. maximum, nor ¾ in. in 40 ft. or more.

3.1.3.3 Variation of linear building line: For position indicated in plan and related portion of columns, walls and partitions, do not exceed ½ in. in any bay or 20 ft. maximum, nor ¾ in. in 40 ft. or more.

3.1.3.4 Variation in cross-sectional dimensions: For columns and thickness of walls, from dimensions indicated, do not exceed minus ¼ in. nor plus ½ in.

3.1.4 In all masonry walls install mortar netting at the level of the weep holes and flashing.

3.2 Masonry Protections:

3.2.1 Protect masonry materials during storage and construction from wetting by rain, snow or ground water and from soilage or intermixture with earth or other materials.

3.2.2 Do not use metal reinforcing or ties having loose rust or other coatings, including ice, which will reduce or destroy bond.

3.2.3 In exposed work, do not use masonry units with chips, cracks, voids, discolorations or other defects which might be visible or cause staining in the finished work.

3.2.4 Protect partially completed masonry against weather, when work is not in progress, by covering top of walls with strong, waterproof, non-staining membrane. Extend membrane at least 2 feet down both sides of walls and hold securely in place.

3.2.5 Protect masonry surfaces not being worked on during construction work. At such time as rain or snow is imminent or work is discontinued, protect work with waterproof membrane, well secured. When work is resumed, clean top surfaces of loose mortar and wet brick as required. Remove all masonry determined to be damaged by freezing conditions.

3.3 Preparation:

3.3.1 Wetting of Masonry Units.

3.3.1.1 Lay concrete masonry units dry. Do not wet concrete masonry units.

3.4 General Installation Requirements:

3.4.1 Thickness: Build walls, floors and other masonry construction to the full thickness indicated. Build single-wythe walls (if any) to the actual thickness of the masonry units, using units of nominal thickness shown or specified.

3.4.2 Build chases and recesses as shown or required for the work of other trades. Provide not less than 8 inches of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

3.4.3 Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.

3.4.4 Cut masonry units using motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to get adjoining work neatly. Use full-size units without cutting wherever possible.

3.5 CMU Types:

3.5.1 75 percent solid or solid load bearing units where indicated, required for bearing and to achieve indicated fire rating.

3.5.2 Hollow load bearing units for all exterior wall construction and for interior load bearing walls.

3.5.3 Hollow non-load bearing units for interior non-load bearing walls and furring.

3.6 Bond and Coursing:

3.6.1 CMU:

3.6.1.1 Erect CMU in running bond.

3.6.1.2 Vertical coursing for CMU shall be one course in 8 in. Horizontal coursing shall be as required to produce joints 3/8 in. wide.

3.6.1.3 Lay out horizontal coursing so that no exposed CMU is less than 4 in. (nominal) in length.

3.7 Laying Masonry Walls: (General)

3.7.1 Mortar types shall be as specified in Section 04100 – Mortar.

3.7.2 Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to properly locate openings, movement-type joints, returns and offsets. Avoid the use of less than half-size units are corners, jambs and wherever possible at other locations.

3.7.3 Lay-up walls plumb and true to comply with specified tolerances, with courses level, accurately spaced, and coordinated with other work.

3.7.4 Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

3.8 CMU Installation:

3.8.1 Erect CMU walls, partitions in location indicated. Bed each course solidly in specified mortar with vertical joints breaking halfway over course below. Butter vertical joints entire height of units. Bond each course at corners, intersections. Either bond into or anchor to adjacent construction with reinforcing.

3.8.2 Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footing and foundations walls and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced to filled with grout.

3.8.3 Extend indicated interior CMU walls and partitions up solidly against underside of structure above. Pack all voids solidly with mortar.

3.8.4 Cut joints flush for masonry walls which will be concealed or covered by other materials. Tool exposed joints slightly concave.

3.9 Additional Masonry Requirements:

3.9.1 Collar Joints:

3.9.1.1 Fill the vertical longitudinal joint between wythes solidly with mortar by parging the in place wythe and shoving units into the parging, for the following masonry work:

3.9.1.1.1 Exterior walls, except cavity walls.

3.9.1.1.2 Load-bearing interior walls and partitions where metal ties or horizontal reinforcing are specified for structural bonding.

3.9.2 Stopping and Resuming Work:

3.9.2.1 Rack back 1/2-CMU length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.

3.9.3 Built-In Work:

3.9.3.1 As the work progresses, build-in items specified under this and other Sections of these Specifications. Fill in solidly with masonry around built-in items.

3.9.3.1.1 Fill space between hollow metal frames and masonry solidly with mortar.

3.9.3.1.2 Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and red mortar or grout into core.

3.9.4 Non-Bearing Interior Partitions: Build full height of story to underside of structure above, unless otherwise shown.

3.9.4.1 Wedge non-bearing partitions against structure above with small pieces of tile, slate or metal and fill joint with mortar. Delay wedging and grouting until dead load deflection of structure above approaches final position.

3.9.5 Reinforcing:

3.9.5.1 Horizontal joint reinforcing:

3.9.5.1.1 Provide continuous horizontal joint reinforcing as shown and specified. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls and 1/2 inch at other locations. Lap reinforcement a minimum of 6 inches at ends of units. Do not bridge control and expansion joints with reinforcing except at wall openings.

3.9.5.1.2 Reinforce all walls with continuous horizontal joint reinforcing unless specifically noted or specified to be omitted.

3.9.5.1.3 Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

3.9.5.1.4 Space continuous horizontal reinforcing as follows:

3.9.5.1.4.1 For single wythe walls, space reinforcing at 16 inches O.C. vertically, unless otherwise shown.

3.9.5.1.4.2 Reinforce masonry openings greater than 1 foot wide, with horizontal joint placed in 2 horizontal joints approximately 8 inches apart, immediately above the lintel and immediately below the sill. Extend reinforcing a minimum of 2 feet beyond jambs of the opening, bridging control joints where provided.

3.9.5.1.5 Lap reinforcing min. 6 inches at splices.

3.9.5.2 Vertical reinforcing:

3.9.5.2.1 Install size and spacing as required by structural drawings.

3.9.6 Anchoring Masonry Work:

3.9.6.1 Provide anchoring devices of the type shown and as specified. If not shown or specified, provide standard type for facing and back-up involved.

3.9.6.2 Anchor masonry to structural members where masonry abuts or faces such members to comply with the following:

3.9.6.2.1 Provide an open space not less than ½ inch in width between masonry and structural member, unless otherwise shown. Keep open space free of mortar or other rigid materials.

3.9.6.2.2 Anchor masonry to structural members with metal ties embedded in masonry joints and attached to structure. Provide anchors with flexible tie sections, unless otherwise shown.

3.9.6.2.3 Space anchors as shown, but not more than 24 inches O.C. vertically and 36 inches O.C. horizontally.

3.9.6.3 Anchor single wythe masonry veneer to backing with metal ties as follows:

3.9.6.3.1 Anchor veneer to structural members with metal anchors embedded in masonry joints and attached to structure. Provide anchors with flexible tie section, unless otherwise shown.

3.9.7 Control and Expansion Joints:

3.9.7.1 Provide vertical expansion, control and isolation joints in masonry where shown. Build-in related items as the masonry work progresses. Rake out mortar in preparation for application of caulking and sealants.

3.9.7.2 Control joint spacing: If location of control joints are not shown, place vertical joints spaced not to exceed 50 feet O.C. for clay masonry or 35 feet O.C. for concrete masonry wythes if reinforced, or 30 feet O.C., if not reinforced. Locate control joints at points of natural weakness in the masonry work including the following:

3.9.7.2.1 At structural column or joint between bays.

3.9.7.2.2 Above expansion or control joints in the supporting structure.

3.9.7.2.3 Above major openings at end of lintels upward and below at ends of sills down ward place at one side of jamb for openings less than 6 feet wide and at both sides for openings over 6 feet wide.

3.9.7.2.4 At vertical chases, recesses and other points of reduction in wall thickness.

3.9.7.2.5 At locations where masonry wall height changes by more than 20 percent.

3.9.7.2.6 Where masonry abuts supporting structure.

3.9.7.2.7 At a distance equal to ½ the wall height from corners or intersections with other masonry.

3.9.8 Lintels:

3.9.8.1 Provide masonry lintels where shown and wherever openings of more than 12 inches are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels. Thoroughly cure precast lintels before handling and installation. Temporarily support formed-in-place lintels.

3.9.8.2 Unless otherwise shown, provide one horizontal reinforcing bar-top and bottom for each 4 inches or less of wall thickness, of size-number not less than the number of feet of opening width.

3.9.8.3 For hollow masonry unit walls, use specially formed U-shaped lintel units with reinforcing bars placed as shown, filled with Type M mortar or concrete grout.

3.9.8.4 Provide 8 inch min. bearing each end.

3.9.9 Reinforced Masonry:

3.9.9.1 All voids in masonry units containing reinforcing bars shall be completely filled with grout.

3.9.9.2 Fine grout shall be used to fill voids up to 4 inches wide. Coarse grout shall be used in wider voids.

3.9.9.3 Grouting shall be placed in maximum lifts of 4 feet in height.

3.9.9.4 Forms, or shoring where required, shall remain in place until masonry can carry own weight and construction loads; beams minimum 10 days, slabs minimum 7 days.

3.9.9.5 Reinforcing bars shall be placed accurately and secured to prevent displacement. Splices shall be sufficient to develop full tension in bars.

3.9.9.6 Grout spaces less than 2 inches wide shall be grouted in lifts not exceeding 8 inches.

3.9.10 Flashing of Masonry Work:

3.9.10.1 Provide flashings in masonry work where specified and where shown. Extend flashing to form continuous watertight installation.

3.9.10.2 Prepare masonry surfaces smooth and free from projections which might puncture flashing. Place through-wall flashing on bed of mortar and cover with mortar.

3.9.10.3 Extend flashings beyond edge of lintels and sills at least 4 inches. At ends of runs and at interruptions turn up edge on sides to form pan to direct moisture to exterior. At penetrations and interruptions, form turned up pan with extra pieces and seal flashing before covering with mortar.

3.9.10.4 Install membrane flashings in accordance with manufacturer's instructions and as specified.

3.9.10.5 Provide weep holes in the head joints of the first course of masonry immediately above concealed flashings. Space 24 inches O.C. unless otherwise shown.

3.10 Cleaning:

3.10.1 Progress work in as clean a manner as possible - remove excess materials, mortar droppings daily. Remove mortar droppings on connecting or adjoining work before final set. Keep edge of scaffolding boards 2 in. min. away from face of wall.

3.10.2 Remove and replace masonry units which are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

3.10.3 Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar.

3.10.4 Point-up all joints at corners, openings and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.

3.10.5 Final Cleaning: After mortar is thoroughly set and cured, clean sample wall area of approximately 20 sq. ft. as follows. Obtain Project Engineer's acceptance of sample cleaning before proceeding to clean rest of masonry work.

3.10.6 Dry clean to remove large particles of mortar using wood paddles and scrappers. Use chisel or wire brush if required.

3.10.7 Presoak wall by saturating with water and flush off loose mortar and dirt.

3.10.8 Scrub down wall with stiff fiber brush and a detergent as specified.

3.10.9 Rinse walls, using clean, pressurized water, to neutralize cleaning solution and remove loose material.

3.10.10 Acid cleaning of masonry will not be permitted.

End of Section

Section 051200
Structural Steel Framing

1 GENERAL

1.1 Summary

1.1.1 Section Includes:

1.1.1.1. Structural steel.

1.1.1.2. Shrinkage-resistant grout.

1.2 Definitions

1.2.1. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 Action Submittals

1.3.1. Product Data:

1.3.1.1. Shrinkage-resistant grout.

1.3.2. Shop Drawings: Show fabrication of structural-steel components.

1.4 Informational Submittals

1.4.1. Welding certificates.

1.4.2. Mill test reports for structural-steel materials, including chemical and physical properties.

1.4.3. Source quality-control reports.

1.4.4. Field quality-control reports.

1.5 Quality Assurance

1.5.1. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

1.5.2. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

1.5.3. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

2 PRODUCTS

2.1 Performance Requirements

2.1.1 Comply with applicable provisions of the following specifications and documents:

2.1.1.1 ANSI/AISC 303.

2.1.1.2 ANSI/AISC 360.

2.1.1.3 RCSC's "Specification for Structural Joints Using High-Strength Bolts."

2.1.2 Connection Design Information:

2.1.2.1 Connection designs have been completed and connections indicated on the Drawings.

2.1.3 Moment Connections: Type PR, partially restrained.

2.1.4 Construction: Combined system of moment frame and braced frame.

2.2 Structural-Steel Materials

2.2.1 W-Shapes: ASTM A992/A992M, Grade 50].

2.2.2 Channels, Angles: ASTM A36/A36M.

2.2.3 Plate and Bar: ASTM A36/A36M.

2.2.4 Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.

2.2.5 Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

2.2.6 Welding Electrodes: Comply with AWS requirements.

2.3 Bolts And Connectors

2.3.1 High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

2.3.2 Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 Rods

2.4.1 Unheaded Anchor Rods: ASTM F1554, Grade 55, weldable.

2.4.2.1 Configuration: Straight.

2.4.2.2 Finish: Plain.

2.4.2 Headed Anchor Rods: ASTM F1554, Grade 55, weldable, straight.

2.4.2.1 Finish: Plain.

2.4.3 Threaded Rods: ASTM A36/A36M.

2.4.3.1 Finish: Plain.

2.5 Primer

2.5.1 Steel Primer:

2.5.1.1 Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.6 Shrinkage-Resistant Grout

2.6.1 Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

2.6.2 Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 Fabrication

2.7.1 Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

2.8 Shop Connections

2.8.1 High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

2.8.1.1 Joint Type: Snug tightened.

2.8.2 Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.9 Shop Priming

2.9.1 Shop prime steel surfaces, except the following:

2.9.1.1 Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.

2.9.1.2 Surfaces to be field welded.

2.9.1.3 Surfaces of high-strength bolted, slip-critical connections.

2.9.2 Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

2.9.2.1 SSPC-SP 2.

2.9.2.2 SSPC-SP 3.

2.9.3 Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.10 Source Quality Control

2.10.1 Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

2.10.1.1 Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

2.10.1.2 Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

2.10.1.3 Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

2.10.1.3.1 Liquid Penetrant Inspection: ASTM E165/E165M.

2.10.1.3.2 Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.

2.10.1.3.3 Ultrasonic Inspection: ASTM E164.

2.10.1.3.4 Radiographic Inspection: ASTM E94/E94M.

2.10.1.4 In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M.

2.10.1.5 Prepare test and inspection reports.

3 EXECUTION

3.1 Examination

3.1.1 Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Erection

3.2.1 Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

3.2.2 Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

3.2.2.1 Set plates for structural members on wedges, shims, or setting nuts as required.

3.2.2.2 Weld plate washers to top of baseplate.

3.2.2.3 Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.

3.2.2.4 Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation

instructions for grouting.

3.2.3 Maintain erection tolerances of structural steel within ANSI/AISC 303.

3.3 Field Connections

3.3.1 High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

3.3.1.1 Joint Type: Snug tightened.

3.3.2 Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

3.3.1.2 Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 Field Quality Control

3.4.1 Special Inspections: Owner will engage a special inspector to perform the following special inspections:

3.4.1.1 Verify structural-steel materials and inspect steel frame joint details.

3.4.1.2 Verify weld materials and inspect welds.

3.4.1.3 Verify connection materials and inspect high-strength bolted connections.

3.4.2 Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

3.4.2.1 Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

3.4.2.2 Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

3.4.2.2.1 In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

3.4.2.2.1.1 Liquid Penetrant Inspection: ASTM E165/E165M.

3.4.2.2.1.2 Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld.

Cracks or zones of incomplete fusion or penetration are not accepted.

3.4.2.2.1.3 Ultrasonic Inspection: ASTM E164.

3.4.2.2.1.4 Radiographic Inspection: ASTM E94/E94M.

End Of Section 051200

Section 053100
Steel Decking

1 GENERAL

1.1 Summary

1.1.1 Section Includes:

1.1.1.1 Composite floor deck.

1.2 Action Submittals

1.2.1 Product Data:

1.2.1.1 Composite floor deck.

1.2.2 Shop Drawings:

1.2.2.1 Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 Informational Submittals

1.3.1 Certificates:

1.3.1.1 Welding certificates.

1.3.1.2 Product Certificates: For each type of steel deck.

1.3.2 Test and Evaluation Reports:

1.3.2.1 Product Test Reports: For tests performed by a qualified testing agency, indicating that power-actuated mechanical fasteners comply with requirements.

1.3.2.2 Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

1.3.3 Field Quality-Control Submittals:

1.3.1.1 Field quality-control reports.

1.3.4 Qualification Statements: For welding personnel.

1.4 Quality Assurance

1.4.1 Qualifications:

1.4.1.1 Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding code:

1.4.1.1.1 AWS D1.3/D1.3M.

1.5 Delivery, Storage, and Handling

1.5.1 Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

2 PRODUCTS

2.1 Performance Requirements

2.1.1 AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

2.2 Composite Floor Deck

2.2.1 Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:

2.2.1.1 Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, G90 zinc coating.

2.2.1.2 Profile Depth: 1-1/2 inches.

2.2.1.3 Design Uncoated-Steel Thickness: 0.0358 inch.

2.2.1.4 Span Condition: Simple span.

2.3 Accessories

2.3.1 Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

2.3.2 Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

2.3.3 Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

2.3.4 Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

2.3.5 Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

2.3.6 Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI standards for overhang and slab depth.

2.3.6 Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

2.3.7 Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

3 EXECUTION

3.1 Installation General

3.1.1 Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.

3.1.2 Install temporary shoring before placing deck panels if required to meet deflection limitations.

3.1.3 Locate deck bundles to prevent overloading of supporting members.

3.1.4 Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

3.1.5 Place deck panels flat and square and fasten to supporting frame without warp or deflection.

3.1.6 Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

3.1.7 Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

3.1.8 Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

3.1.9 Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

3.2 Installation of Floor Deck

3.2.1 Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

3.2.1.1 Weld Diameter: 5/8 inch, nominal.

3.2.1.2 Weld Spacing:

3.2.1.2.1 Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.

3.2.1.2.2 Space and locate welds as indicated.

3.2.2 Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:

3.2.2.1 Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

3.2.3 End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches with end joints as follows:

3.2.3.1 End Joints: Lapped.

3.2.4 Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.

3.2.5 Floor Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.3 Repair

3.3.1 Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

3.4 Field Quality Control

3.4.1 Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

3.4.2 Tests and Inspections:

3.4.2.1 Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.

3.4.2.1.1 Field welds will be subject to inspection.

3.4.2.2 Steel decking will be considered defective if it does not pass tests and inspections.

3.4.3 Prepare test and inspection reports.

End Of Section

Section 054000
Cold-Formed Metal Framing

1 GENERAL

1.1 Summary

1.1.1. Section Includes:

1.1.1.1. Load-bearing wall framing.

1.1.1.2. Exterior non-load-bearing wall framing.

1.1.1.3. Interior non-load-bearing wall framing, for framing that exceeds the height limitations of standard, nonstructural metal framing.

1.1.1.4. Floor joist framing.

1.1.1.5. Roof rafter framing.

1.1.1.6. Ceiling joist framing.

1.1.1.7. Soffit framing.

1.2 Action Submittals

1.2.1. Product Data: For the following:

1.2.1.1. Cold-formed steel framing materials.

1.2.1.2. Load-bearing wall framing.

1.2.1.3. Exterior non-load-bearing wall framing.

1.2.1.4. Interior non-load-bearing wall framing.

1.2.1.5. Vertical deflection clips.

1.2.1.6. Single deflection track.

1.2.1.7. Double deflection track.

1.2.1.8. Drift clips.

1.2.1.9. Floor joist framing.

1.2.1.10. Roof-rafter framing.

1.2.1.11. Ceiling joist framing.

1.2.1.12. Soffit framing.

1.2.1.13. Post-installed anchors.

1.2.1.14. Power-actuated anchors.

1.2.1.15. Sill sealer gasket.

1.2.1.16. Sill sealer gasket/termite barrier.

1.2.2. Sustainable Design Submittals:

1.2.2.1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.2.2.2. Environmental Product Declaration (EPD): For each product.

1.2.2.3. Health Product Declaration (HPD): For each product.

1.2.2.4. Construction and Demolition Waste Management Planning: Develop and implement a construction and demolition waste management plan.

1.2.3. Shop Drawings:

1.2.3.1. Provide Shop Drawings prepared by cold-formed steel framing manufacturer.

1.2.3.2. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.

1.2.3.3. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.2.3.4. Delegated Design Submittal: For cold-formed steel framing.

1.3 Informational Submittals

1.3.1. Qualification Data: For testing agency.

1.3.2. Welding certificates.

1.3.3. Product Certificates: For each type of code-compliance certification for studs and tracks.

1.3.4. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1.3.4.1. Steel sheet.

1.3.4.2. Expansion anchors.

1.3.4.3. Power-actuated anchors.

1.3.4.4. Mechanical fasteners.

1.3.4.5. Vertical deflection clips.

1.3.4.6. Horizontal drift deflection clips

1.3.4.7. Miscellaneous structural clips and accessories.

1.3.5. Research Reports:

1.3.5.1. For cold-formed steel framing.

1.3.5.2. Steel framing manufacturer to have a third-party evaluation report for its products that are reviewed to the local building code or its model code (IBC 2015 and AISI S100).

1.3.5.3. For sill sealer gasket/termite barrier, showing compliance with ICC-ES AC380.

1.4 Quality Assurance

1.4.1. Manufacturer Qualifications: Member in good standing of the Steel Framing Industry Association (SFIA).

1.4.1.1. Products to be certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS Accreditation Criteria for Inspection Agencies.

1.4.2. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

1.4.3. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the Commonwealth of Virginia and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed steel framing that are similar to those indicated for this Project in material, design, and extent.

1.4.4. Testing Agency Qualifications: Qualified in accordance with ASTM E329 for testing indicated.

1.4.5. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment, indicating steel sheet

complies with requirements, including base-steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

1.4.6. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified in accordance with the product-certification program of the SFIA.

1.4.7. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1.4.7.1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.4.7.2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.4.8. Fire-Test-Response Characteristics: Where indicated, provide cold-formed steel framing identical to that of assemblies tested for fire resistance per ASTM E119 by, and displaying a classification label from, a testing and inspecting agency acceptable to authorities having jurisdiction.

1.4.9. Comply with the following AISI specifications and standards:

1.4.9.1. AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members."

1.4.9.2. AISI S200, "North American Standard for Cold-Formed Steel Framing - General Provisions."

1.4.9.3. AISI S201, "North American Standard for Cold-Formed Steel Framing - Product Standard."

1.4.9.4. AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

1.4.9.5. AISI S240, "North American Standard for Cold-Formed Steel Structural Framing."

1.5 Delivery, Storage, and Handling

1.5.1. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

2 PRODUCTS

2.1 Manufacturers

2.1.1. Basis-of-Design Product: Subject to compliance with requirements, provide cold-formed steel framing products by ClarkDietrich; as specified in other Part 2 articles or comparable product by one of the following current members of the SFIA:

2.1.1.1. CEMCO; California Expanded Metal Products Co.

2.1.1.2. Telling Industries.

2.2 Performance Requirements

2.2.1. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 - Quality Requirements to design cold-formed steel framing.

2.2.2. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

2.2.2.1. Design Loads:

2.2.2.1.1. Dead Loads: refer to Structural Engineering documents

2.2.2.1.2. Live Loads: refer to Structural Engineering documents

2.2.2.1.3. Seismic Loads: refer to Structural Engineering documents

2.2.2.1.4. Building Code Requirements: VUSBC 2015

2.2.2.2. Deflection Limits: Design framing systems to withstand without deflections greater than the following:

2.2.2.2.1. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).

2.2.2.3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).

2.2.2.4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

2.2.2.4.1. Upward and downward movement of 3/4 inch (19 mm) or as referenced in Structural Engineering documents

2.2.2.5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

2.2.3. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, ASTM C955, AISI S200, ASTM C955 and Section 8 AISI S240.

2.2.4. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2.4.1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 Cold-Formed Steel Framing Materials

2.3.1. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.3.2. Framing Members, General: Comply with ASTM C955, AISI S200 and ASTM C955, Section 8 AISI S240 for conditions indicated.

2.3.3. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

2.3.3.1. Grade: ST33H (ST230H) / ST50H (ST340H) As required by structural performance.

2.3.3.1.1. Coating: as indicated on Drawings or refer to Structural Engineering documents.

2.3.4. Steel Sheet for Vertical Deflection Clips: ASTM A1003/A1003M, ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

2.3.4.1. Grade: As required by structural performance.

2.3.4.2. Coating: G-60 Galvanized finish.

2.4 Interior Non-Load-Bearing Wall Framing

2.4.1. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

2.4.1.1. Minimum Base-Steel Thickness: 0.0428 inch (1.09 mm) or as specified by Structural Engineering documents

2.4.1.2. Minimum Flange Width: 1-5/8 inches (41 mm) or as specified by Structural Engineering documents

2.4.1.3. Section Properties: as specified by Structural Engineering documents for minimum allowable calculated section modulus, moment of inertia, and allowable moment

2.4.2. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

2.4.2.1. Minimum Base-Steel Thickness: 0.0428 inch (1.09 mm) or as specified by Structural Engineering documents. At minimum, Matching steel studs.

2.4.2.2. Flange Width: 1-1/4 inches (32 mm)

2.4.3. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

2.4.3.1. Basis-of-Design Product: Subject to compliance with requirements, equal to ClarkDietrich; Fast Top Clip (FTC) or comparable product by one of the current members of the SFIA.

2.4.4. Deflection Track and Firestop Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thicknesses not less than indicated for studs and in width to accommodate depth of studs.

2.4.4.1. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich; BlazeFrame Deflection Track or comparable product by one of current members of the SFIA.

2.4.4.2. Minimum Base-Steel Thickness: 0.0538 inch (1.37 mm) or as specified by Structural Engineering documents

2.4.4.3. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications or as specified by Structural Engineering documents.

2.4.5. Slotted Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; punched with vertical slots in both legs. Studs should be positively attached to deep-leg track using vertical slots while allowing free vertical movement. Legs designed to support horizontal and lateral loads and transfer them to the primary structure, as follows:

2.4.5.1. Basis-of-Design Product: Subject to compliance with requirements, equal to ClarkDietrich; BlazeFrame DSL MaxTrak Slotted Deflection Track or comparable product.

2.4.5.2. Standard Leg: 2-1/2 inches (63.5 mm).

2.4.5.3. Standard Vertical Slot in Leg: 1-1/2 inches (38.1 mm).

2.4.5.4. Minimum Base Steel Thickness: 0.0428 inch (1.09 mm) or as specified by Structural Engineering documents

2.4.6. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure. Install a continuous row of bridging, composed of 1-1/2-inch (38-mm) cold-formed channel secured to each stud with clip angle, or bridging, or spacer bar, at upper-most knockout, not more than 12 inches (305 mm) from top of wall.

2.4.6.1. Basis-of-Design Product: Subject to compliance with requirements, equal to ClarkDietrich; BlazeFrame DL Deflection Track or comparable product

2.4.6.2. Minimum Base-Steel Thickness: 0.0428 inch (1.09 mm) or as specified by Structural Engineering documents

2.4.6.3. Flange Width: 2 inches (51 mm).

2.4.7. U-Channel Assembly: Manufacturer's standard length U-channel for lateral bracing for high interior partitions constructed of structural studs.

2.4.7.1. Basis-of-Design Product: Subject to compliance with requirements, equal to ClarkDietrich; U-Channel and FastBridge Clip FB43, FB68 or comparable product.

2.4.7.2. U-Channel Size: 1-1/2 inches (38.1 mm).

2.4.7.3. U-Channel Minimum Base-Steel Thickness: 0.0538 inch (1.37 mm).

2.4.8. Bridging and Spacer Bar:

2.4.8.1. Basis-of-Design Product: Subject to compliance with requirements, equal to ClarkDietrich; TradeReady Spazzer 5400 (SPZS) Spazzer Bar Guard (SPBG) or comparable product.

2.4.8.2. Minimum Base-Steel Thickness: 0.0538 inch (1.37 mm).

2.4.8.3. Size: 1-1/4 by 1-1/4 by 50 inches (32 by 32 by 1270 mm) long, pre-notched at 12, 16, and 24 inches (305, 406, and 610 mm) o.c.

2.4.9. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

2.4.9.1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

2.4.9.1.1. Minimum Base-Steel Thickness: 0.0329 inch (0.84 mm) or as specified by Structural Engineering documents.

2.4.9.1.2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications or as specified by Structural Engineering documents.

2.4.9.2. Inner Track: Of web depth indicated, and as follows:

2.4.9.2.1. Minimum Base-Steel Thickness: 0.0428 inch (1.09 mm) or as specified by Structural Engineering documents

2.4.9.2.2. Flange Width: dimension equal to sum of outer deflection track flange width plus 1 inch (25 mm) or as specified by Structural Engineering documents.

2.5 Soffit Framing

2.5.1. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

2.5.1.1. Minimum Base-Steel Thickness: 0.0329 inch (0.84 mm) or as specified by Structural Engineering documents.

2.5.1.2. Minimum Flange Width: 1-5/8 inches (41 mm) or as specified by Structural Engineering documents.

2.5.1.3. Section Properties: Minimum allowable calculated section modulus, moment of inertia, and allowable moment or as specified by Structural Engineering documents.

2.6 Framing Accessories

2.6.1. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

2.6.2. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

2.6.2.1. Supplementary framing.

2.6.2.2. Bracing, Bridging, and Solid Blocking:

2.6.2.2.1. Basis-of-Design Product: Subject to compliance with requirements, equal to ClarkDietrich; Spazzer 5400 Bridging Bar (SPZS) or Spazzer Bar Guard (SPBG)] or comparable product or as specified by Structural Engineering documents.

2.6.2.3. Web Stiffeners:

2.6.2.3.1. Basis-of-Design Product: Subject to compliance with requirements, equal to ClarkDietrich; Quick Twist Web Stiffener (QTWS) or comparable product or as specified by Structural Engineering documents.

2.6.2.4. Anchor Clips:

2.6.2.4.1. Basis-of-Design Product: Subject to compliance with requirements, equal to ClarkDietrich; Holdown (CD Series) Moment Clip (MC Series) or comparable product or as specified by Structural Engineering documents.

2.6.2.5. End clips.

2.6.2.6. Foundation Clips:

2.6.2.6.1. Basis-of-Design Product: Subject to compliance with requirements, equal to ClarkDietrich; Pony Wall PW24, PW36, PW48 or comparable product.

2.6.2.7. Gusset plates.

2.6.2.8. Stud kickers and knee braces.

2.6.2.9. Joist Hangers and End Closures:

2.6.2.9.1. Basis-of-Design Product: Subject to compliance with requirements, equal to ClarkDietrich; Universal Joist Hanger (UJH) or comparable product.

2.6.2.10. Hole-reinforcing plates.

2.6.2.11. Backer plates.

2.7 Anchors, Clips, and Fasteners

2.7.1. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process in accordance with ASTM A123/A123M.

2.7.2. Anchor Bolts: ASTM F1554, Grade 55, threaded carbon-steel (hex-headed bolts, headless, hooked bolts, headless bolts, with encased end threaded, or as specified by

Structural Engineering documents, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process in accordance with ASTM A153/A153M, Class C mechanically deposition in accordance with ASTM B695, Class 50.

2.7.3. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.

2.7.3.1. Uses: Securing cold-formed steel framing to structure.

2.7.3.2. Type: Torque-controlled expansion anchor, torque-controlled adhesive anchor, adhesive anchor or as specified by Structural Engineering documents.

2.7.3.3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.

2.7.3.4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1), Group 2 (A4) stainless steel bolts, ASTM F593, and nuts, ASTM F594 (ASTM F836M).

2.7.4. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

2.7.5. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

2.7.5.1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

2.7.6. Welding Electrodes: Comply with AWS standards.

2.8 Miscellaneous Materials

2.8.1. Galvanizing Repair Paint: ASTM A780/A780M MIL-P-21035B or SSPC-Paint 20.

2.8.2. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

2.8.3. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

2.8.4. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

2.8.5. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.8.6. Sill Sealer Gasket/Termite Barrier: Minimum 68 mil (1.7 mm) nominal thickness, self-adhering sheet consisting of 64 mils (1.6 mm) of rubberized asphalt laminated on one side to a 4 mil (0.10 mm) 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.

2.8.6.1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2.8.6.1.1. Polyguard Products, Inc.

2.8.6.2. Physical Properties:

2.8.6.2.1. Peel Adhesion: 17.0 lb/in of width (2.9 N/mm of width) when tested in accordance with ASTM D412.

2.8.6.2.2. Low-Temperature Flexibility: Pass at minus 25 deg F (minus 32 deg C) when tested in accordance with ASTM D146/D146M.

2.8.6.2.3. Water Vapor Permeance: 0.05 perm (0.44 ng/Pa x s x sq. m) maximum when tested in accordance with ASTM E96/E96M, Method B.

2.8.6.2.4. Resistance to Termite Penetration: Comply with ICC-ES AC380.

2.9 Fabrication

2.9.1. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, in accordance with referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

2.9.1.1. Fabricate framing assemblies using jigs or templates.

2.9.1.2. Cut framing members by sawing or shearing; do not torch cut.

2.9.1.3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

2.9.1.3.1. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

2.9.1.3.2. Locate mechanical fasteners and install in accordance with Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

2.9.1.4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, in accordance with shop drawings.

2.9.2. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

2.9.3. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:

2.9.3.1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

2.9.3.2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

3 EXECUTION

3.1 Examination

3.1.1. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

3.1.2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

3.2.1. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

3.2.2. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

3.2.3. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

3.2.4. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.2.5. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 Installation, General

3.3.1. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

3.3.2. Install cold-formed steel framing in accordance with ASTM C1007, AISI S240, and manufacturer's written instructions unless more stringent requirements are indicated.

3.3.3. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

3.3.3.1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

3.3.4. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

3.3.4.1. Cut framing members by sawing or shearing; do not torch cut.

3.3.4.2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

3.3.4.2.1. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

3.3.4.2.2. Locate mechanical fasteners, install in accordance with Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

3.3.5. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

3.3.6. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

3.3.7. Include details on Drawings indicating expansion-joint construction and locations.

3.3.8. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

3.3.9. Retain first paragraph below if insulation within framing assemblies is required.

3.3.10. Install insulation, specified in Section 072100 - Building Insulation, in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

3.3.11. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 Installation of Interior Non-Load-Bearing Wall Framing

3.4.1. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

3.4.2. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

3.4.2.1. Stud Spacing: 16 inches O.C.

3.4.3. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

3.4.4. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

3.4.4.1. Install single deep-leg deflection tracks and anchor to building structure.

3.4.4.2. Install double deep-leg deflection tracks and anchor outer track to building structure.

3.4.4.3. Connect vertical deflection clips to studs and anchor to building structure.

3.4.4.4. Connect drift clips to cold-formed steel framing and anchor to building structure.

3.4.5. Install horizontal bridging in wall studs, spaced vertically in rows indicated on shop drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

3.4.5.1. Channel Bridging: Cold-formed steel channel, welded or mechanically fastened to webs of punched studs.

3.4.5.2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

3.4.5.3. Bar Bridging: Proprietary bridging bars installed in accordance with manufacturer's written instructions.

3.4.6. Top Bridging for Single Deflection Track: Install according to approved shop drawing submittals.

3.4.7. Install solid blocking according to approved shop drawing submittals.

3.4.8. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

End of Section

Section 055313
Bar Gratings

1 GENERAL

1.1 Summary

1.1.1 Section Includes:

1.1.1.1 Metal bar gratings.

1.1.1.2 Metal bar grating stair treads.

1.2 Action Submittals

1.2.1 Product Data: For each type of product.

1.2.2 Shop Drawings: Include plans, sections, and attachment details.

1.3 Informational Submittals

1.3.1 Informational Certificates:

1.3.1.1 Welding certificates

1.3.1.2 Delegated design engineer qualifications.

1.4 Quality Assurance

1.4.1 Qualifications:

1.4.1.1 Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1.4.1.1.1 AWS D1.2/D1.2M

2 PRODUCTS

2.1 Manufactures

2.1.1 Manufacturers: Subject to compliance with requirements, provide products by the following:

2.1.1.1 Ohio Gratings, Inc.

2.2 Performance Requirements

2.2.1 Structural Performance: Gratings to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

2.2.1.1 Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft.

2.2.1.2 Limit deflection to L/360 or 1/4 inch, whichever is less.

2.3 Metal Bar Gratings

2.3.1 Metal Bar Grating Standards: Comply with NAAMM MBG 531.

2.3.2 Pressure-Locked, Aluminum I-Bar Grating: Fabricated by swaging crossbars between bearing bars.

2.3.2.1 Bearing Bar Spacing: 11/16 inch o.c.

2.3.2.2 Bearing Bar Depth: 1-1/2 inches.

2.3.2.3 Bearing Bar Flange Width: 1/4 inch.

2.3.2.4 Crossbar Spacing: 4 inches o.c.

2.3.2.5 Traffic Surface: Striated.

2.3.2.6 Aluminum Finish: Mill finish.

2.3.3 Grating Stair Treads fabricated from Pressure-Locked, Aluminum I-Bar Grating: Fabricated by swaging crossbars between bearing bars.

2.3.3.1 Bearing Bar Spacing: 11/16 inch o.c.

2.3.3.2 Bearing Bar Depth: 1-3/4 inches.

2.3.3.3 Bearing Bar Flange Width: 1/4 inch.

2.3.3.4 Crossbar Spacing: 4 inches o.c.

2.3.3.5 Traffic Surface: Striated.

2.3.3.6 Nosings: Grooved

2.3.3.7 Risers: Closed.

2.3.3.8 Aluminum Finish: Mill finish.

2.4 Fasteners

2.4.1 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.

2.4.1.1 Provide stainless steel fasteners for fastening aluminum

2.5 Aluminum

2.5.1 General: Provide alloy and temper recommended by aluminum producer for type of use indicated, with not less than the strength and durability properties of alloy, and temper designated below for each aluminum form required.

2.5.2 Extruded Bars and Shapes: ASTM B221, alloys as follows:

2.5.2.1 Alloy 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.

2.5.2.2 Alloy 6061-T1, for grating crossbars.

2.5.3 Aluminum Sheet: ASTM B209, Alloy 5052-H32.

2.6 Fabrication

2.6.1 Cut, drill, and punch material 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.

2.6.2 Fit exposed connections accurately together to form hairline joints.

3 EXECUTION

3.1 Installation, General

3.1.1 Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

3.1.2 Fit exposed connections accurately together to form hairline joints.

3.1.3 Corrosion Protection: With a heavy coat of bituminous paint, coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals

3.2 Installation of Metal Bar Gratings

3.2.1 Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

3.2.2 Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for

type of installation conditions shown.

3.2.3 Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

End of Section

Section 057300
Decorative Metal Railings

1 GENERAL

1.1 Summary

1.1.1 Section Includes:

1.1.1.1 Aluminum decorative railings.

1.2 Action Submittals

1.2.1 Product Data:

1.2.1.1 Manufacturer's product lines of decorative metal railings assembled from standard components.

1.2.1.2 Handrail brackets.

1.2.1.3 Metal finishes.

1.2.2 Shop Drawings: Include plans, elevations, sections, and attachment details.

1.2.3 Samples: For each type of exposed finish required.

1.2.4 Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 Informational Submittals

1.3.1 Qualification Data: For delegated-design professional engineer.

1.3.2 Welding certificates.

1.3.3 Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

1.3.4 Preconstruction test reports.

1.4 Quality Assurance

1.4.1 Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1.4.1.1 AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

2 PRODUCTS

2.1 Performance Requirements

2.1.1 Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

2.1.2 Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

2.1.2.1 Handrails and Top Rails of Guards:

2.1.2.1.1 Uniform load of 50 lbf/ft. applied in any direction.

2.1.2.1.2 Concentrated load of 200 lbf applied in any direction.

2.1.2.1.3 Uniform and concentrated loads need not be assumed to act concurrently.

2.1.2.2 Infill of Guards:

2.1.2.2.1 Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.

2.1.2.2.2 Infill load and other loads need not be assumed to act concurrently.

2.2 Metals, General

2.2.1 Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.2.2 Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.3 Aluminum Decorative Railings

2.3.1 Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

2.3.2 Extruded Bars and Shapes, Including Extruded Tubing: ASTM B221, Alloy 6063-T5/T52.

2.3.3 Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.

2.3.4 Plate and Sheet: ASTM B209, Alloy 6061-T6.

2.3.5 Die and Hand Forgings: ASTM B247, Alloy 6061-T6.

2.4 Fasteners

2.4.1 Fastener Materials:

2.4.1.1 Aluminum Railing Components: Type 304 stainless steel fasteners.

2.5 Miscellaneous Materials

2.5.1 Handrail Brackets: Cast-aluminum center of handrail 2-1/2 inches from face of railing or wall.

2.5.2 Welding Rods and B are Electrodes: Select according to AWS specifications for Metal alloy welded.

2.5.2.1 For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

2.5.3 Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 Fabrication

2.6.1 Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

2.6.2 Connections: Fabricate railings with welded or mechanical connections unless otherwise indicated.

2.6.3 Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

2.6.3.1 At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.

2.6.4 Form changes in direction as follows:

2.6.4.1 By bending or by inserting prefabricated elbow fittings.

2.6.5 Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

2.6.6 Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

2.6.7 Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch or less.

2.6.8 Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

2.7 Aluminum finishes

2.7.1 Finish: Smooth Mill Finish

3 EXECUTION

3.1 Installation General

3.1.1 Perform cutting, drilling, and fitting required for installing railings.

3.1.1.1 Fit exposed connections together to form tight, hairline joints.

3.1.1.2 Install railings level, plumb, square, true to line; without distortion, warp, or rack.

3.1.1.3 Set railings accurately in location, alignment, and elevation; measured from established lines and levels.

3.1.1.4 Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

3.1.1.5 Set posts plumb within a tolerance of 1/16 inch in 3 feet.

3.1.1.6 Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

3.1.2 Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

3.1.2.1 Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 Anchoring Posts

3.2.1 Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

3.3 Attaching Railings

3.3.1 Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

3.3.2 Secure wall brackets and railing end flanges to building construction as follows:

3.3.2.1 For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

3.3.2.2 For hollow masonry anchorage, use toggle bolts.

3.3.2.3 For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

3.3.2.4 For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.

3.3.2.5 For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.3.3 Touchup Painting:

3.3.3.1 Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

3.4 Cleaning

3.4.1 Clean aluminum by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

End of Section

Section 06160
Sheathing

1 GENERAL

1.1 Section Requirements

1.1.1 Submittals: ICC-ES evaluation reports for preservative-treated plywood fire-retardant-treated plywood.

2 PRODUCTS

2.1 Wood Panel Products, General

2.1.1 Plywood: DOC PS 1.

2.1.2 Oriented Strand Board: DOC PS 2.

2.2 Treated Plywood

2.2.1 Preservative-Treated Plywood: AWPA C9.

2.2.1.1 Use treatment containing no arsenic or chromium.

2.2.1.2 Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

2.2.2 Provide preservative-treated plywood for items indicated on Drawings and plywood in contact with masonry or concrete or used with flashing, vapor barriers, and waterproofing.

2.2.3 Fire-Retardant-Treated Plywood: Comply with performance requirements in AWPA C27, labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.

2.2.3.1 Use Exterior type for exterior locations and where indicated.

2.2.3.2 Use Interior Type A, High Temperature (HT) for roof sheathing and where indicated.

2.2.3.3 Use Interior Type A unless otherwise indicated.

2.2.3.4 Identify with appropriate classification marking of a testing and inspecting agency acceptable to authorities having jurisdiction.

2.3 Wall Sheathing

2.3.1 Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.

2.4 Roof Sheathing

2.4.1 Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural I sheathing size as indicated.

2.5 Wall Sheathing – on cold form studs: GP Densglass fireguard, 5/8” thickness

2.6 Miscellaneous Products

2.6.1 Fasteners: Size and type indicated.

2.6.1.1 For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.

2.6.1.2 Power-Driven Fasteners: CABO NER-272.

2.6.2 Adhesives for Field Gluing Panels to Framing: APA AFG-01.

3 EXECUTION

3.1 Installation

3.1.1 Securely attach to substrates, complying with the following:

3.1.1.1 CABO NER-272 for power-driven fasteners.

3.1.1.2 Table 2304.9.1, "Fastening Schedule," in the IBC; unless otherwise indicated.

3.1.2 Fastening Methods:

3.1.2.1 Wall and Roof Sheathing:

3.1.2.1.1 Nail to wood framing.

End of Section

Section 06200
Finish Carpentry

1 GENERAL

1.1 Section Requirements

1.1.1 Submittals: Samples for hardwood veneer.

2 PRODUCTS

2.1 Materials

2.1.1 Lumber: DOC PS 20 and grading rules of inspection agencies certified by American Lumber Standards Committee Board of Review.

2.1.1.1 Softwood Plywood: DOC PS 1.

2.1.1.2 Hardwood Plywood: HPVA HP-1.

2.1.2 MDF: ANSI A208.2, Grade 130, made with binder containing no urea-formaldehyde resin.

2.1.3 Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea-formaldehyde resin.

2.1.4 Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

2.2 Delivery, Storage, and Handling

2.2.1 Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

2.2.2 Storage: Store materials in accordance with manufacturer's instructions.

2.2.3 Indoor Storage: Store materials flat.

2.2.4 Outdoor Storage: Store materials under cover, protected from weather, off ground, and on flat base.

2.2.5 Keep materials dry.

2.2.6 Handling: Protect materials during handling and installation to prevent damage.

2.3 Interior Standing and Running Trim

2.3.1 Interior Softwood Lumber Trim: Clear Poplar or fir

2.3.1.1 Maximum Moisture Content: 15 percent.

2.3.2 Interior Hardwood Lumber Trim: Clear, kiln-dried oak or white maple as selected by the Owner.

3 EXECUTION

3.1 Installation

3.1.1 Condition finish carpentry in installation areas for 24 hours before installing.

3.1.2 Prime and back prime lumber for painted finish exposed on the exterior. Prime cut ends.

3.1.3 Finish coating: Finish trim with two coats of paint within 90 days after installation. If the material is not painted within 90 days, reprime the trim using an exterior primer that is recommended for wood product and is compatible with the topcoat to be used. Use the same primer for repair of any damage to the original factory applied primer. A total field-applied dry film paint thickness of a minimum of 2-1/2 mils is required.

3.1.4 Install finish carpentry level, plumb, true, and aligned with adjacent materials. Scribe and cut to fit adjoining work. Refinish and seal cuts.

3.1.5 Install standing and running trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Stagger joints in adjacent and related trim. Cope at returns and miter at corners.

3.1.6 Select and arrange paneling for best match of adjacent units. Install with uniform tight joints.

End of Section

Section 061000
Rough Carpentry

1 GENERAL

1.1 Summary

1.1.1 This Section includes the following:

1.1.1.1 Framing with dimension lumber.

1.1.1.2 Framing with engineered wood products.

1.1.1.3 Rooftop equipment bases and support curbs.

1.1.1.4 Wood blocking, cants, and nailers.

1.1.1.5 Wood furring and grounds.

1.1.1.6 Wood sleepers.

1.1.1.7 Utility shelving.

1.1.1.8 Plywood backing panels.

1.2 Definitions

1.2.1 Exposed Framing: Framing not concealed by other construction.

1.2.2 Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

1.2.3 Lumber grading agencies, and the abbreviations used to reference them, include the following:

1.2.3.1 NeLMA: Northeastern Lumber Manufacturers' Association.

1.2.3.2 NLGA: National Lumber Grades Authority.

1.2.3.3 SPIB: The Southern Pine Inspection Bureau.

1.3 Submittals

1.3.1 Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.3.1.1 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.

1.3.1.2 For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.3.1.3 Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.3.2 Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.3.3 Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

1.3.4 Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1.3.4.1 Wood-preservative-treated wood.

1.3.4.2 Engineered wood products.

1.3.4.3 Power-driven fasteners.

1.3.4.4 Powder-actuated fasteners.

1.3.4.5 Expansion anchors.

1.3.4.6 Metal framing anchors.

1.4 Quality Assurance

1.4.1 Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.

1.5 Delivery, Storage, And Handling

1.5.1 Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

2 PRODUCTS

2.1. Wood Products, General

2.1.1 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.

2.1.1.1 Factory mark each piece of lumber with grade stamp of grading agency.

2.1.1.2 For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece In DOC PS 20, dressed sizes of green lumber are larger than dry lumber.

2.1.1.3 Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

2.1.1.4 Provide dressed lumber, S4S, unless otherwise indicated.

2.1.2 Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

2.1.2.1 Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2. Wood-Preservative-Treated Lumber

2.2.1 Preservative Treatment by Pressure Process: AWPA C2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

2.2.1.1 Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

2.2.1.2 For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

2.2.2 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.

2.2.3 Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

2.2.3.1 For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

2.2.4 Application: Treat items indicated on Drawings, and the following:

2.2.4.1 Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2.2.4.2 Wood sills, sleepers, blocking and similar concealed members in contact with masonry or concrete.

2.2.4.3 Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.

2.2.4.4 Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.

2.2.4.5 Wood floor plates that are installed over concrete slabs-on-grade.

2.3. Dimension Lumber Framing

2.3.1 Maximum Moisture Content: 19 percent.

2.3.2 Non-Load-Bearing Interior Partitions and ceiling joists: Construction or No. 2 grade any of the following species:

2.3.2.1 Mixed southern pine; SPIB.

2.3.2.2 Spruce-pine-fir; NLGA.

2.3.2.3 Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

2.3.2.4 Eastern softwoods; NeLMA.

2.3.2.5 Species group below includes hem-fir and spruce-pine-fir (south).

2.3.2.6 Exterior and Load-Bearing Walls: As noted

2.3.3 Joists, Rafters, and Other Framing Not Listed Above: As noted

2.4 Engineered Wood Products

2.4.1 Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559 and containing no urea formaldehyde.

2.4.1.1 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:

2.4.1.1.1 Boise Cascade Corporation.

2.4.1.1.2 Georgia-Pacific.

2.4.1.1.3 Louisiana-Pacific Corporation.

2.4.1.1.4 Weyerhaeuser Company.

2.4.1.2 Extreme Fiber Stress in Bending, Edgewise: As noted

2.4.1.3 Modulus of Elasticity, Edgewise: As noted

2.4.2 Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559 and containing no urea formaldehyde.

2.4.2.1 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:

2.4.2.1.1 Weyerhaeuser Company.

2.4.2.2 Extreme Fiber Stress in Bending, Edgewise: 2900 psi (20 MPa) for 12-inch nominal- (286-mm actual-) depth members.

2.4.2.3 Modulus of Elasticity, Edgewise: 2,200,000 psi (15 100 MPa).

2.5 Miscellaneous Lumber

2.5.1 General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

2.5.1.1 Blocking.

2.5.1.2 Nailers.

2.5.1.3 Rooftop equipment bases and support curbs.

2.5.1.4 Cants

2.5.1.5 Furring.

2.5.1.6 Grounds.

2.5.1.7 Utility shelving.

2.5.2 For items of dimension lumber size, provide grade lumber with 19 percent maximum moisture content of any species.

2.5.3 For items of dimension lumber size, provide grade lumber with 19 percent maximum moisture content and any of the following species:

2.5.3.1 Mixed southern pine; SPIB.

2.5.3.2 Spruce-pine-fir; NLGA.

2.5.3.3 Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

2.5.3.4 Eastern softwoods; NeLMA.

2.5.4 For exposed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

2.5.4.1 Mixed southern pine, No. 1 grade; SPIB.

2.5.4.2 Spruce-pine-fir (south) or spruce-pine-fir, select Merchantable or No. 1 common grade; NeLMA, NLGA, WCLIB, or WWPA.

2.5.5 For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

2.5.5.1 Mixed southern pine, No. 2 grade; SPIB.

2.5.5.2 Spruce-pine-fir (south) or spruce-pine-fir, Construction or 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

2.5.6 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.

2.5.7 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.

2.5.8 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

2.6.1 Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

2.7 Fasteners

2.7.1 General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

2.7.1.1 Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

2.7.2 Nails, Brads, and Staples: ASTM F 1667.

2.7.3 Power-Driven Fasteners: NES NER-272.

2.7.4 Wood Screws: ASME B18.6.1.

2.7.5 Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

2.7.6 Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

2.8 Metal Framing Anchors

2.8.1 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:

2.8.2 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2.8.3 Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings or comparable products by one of the following:

2.8.3.1 Alpine Engineered Products, Inc.

2.8.3.2 Cleveland Steel Specialty Co.

2.8.3.3 Harlen Metal Products, Inc.

2.8.3.4 KC Metals Products, Inc.

2.8.3.5 Simpson Strong-Tie Co., Inc.

2.8.3.6 Southeastern Metals Manufacturing Co., Inc.

2.8.3.7 USP Structural Connectors.

2.8.4 Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.8.5 Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

2.8.5.1 Use for interior locations where stainless steel is not indicated.

2.9 Miscellaneous Materials

2.9.1 Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.

2.9.2 Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

2.9.3 Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

2.9.4 Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

3 EXECUTION

3.1. Installation, General

3.1.1 Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

3.1.2 Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

3.1.3 Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

3.1.4 Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.

3.1.5 Do not splice structural members between supports, unless otherwise indicated.

3.1.6 Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

3.1.6.1 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 (406 mm) o.c.

3.1.7 Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

3.1.7.1 Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.

3.1.7.2 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 (2438 mm) 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- (38-mm actual-) thickness.

3.1.7.3 Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.

3.1.7.4 Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.

3.1.8 Sort and select lumber so that natural characteristics will 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.

3.1.9 Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

3.1.9.1 Use inorganic boron for items that are continuously protected from liquid water.

3.1.9.2 Use copper naphthenate for items not continuously protected from liquid water.

3.1.10 Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

3.1.10.1 NES NER-272 for power-driven fasteners.

3.1.10.2 Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

3.1.11 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 between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.1.12 For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

3.1.12.1 Comply with approved fastener patterns where applicable.

3.1.12.2 Use finishing nails, unless otherwise indicated.

3.2. Wood Ground, Sleeper, Blocking, and Nailer Installation

3.2.1 Install where indicated and where required for screeding or 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.

3.2.2 Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.2.3 Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) 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. Wood Furring Installation

3.3.1 Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.3.2 Furring to Receive Plywood: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring horizontally and vertically at 24 inches.

3.3.3 Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring vertically at 24 inches.

3.4. Wall and Partition Framing Installation

3.4.1 General: Provide single bottom plate and double top plates except where specifically detailed to use single top plates. Where single top plates are used, studs shall align from floor to floor. At plate splices, use a minimum 1 ¼" wide x 18 ga. metal strap with (8) 8d each side of splice.

3.4.2 Construct corners and intersections with OVE framing techniques.

3.4.3 Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.

3.4.3.1 For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal (89-mm actual) depth for openings 48 inches (1200 mm) and less in width, 6-inch nominal (140-mm actual) depth for openings 48 to 72 inches (1200 to 1800 mm) in width, 8-inch nominal (184-mm actual) depth for openings 72 to 120 inches (1800 to 3000 mm) in width, and not less than 10-inch nominal (235-mm actual) depth for openings 10 to 12 feet (3 to 3.6 m) in width.

3.4.3.2 For load-bearing walls, provide framing as noted.

3.5. Ceiling Joist and Rafter Framing Installation

3.5.1 Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.

3.5.1.1 Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal- (19-by-184-mm actual-) size or 2-by-4-inch nominal- (38-by-89-mm actual-) size stringers spaced 48 inches (1200 mm) o.c. crosswise over main ceiling joists.

3.5.2 Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

3.5.2.1 At valleys, provide double-valley rafters of size indicated or, if not

indicated, of same thickness as regular rafters and 2 inches (50 mm) deeper. Bevel ends of jack rafters for full bearing against valley rafters.

3.5.2.2 At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches (50 mm) deeper. Bevel ends of jack rafters for full bearing against hip rafter.

3.5.3 Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions, if any.

3.6. Stair Framing Installation

3.6.1 Provide stair framing members of size, space, and configuration indicated or, if not indicated, to comply with the following requirements:

3.6.1.1 Stringer Size: 2-by-12-inch nominal- (38-by-286-mm actual-) size, minimum.

3.6.1.2 Stringer Material: Solid lumber. #2 southern Yellow Pine or Spruce.

3.6.1.3 Notching: Notch stringers to receive treads, risers, and supports; leave at least 3-1/2 inches (89 mm) of effective depth.

3.6.1.4 Stringer Spacing: At least 3 stringers for each 36-inch (914-mm) clear width of stair.

3.6.2 Provide stair framing with no more than 3/16-inch (4.7-mm) variation between adjacent treads and risers and no more than 3/8-inch (9.5-mm) variation between largest and smallest treads and risers within each flight.

3.7. Protection

2.7.1 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.

2.7.2 Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

End of Section

Section 07260
Underslab Vapor Barriers

1 GENERAL

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

1.2 Summary

1.2.1 This section includes the following:

1.2.1.1 Underslab vapor barriers and accessories for slabs-on-grade.

1.2.2 Related Sections include the following:

1.2.2.1 Division 3 Section “Cast-in-Place Concrete” for preparation and placement of slabs-on-grade that include underslab vapor barriers.

1.2.2.2 Division 13 Section “Metal Building Systems” for vapor barriers in other locations.

1.3 References

1.3.1 Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1.3.1.1 American Society for Testing and Materials (ASTM):

1.3.1.1.1. E 96-00 Standard Test Methods for Water Vapor Transmission of Materials.

1.3.1.1.2. E 154-99 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs.

1.3.1.1.3. E 1643-98 Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

1.3.1.1.4. E 1745-97 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

1.3.1.2 American Concrete Institute (ACI):

1.3.1.2.1. 302.1R-96: Vapor barrier component (plastic membrane) is not less than 10 mils thick.

1.4 Submittals

1.4.1 Submit the following for each type of product selected:

1.4.1.1 Independent laboratory test results showing compliance with ASTM and ACI requirements.

1.4.1.2 Manufacturer's product data.

1.4.1.3 Samples: 12 by 12 inch samples of vapor barrier material, 12 inch sample of tape.

1.4.1.4 Manufacturer's installation instructions, including directions for seaming and sealing penetrations, including pipe boots.

1.5 Definitions: WVTR: Water vapor transmission rate, measured in perms.

2 PRODUCTS

2.1 Materials

2.1.1 Vapor Barrier:

2.1.1.1 Vapor barrier to comply with the following:

2.1.1.1.1. WVTR of less than 0.008 when tested per ASTM E 96-00.

2.1.1.1.2. ASTM E 1745-97, Class A (Plastics).

2.1.1.2 Products:

2.1.1.2.1. Alumiseal Corp.; Zero Perm.

2.1.1.2.2. Reef Industries, Inc.; Griffolyn VAPORguard.

2.1.1.2.3. Stego Industries LLC; Stego Wrap 15 mil vapor barrier.

2.1.1.2.4. W. R. Meadows; Premoulded Membrane.

2.2 Accessories

2.2.1 Seam Tape: Seam tape to comply with the following:

2.2.1.1 Water Vapor Transmission Rate: 0.3 perms or lower per ASTM E 96-00.

2.2.1.2 Tape recommended by or required by vapor barrier manufacturer. If manufacturer does not require, provide tape meeting indicated requirements.

2.2.2 Vapor-Proofing Mastic: Mastic to comply with the following:

2.2.2.1 Water Vapor Transmission Rate: 0.3 perms or lower per ASTM E 96-00.

2.2.2.2 Mastic recommended or required by vapor barrier manufacturer. If manufacturer does not require, provide mastic meeting indicated requirements.

2.2.3 Pipe Boots:

2.2.3.1 Construct pipe boots from vapor barrier material, seam tape, mastic, or a combination of these, per manufacturer's instructions. If manufacturer's instructions do not indicate, use indicated materials to seal completely around penetrations.

3 EXECUTION

3.1 Examination: Examine substrates and conditions, with Installer present, for compliance with referenced requirements. Notify the responsible party or parties of any unsatisfactory conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 Preparation

3.2.1 Ensure that substrate is acceptable to Architect and geotechnical engineer.

3.2.1.1 Level and tamp or roll aggregate base.

3.3 Installation

3.3.1 Install vapor barrier in accordance with manufacturer's instructions and ASTM E 1643-98.

3.3.1.1 Unroll vapor barrier with long dimension parallel with direction of concrete pour.

3.3.1.2 Lap vapor barrier over footings and seal to foundation walls.

3.3.1.3 Lap joints 6 inches and seal with seam tape.

3.3.1.4 No penetrations of vapor barrier are allowed except reinforcing steel and permanent utilities.

3.3.1.5 Seal all permitted penetrations, including pipes and permanent utilities.

3.3.1.6 Repair damaged areas by cutting patches of vapor barrier material, lapping 6 inches on to undamaged membrane, and sealing all sides with seam tape.

End of Section

Section 072100
Building Insulation

1 GENERAL

1.1 Summary

1.1.1. This Section includes the following:

1.1.1.1. Perimeter insulation under slabs-on-grade.

1.1.1.2. Perimeter wall insulation (supporting backfill).

1.1.1.3. Concealed building insulation.

1.1.1.4. Exposed building insulation.

1.1.1.5. Sound attenuation insulation.

1.2 Submittals

1.2.1. Product Data: For each type of product indicated.

1.2.2. Samples for Verification: Full-size units for each type of exposed insulation indicated.

1.2.3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

1.2.4. Research/Evaluation Reports: For foam-plastic insulation.

1.3 Quality Assurance

1.3.1. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

1.3.2. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1.3.2.1. Surface-Burning Characteristics: ASTM E 84.

1.3.2.2. Fire-Resistance Ratings: ASTM E 119.

1.3.2.3. Combustion Characteristics: ASTM E 136.

1.4 Delivery, Storage, And Handling

1.4.1. Protect insulation materials from physical damage and from deterioration by 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.

1.4.2. Protect plastic insulation as follows:

1.4.2.1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

1.4.2.2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.

1.4.2.3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

2 PRODUCTS

2.1 Manufacturers

2.1.1. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

2.1.1.1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 Foam-Plastic Board Insulation

2.2.1. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:

2.2.1.1. Dow Chemical Company.

2.2.1.2. Owens Corning

2.2.2. Type IV, 1.60 lb/cu. ft. (26 kg/cu. m), unless otherwise indicated.

2.3 Auxiliary Insulating Materials

2.3.1. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by insulation manufacturers for sealing joints and penetrations in vapor-retarder facings.

2.3.2. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2.4 Insulation Fasteners

2.4.1. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:

2.4.1.1. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.

2.4.1.2. Eckel Industries of Canada; Stic-Klip Type N Fasteners.

2.4.1.3. Gemco; Spindle Type.

2.4.1.4. Plate: Perforated galvanized carbon-steel sheet, 0.030-inch (0.762 mm) thick by 2 inches (50 mm) square.

2.4.1.5. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105-inch (2.67 mm) in diameter; length to suit depth of insulation indicated.

2.5 Sound Attenuation Wall Insulation- provide per partition tag locations.

3 EXECUTION

3.1 Examination

3.1.1. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

3.1.1.1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

3.2.1. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 Installation, General

3.3.1. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

3.3.2. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

3.3.3. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

3.3.4. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

3.3.5. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 Installation of Perimeter and Under-Slab Insulation

3.4.1. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

3.4.1.1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) vertically below exterior grade line and 24inches horizontally at slab edge.

3.4.2. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.4.3. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.

3.4.4. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.5 Installation of General Building Insulation

3.5.1. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

3.5.2. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

3.5.3. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

3.5.3.1. Fasten insulation anchors to concrete substrates or CMU with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.

3.5.3.2. Show width of cavity on Drawings.

3.5.3.3. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.

3.5.3.4. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.

3.5.3.5. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.6 Protection

3.6.1. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.7 Insulation Schedule

3.7.1. Coordinate location and installation of insulation types as indicated on the Drawings: see schedule on drawings.

End of Section

Section 074114
Standing-Seam Metal Roof Panels

1 GENERAL

1.1 Related Documents

1.1.1 Drawings and other Contract Documents, listed in the agreement between the Owner and Contractor, apply to this Section.

1.2 Summary

1.2.1 Section includes standing-seam metal roof panels.

1.3 Design And Performance Requirements

1.3.1 Air Infiltration:

1.3.1.1 <.01 cfm/sf @ 20 psf pressure differential per ASTM E 1680

1.3.2 Water Resistance:

1.3.2.1 No water penetration under 5 gal/hr spray at 20 psf pressure differential per ASTM E 1646

1.3.3 Static Water Pressure Head Test:

1.3.3.1 No leakage up to 6 hours per ASTM E 2140-01

1.4 Submittals

1.4.1 Product Data: For each type of product.

1.4.1.1 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

1.4.2 Shop Drawings:

1.4.2.1 Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

1.4.2.2 Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

1.4.2.3 If a WTW is required, shop drawings or Fabral's standard details must be reviewed by the manufacturer prior to installation

1.4.3 Samples: For each type of exposed finish required, prepared on Samples of size indicated below.

1.4.3.1 Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.4.3.2 Include similar Samples of trim and accessories involving color selection.

1.4.4 Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.4.5 Field quality-control reports.

1.4.6 Sample Warranties: For special warranties.

1.4.7 Maintenance Data: For metal panels to include in maintenance manuals.

1.5 Quality Assurance

1.5.1 Installer Qualifications: Installer of sheet metal roofing for a minimum of 10 years documented experience.

1.5.2 Panel Manufacturer: Minimum of 10 years' experience in manufacturing architectural roof panels in a permanent stationary indoor facility. Provide facility information if requested.

1.6 Delivery, Storage, And Handling

1.6.1 Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

1.6.2 Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

1.6.3 Store panels, flashings and accessories in a safe, dry environment under a waterproof breathable covering to prevent water damage. Allow for adequate ventilation to prevent condensation. Panels and flashings with strippable film shall not be stored in direct sunlight.

1.6.4 Remove strippable protective covering on metal panels during installation.

1.6.5 Upon receipt of delivery of metal panel system, and prior to signing the delivery ticket, the installer is to examine each shipment for damage and for completion of the consignment.

1.7 Field Conditions

1.7.1 Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.8 Coordination

1.8.1 Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8.2 Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 Warranty

1.9.1 Material and Workmanship Warranty: Manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1.9.1.1 Failures include, but are not limited to, the following:

1.9.1.1.1 Structural failures including rupturing, cracking, or puncturing.

1.9.1.1.2 Deterioration of metals and other materials beyond normal weathering.

1.9.1.2 Warranty Period: Two years from date of Substantial Completion.

1.9.2 Paint Finish Warranty: 30 years from date of Substantial Completion. If metallic colors are used, the “fade” part of the warranty shall be removed.

1.9.2.1 30 years for Kynar type finish.

1.9.3 Installer’s Warranty: Submit installer's warranty, signed by Installer, covering the work of this Section, including all components of roof panels for the following warranty period:

1.9.3.1 Warranty Period: Two years from date of Substantial Completion

1.9.4 Weather-tight Warranty:

1.9.4.1 Warranty Period: Twenty years from date of Substantial Completion

2 PRODUCTS

2.1 Manufacturer: FABRAL OR EQ.

2.2 Standing-Seam Metal Roof Panels

Powerseam

2.2.1 AZ50 Galvalume Steel:

2.2.1.1 Material Gauge: [**24**] gauge.

2.2.1.2 Exterior Finish: As selected from manufacturer's premium finishes.

2.2.1.3 Color: As selected from manufacturer's full range.

2.2.2 Rib Spacing: NONE

2.2.3 Panel Coverage: [**16**] inches.

2.2.4 Panel Height: 1 inch.

2.3 Materials

2.3.1 Metallic-Coated Steel Sheet: aluminum-zinc alloy-coated steel sheet (Galvalume) complying with ASTM A 792/A 792M, Class AZ50/AZ55 coating designation; structural quality. Pre-painted by the coil- coating process to comply with ASTM A 755/A 755M.

2.3.2 Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

2.4 Miscellaneous Materials

2.4.1 Miscellaneous Metal Sub-framing and Furring: Provide manufacturer's standard sections as required for support and alignment of metal panel system.

2.4.2 Panel Accessories: Provide components required for a complete, weather-tight panel system including trim, copings, fasciae, mullions, sills, corner units, panel clips, flashings, sealants, gaskets, fillers, panel closures, and similar items. Match material and finish of metal panels unless otherwise indicated.

2.4.3 Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

2.4.4 Panel Fasteners: Self-tapping screws designed to withstand design loads.

2.4.5 Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are non-staining, and do not damage panel finish.

2.4.5.1 Sealant Tape: Buytl

2.4.5.2 Joint Sealant: One Part Poly

2.4.5.3 Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 Fabrication

2.5.1 General: Provide factory-formed metal roof panel system complying with ASTM E 1514 requirements.

2.5.2 Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

2.5.3 Form panels in continuous lengths, endlaps are not permitted.

2.5.4 Field forming of panels shall be done by factory employees operating the machines.

2.5.5 Fabricate metal panel joints with factory-installed butyl sealant that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

2.5.6 Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.5.6.1 Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

2.5.6.2 Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

2.5.6.3 Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

2.5.6.4 Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.

2.5.6.5 Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

2.5.6.6 Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

2.5.6.6.1 Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 Finishes

2.6.1 Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.6.2 Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 Steel Panels and Accessories:

2.7.1 Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2.7.2 Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2.7.3 Three-Coat Metallic Fluoropolymer: AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent 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.

2.7.4 Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

3 EXECUTION

3.1 Examination

3.1.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

3.1.1.1 Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.

3.1.1.2 Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

3.1.2 Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

3.2.1 Miscellaneous Supports: Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 Metal Panel Installation

3.3.1 General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

3.3.1.1 Shim or otherwise plumb substrates receiving metal panels.

3.3.1.2 Flash and seal metal panels at perimeter of all openings. Refer to manufacturers recommendations.

3.3.1.3 Install flashing and trim as metal panel work proceeds.

3.3.1.4 Panels to be in one continuous length, long length roofs must be field formed by Manufacturer.

3.3.1.5 Provide weather-tight escutcheons for pipe- and conduit-penetrating panels.

3.3.2 Fasteners:

3.3.2.1 Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized- steel fasteners for surfaces exposed to the interior.

3.3.3 Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.3.4 Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

3.3.5 Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

3.3.5.1 Install clips to supports with self-tapping fasteners.

3.3.5.2 Install pressure plates at locations indicated in manufacturer's written installation instructions.

3.3.5.3 Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so metal roof panels, and factory-applied sealant are completely engaged.

3.3.6 Accessory Installation: Install accessories with positive anchorage to building and weather tight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

3.3.7 Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.3.7.1 Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.

3.3.7.2 Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 Erection Tolerances

3.4.1 Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.5 Field Quality Control

3.5.1 Manufacturer's Field Service: Engage a factory-authorized service representative to inspect metal roof panel installation, including accessories. Report results in writing.

3.5.2 Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

3.5.3 Prepare inspection reports.

3.5.4 Installer must have installation shop drawings on site at all times.

3.6 Cleaning And Protection

3.6.1 Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

3.6.2 Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

End of Section

Section 08110
Steel Doors and Frames

1 GENERAL

1.1 Related Documents: Drawings and general provisions of the Contract apply to this Section.

1.2 Doors on the exterior walls are Owner furnished. The Contractor shall supply all other required doors.

1.3 Summary

1.3.1 Section includes:

1.3.1.1 Standard hollow metal doors and frames.

1.3.2 Related sections:

1.3.2.1 Division 8 Section “Door Hardware”

1.4 Definitions

1.4.1 Minimum Thickness: Minimum thickness of base metal without coatings.

1.4.2 Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.5 Submittals

1.5.1 Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, and finishes.

1.5.2 Shop Drawings: Include the following:

1.5.2.1 Elevations of each door design.

1.5.2.2 Details of doors, including vertical and horizontal edge details and metal thicknesses.

1.5.2.3 Frame details for each frame type, including dimensioned profiles and metal thicknesses.

1.5.2.4 Locations of reinforcement and preparations for hardware.

1.5.2.5 Details of each different wall opening condition.

1.5.2.6 Details of anchorages, joints, field splices, and connections.

1.5.2.7 Details of accessories.

1.5.2.8 Details of moldings, removable stops, and glazing.

1.5.3 Other Action Submittals:

1.5.3.1 Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

1.5.4 Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.6 Quality Assurance

1.6.1 Source Limitations: Obtain hollow metal work from single source from single manufacturer.

1.7 Delivery, Storage, and Handling

1.7.1 Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.

1.7.1.1 Provide additional protection to prevent damage to finish of factory-finished units.

1.7.2 Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

1.7.3 Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.

1.7.3.1 Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.8 Project Conditions

1.8.1 Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 Coordination

1.9.1 Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages,

including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.9.2 Coordinate rough opening size with building manufacturer prior to ordering frames or building.

2 PRODUCTS

2.1 Manufacturers

2.1.1 Manufacturers: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2.1.1.1 Ceco Door Products; an Assa Abloy Group company.

2.1.1.2 Curries Company; an Assa Abloy Group company.

2.1.1.3 Steelcraft; an Ingersoll-Rand company.

2.1.1.4 Allied Steel Products, Inc.

2.1.1.5 Republic Builders Products Corp./ Subsidy of Republic Steel

2.1.1.6 Approved equal.

2.2 Materials

2.2.1 Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

2.2.2 Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

2.2.3 Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) metallic coating.

2.2.4 Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.

2.2.4.1 For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

2.2.5 Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

2.2.6 Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-

spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

2.2.7 Glazing: Comply with requirements in Division 8 Section "Glazing." Glazing shall be double pane, low-E argon gas filled.

2.2.8 Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 Standard Hollow Metal Doors

2.3.1 General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

2.3.1.1 Design: Flush panel, 16 ga, fully welded seams ground smooth.

2.3.1.2 Core Construction: Manufacturer's standard polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.

2.3.1.2.1 Thermal-Rated (Insulated) Doors: At exterior locations, provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0 deg F x h x sq. ft./Btu (0.704 K x sq. m/W) when tested according to ASTM C 1363.

2.3.1.3 Vertical Edges for Single-Acting Doors: Manufacturer's standard.

2.3.1.4 Top and Bottom Edges: Closed with flush or inverted 0.042-inch-(1.0-mm-) thick, end closures or channels of same material as face sheets.

2.3.1.5 Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

2.3.2 Exterior Doors: 16 ga. Fully welded seams ground smooth. Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

2.3.2.1 Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).

2.3.3 Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

2.3.4 Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 Standard Hollow Metal Frames

2.4.1 General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

2.4.2 Exterior Frames: Fabricated from metallic-coated steel sheet, 16 gage, drywall returns all frames interior and exterior.

2.4.2.1 Fabricate frames with mitered corners.

2.4.2.2 Fabricate frames as full profile welded unless otherwise indicated.

2.4.2.3 Frames for Level 3 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.

2.4.3 Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 Frame Anchors

2.5.1 Jamb Anchors:

2.5.1.1 Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.

2.5.2 Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

2.5.2.1 Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.6 Fabrication

2.6.1 Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

2.6.2 Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

2.6.3 Hollow Metal Doors:

2.6.3.1 Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

2.6.3.2 Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

2.6.4 Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

2.6.4.1 Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

2.6.4.2 Provide countersunk, flat-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.6.4.3 Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

2.6.4.4 Jamb Anchors: Provide number and spacing of anchors as follows:

2.6.4.4.1 Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

2.6.4.4.1.1. Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.

2.6.4.4.1.2. Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.

2.6.4.4.1.3. Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.

2.6.4.5 Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.

2.6.4.5.1 Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

2.6.4.5.2 Double-Door Frames: Drill stop in head jamb to receive two door silencers.

2.6.5 Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.6.6 Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."

2.6.6.1 Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.

2.6.6.2 Reinforce doors and frames to receive non-templated, mortised and surface-mounted door hardware.

2.6.6.3 Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

2.6.6.4 Coordinate locations of conduit and wiring boxes for electrical connections with Division 16 Sections.

2.7 Steel Finishes

2.7.1 Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

2.7.1.1 Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

3 EXECUTION

3.1 Installation

3.1.1 Hollow Metal Frames: Comply with ANSI/SDI A250.11.

3.1.1.1 Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

3.1.1.1.1 At fire-protection-rated openings, install frames according to NFPA 80.

3.1.1.1.2 Where frames are fabricated in sections because of shipping or handling limitations, field splice at ap-

proved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.

3.1.1.1.3 Install frames with removable glazing stops located on secure side of opening.

3.1.1.1.4 Install door silencers in frames before grouting.

3.1.1.1.5 Remove temporary braces necessary for installation only after frames have been properly set and secured.

3.1.1.1.6 Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

3.1.1.1.7 Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

3.1.1.2 Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

3.1.1.2.1 Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3.1.1.3 Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.

3.1.1.4 Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

3.1.1.5 In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

3.1.1.6 In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

3.1.1.7 Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support

at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.

3.1.1.8 Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb.

3.1.1.8.1 Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

3.1.1.8.2 Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.

3.1.1.8.3 Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

3.1.1.8.4 Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

3.1.2 Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

3.1.2.1 Non-Fire-Rated Standard Steel Doors:

3.1.2.1.1 Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).

3.1.2.1.2 Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).

3.1.2.1.3 Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).

3.1.2.1.4 Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

3.1.2.2 Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.1.3 Glazing: Comply with hollow metal manufacturer's written instructions.

3.1.3.1 Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.2 Adjusting and Cleaning

3.2.1 Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

3.2.2 Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

3.2.3 Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions

End of Section

Section 08411
Aluminum-Framed Entrances and Storefronts

1 GENERAL

1.1 Section Requirements

1.1.1 Submittals: Product Data, Shop Drawings, and color Samples.

1.1.1.1 For entrance doors, include hardware schedule.

2 PRODUCTS

2.1 Aluminum-Framed Storefronts

2.1.1 Products:

2.1.1.1 Kawneer: Tri-Fab VG 451T, or approved equal.

2.1.2 Accessible Entrances: Comply with ICC/ANSI A117.1

2.1.3 Performance Requirements:

2.1.3.1 Limit deflection of framing members normal to wall plane to 1/175 of clear span or an amount that restricts edge deflection of individual glazing lites to 1/2 inch, whichever is less.

2.1.3.2 Limit deflection of framing members parallel to glazing plane to L/360 of clear span or 1/8 inch, whichever is smaller.

2.1.3.3 Structural Testing: Systems tested according to ASTM E 330 at 150 percent of inward and outward wind-load design pressures do not evidence material failures, structural distress, deflection failures, or permanent deformation of main framing members exceeding 0.2 Insert number percent of clear span.

2.1.3.4 Air Infiltration: Limited to 0.06 cfm/sq. ft. of system surface area when tested according to ASTM E 283 at a static-air-pressure difference of 1.57 lbf/sq. ft.

2.1.3.5 Water Penetration: Systems do not evidence water leakage when tested according to ASTM E 331 at minimum differential pressure of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

2.1.4 Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated; ASTM B 209 sheet; ASTM B 221 extrusions.

2.1.5 Glazing: As specified in Section 08800 – Glazing, minimum 1” insulated, low E, argon filled, gray tint tempered where required by code. Maximum U value = 0.28; maximum SHGC = 0.30. Entrance door maximum U = 0.70.

2.1.6 Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

2.1.7 Doors: (where applicable) 1-3/4-inch- thick glazed doors with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods. Provide snap-on extruded-aluminum glazing stops, and preformed gaskets.

2.1.7.1 Door Design: As indicated.

2.1.7.2 Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.

2.1.7.3 Interior Doors: Provide ANSI/BHMA A156.16 silencers, three on strike jamb of single-door frames and two on head of double-door frames.

2.1.7.4 Exterior Doors: Provide compression weather stripping at fixed stops. At other locations, provide sliding weather stripping retained in adjustable strip mortised into door edge.

2.1.7.5 Hardware: As specified in Division 08 Section "Door Hardware."

2.1.8 Fasteners and Accessories: Compatible with adjacent materials, corrosion resistant, nonstaining, and nonbleeding. Use concealed fasteners except for application of door hardware.

2.1.9 Fabrication: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.1.9.1 Door Framing: Reinforce to support imposed loads. Factory assemble door and frame units and factory install hardware to greatest extent possible. Reinforce door and frame units for hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.

2.1.10 Aluminum Finish: Fluoropolymer two-coat coating system complying with AAMA 2604. Color to match Architect’s approved color sample.

3 EXECUTION – Not used.

End of Section

Section 087100
Exterior Door Hardware

1 GENERAL

1.1 Summary

1.1.1 Section Includes:

1.1.1.1 Work under this section comprises of furnishing and installing commercial door hardware needed for a complete and operational system to include trim, attachments and provide a detailed finish hardware schedule for review showing proposed hardware sets for each opening for the following:

1.1.1.1.1 Swinging doors

1.2 References

1.2.1 Publications listed herein are part of this specification to extent referenced.

1.2.2 American National Standards Institute:

1.2.2.1 ANSI A156 Series

1.2.2.2 ANSI A115W Wood Door Hardware Standards; Hardware Preparation

1.2.2.3 ANSI A115 Specifications for Steel Door and Frame Preparation for Hardware

1.2.2.4 ANSI A117.1 Accessible and Usable Buildings and Facilities

1.2.2.5 ANSI A250.6 Hardware on Steel Doors (Reinforcement - Applications)

1.2.3 Americans with Disabilities Act Accessibility Guidelines (ADAAG)

1.2.4 Door and Hardware Institute:

1.2.4.1 DHI Publication - Abbreviations and Symbols

1.2.4.2 DHI Publication - Basic Architectural Hardware

1.2.4.3 DHI Publication - Hardware for Labeled Fire Doors (with supplements)

1.2.4.4 DHI Publication - Hardware Reinforcements on Steel Doors and Frames

1.2.4.5 DHI Publication - Installation Guide for Doors and Hardware

1.2.4.6 DHI Publication - WDHS-1 Template Book Criteria for Wood Doors

1.2.4.7 DHI Publication - WDHS-3 Recommended Hardware Locations for Wood Flush Doors

1.2.4.8 DHI Publication - For Processing Hardware Schedules and Templates

1.2.5 National Fire Protection Association:

1.2.5.1 NFPA 70 National Electrical Code

1.2.5.2 NFPA 80 Standard for Fire Doors and Windows

1.2.5.3 NFPA 101 Life Safety Code

1.2.5.4 NFPA 105 Recommended Practice for the Installation of Smoke-Control Door Assemblies

1.2.5.5 NFPA 252 Standard Methods of Fire Tests of Door Assemblies

1.2.6 Steel Door Institute:

1.2.6.1 SDI-109 Hardware for Standard Steel Doors and Frames

1.2.7 Underwriters Laboratories, Inc.

1.2.7.1 UL Standard 10C Positive Pressure Fire Tests of Door Assemblies

1.2.7.2 UL Standard 1784 Air Leakage Tests of Door Assemblies

1.2.7.3 UL Building Materials Directory

1.2.7.4 International Building Code (IBC) 2006

1.3 Submittals

1.3.1 Submittal Sequence:

1.3.1.1 Submit final Door Hardware Schedule at earliest possible date, particularly where approval of Door Hardware Schedule must precede fabrication of other work that is critical in Project construction schedule.

1.3.1.2 Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to coordinated review of Door Hardware Schedule.

1.3.2 Product Data:

1.3.2.1 Submit manufacturer's technical product fact sheets describing each item of hardware to be provided including material descriptions, dimensions of individual components and profiles, and finishes.

1.3.3 Door Hardware Schedule:

1.3.3.1 Submit door hardware schedule prepared by or under supervision of a DHI certified Architectural Hardware Consultant (AHC) or Certified Door Consultant (CDC) detailing fabrication and assembly of door hardware, as well as procedures and diagrams.

1.3.3.2 Coordinate Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1.3.3.3 Format:

1.3.3.3.1 Comply with scheduling sequence and vertical form as described in DHI's *Sequence and Format for the Hardware Schedule*.

1.3.3.3.2 Horizontal hardware schedules are not acceptable.

1.3.3.3.3 Submit 4 copies of hardware schedule.

1.3.3.4 Organization:

1.3.3.4.1 Organize door hardware schedule into hardware sets indicating complete designations of every item needed for each door or opening.

1.3.3.4.2 Organize door hardware sets in same order as in Door Hardware Schedule contained in Part 3 of this specification.

1.3.3.4.3 For doors of different sizes or where hinges, locks, or closers are different, a separate heading shall be used. No labeled openings shall be combined with non-labeled openings.

1.3.3.5 Content:

1.3.3.5.1 Type, style, function, size, label, hand, and finish for each door hardware item.

1.3.3.5.2 Name and manufacturer of each item.

1.3.3.5.3 Fastenings and other pertinent information.

1.3.3.5.4 Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.

1.3.3.5.5 Explanation of abbreviations, symbols, and codes contained in schedule.

1.3.3.5.6 Mounting locations for door hardware.

1.3.3.5.7 Door and frame sizes and materials.

1.3.4 Shop Drawings:

1.3.4.1 Provide a copy with each hardware schedule submitted.

1.3.5 Samples:

1.3.5.1 Submit samples of door hardware items if requested by Engineer. Accepted samples may be incorporated into Work.

1.3.6 Quality Assurance Submittals:

1.3.6.1 Test Reports:

1.3.6.1.1 Provide product test reports based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, indicating current products comply with requirements.

1.3.6.2 Certificates:

1.3.6.2.1 Submit Product Certificates signed by manufacturers of electrified door hardware certifying that electronic hardware and systems being furnished comply with specified requirements.

1.3.6.2.2 Submit a statement from manufacturer certifying that door hardware is approved for use on types and sizes of labeled fire doors and complies with listed fire door assemblies.

1.3.6.3 Manufacturer's Instructions:

1.3.6.3.1 Submit instructions for installation and maintenance of operating parts and finish.

1.3.6.3.2 Furnish templates and schedules needed for fabrication of hollow metal doors and frames, wood doors and frames, and other items related to hardware.

1.3.6.3.3 Submission for templates and template list shall follow procedures established by DHI publication *For Processing Hardware Schedules and Templates*.

1.3.7 Closeout Submittals:

1.3.7.1 Operation and Maintenance:

1.3.7.1.1 Provide operation and maintenance data for electrically operated and non-electrical hardware consisting of technical information as follows:

1.3.7.1.1.1 Maintenance instructions for each item of hardware

1.3.7.1.1.2 Catalog pages for each product

1.3.7.1.1.3 Parts list for each product

1.3.7.1.1.4 Copy of final hardware schedule

1.3.7.1.1.5 Copy of final keying schedule

1.3.7.1.2 Include a copy of operational and maintenance descriptions in Operation and Maintenance Data Manual.

1.3.7.2 Warranties:

1.3.7.2.1 Submit Special warranties specified in this Section.

1.3.7.3 Keying Schedule:

1.3.7.3.1 Prepare and submit a keying schedule using keyset symbols referenced in DHI manual *Keying Systems and Nomenclature*. Include schematic keying

diagram and index each key set to unique door designations.

1.3.7.3.1.1 Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.

1.3.7.3.2 Provide one complete bitting list of key cuts.

1.3.7.3.3 Keying schedule shall be prepared by or under supervision of supplier, detailing Owner's final keying instructions for locks.

1.3.7.3.4 Submit 4 copies of keying schedule.

1.4 Quality Assurance

1.4.1 Qualifications:

1.4.1.1 Door Hardware Supplier:

1.4.1.1.1 Door hardware supplier shall have warehousing facilities in Project's vicinity and shall employ a qualified Certified Architectural Hardware Consultant (AHC) available during course of Work to consult with Contractor, Engineer, and Owner about door hardware and keying.

1.4.1.2 Architectural Hardware Consultant:

1.4.1.2.1 Architectural Hardware Consultant shall be a person who is currently certified by Door and Hardware Institute as an Architectural Hardware Consultant (AHC) and 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.

1.4.1.3 Installer:

1.4.1.3.1 Door hardware shall be installed by an experienced installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

1.4.1.4 Single Source Responsibility:

1.4.1.4.1 Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

1.4.2 Regulatory Requirements:

1.4.2.1 Hardware and installation shall comply with provisions and standards listed.

1.4.2.2 International Building Code (IBC) 2009

1.4.2.3 Federal Accessibility Regulations:

1.4.2.3.1 Americans with Disabilities Act – ADA

1.4.2.3.2 Uniform Federal Accessibility Standards – UFAS

1.4.2.3.3 ANSI A117.1 Standard for Accessible and Usable Buildings and Facilities

1.4.2.3.4 Accessibility Guidelines for Buildings and Facilities (ADAAG)

1.4.2.4 National Fire Protection Association:

1.4.2.4.1 NFPA 80 Standard for Fire Doors and Windows

1.4.2.4.2 NFPA 101 Life Safety Code

1.4.2.4.3 NFPA 105 Recommended Practice for the Installation of Smoke-Control Door Assemblies

1.4.2.4.4 NFPA 252 Standard Methods of Fire Tests of Door Assemblies

1.4.2.5 Underwriters Laboratories Inc.:

1.4.2.5.1 UL 10C Positive Pressure Fire Tests of Door Assemblies

1.4.2.5.2 UL 1784 Air Leakage Tests of Door Assemblies

1.4.2.6 ANSI/BHMA Standards

1.4.2.6.1 A115-W Series

1.4.2.6.2 A115 Series

1.4.2.6.3 A156 Series

1.4.2.7 Door and Hardware Institute:

1.4.2.7.1 Abbreviations and Symbols

1.4.2.7.2 Basic Architectural Hardware

1.4.2.7.3 Hardware for Labeled Fire Doors (with supplements)

1.4.2.7.4 Hardware Reinforcements on Steel Doors and Frames

1.4.2.7.5 Installation Guide for Doors and Hardware

1.4.2.7.6 WDHS-1 Template Book Criteria for Wood Doors

1.4.2.7.7 WDHS-3 Recommended Hardware Locations for Wood Flush Doors

1.4.3 Certifications:

1.4.3.1 Hardware used in labeled fire or smoke rated openings shall bear identifying label or mark indicating listing by Underwriters Laboratories, Inc., ITS (Warnock Hersey International), or other nationally recognized organizations acceptable to authority having jurisdiction.

1.4.3.2 Provide door hardware for fire-rated door assemblies complying with NFPA 80.

1.4.4 Pre-Installation Meetings:

1.4.4.1 Conduct conference on-site to comply with requirements in Division 1 for Project Meetings.

1.4.4.2 Topics to be discussed at meeting shall include:

1.4.4.2.1 Review items such as proper installation sequence, adjustments, attachment, and location of door hardware.

1.4.4.2.2 Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.4.5 Keying Conference:

1.4.5.1 Conduct conference on-site to comply with requirements in Division 1 for Project Meetings. Participants shall be Owner's representative, Contractor, hardware supplier, and lock manufacturer's representative.

1.4.5.2 Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including but not limited to following:

1.4.5.2.1 Function of building, flow of traffic, purpose of each area, degree of security needed, and plans for future expansion

1.4.5.2.2 Preliminary key system schematic diagram

1.4.5.2.3 Requirements for key control system

1.4.6 Coordination:

1.4.6.1 Templates:

1.4.6.1.1 Obtain and distribute templates for doors, frames, and other work specified to be factory prepared for installing door hardware to parties involved.

1.4.6.1.2 Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with specified requirements.

1.5 Delivery, Storage, And Handling

1.5.1 Packing, Shipping, Handling, and Unloading:

1.5.1.1 Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Site.

1.5.1.2 Tag each item or package separately with identification related to final Door Hardware Schedule, and include basic installation instructions with each item or package.

1.6 Special Warranty

1.6.1 Provide written warranty, executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period. Failures include but are not limited to following:

1.6.1.1 Structural failures including excessive deflection, cracking, or breakage

1.6.1.2 Faulty operation of operators and door hardware

1.6.1.3 Deterioration of metals, metal finishes, and other materials beyond normal weathering

1.6.2 Warranty period shall be for not less than 3 years from Date of Substantial Completion unless otherwise indicated.

1.6.2.1 Locks: 3 years

1.6.2.2 Manual Closers: 10 years

1.6.2.3 Exit Devices: 3 years

1.6.3 Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

1.7 Maintenance

1.7.1 Maintenance Service:

1.7.1.1 Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of door hardware installer.

1.7.1.1.1 Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as needed for proper door hardware operation.

1.7.1.1.2 Provide parts and supplies as used in manufacture and installation of original products.

1.7.1.2 Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

2 PRODUCTS

2.1 Materials

2.1.1 General Requirements:

2.1.1.1 Hardware shall be of best grade, entirely free of imperfections in manufacture and finish, and shall satisfactorily perform various functions needed.

2.1.1.2 Furnish necessary screws, bolts or others fastenings of suitable size and type to anchor hardware in position and match hardware as to material and finish. Provide Phillips flat-head screws except as otherwise indicated.

2.1.1.3 Do not use through-bolts for installations where bolt head or nut opposite face is exposed in other work. Use of sex bolts shall not be allowed.

2.1.1.4 Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as indicated. Items of hardware not definitely specified, but needed for satisfactory installation of hardware shall be provided. Such items shall be of type and quality suitable for service needed and comparable to adjacent hardware.

2.1.1.5 Finishes: Provide Hardware of the following finishes unless otherwise indicated: 626 (US26D) Satin Chromium Plated; 630 (US32D) Satin Stainless Steel; 689 – Factory Painted Aluminum finish

2.1.2 Substitutions:

2.1.2.1 Manufacturers and model numbers listed as “no substitutions” are the only products that will be accepted. The Engineer must approve all other product substitutions. Only approved substitutions will be accepted.

2.2 Hinges

2.2.1 Butt Hinges: ANSI/ BHMA A156.1

2.2.1.1 Provide full mortise, template, 5-knuckle, button tip hinges with non-rising loose pins and ball type bearings.

2.2.1.2 Out-swinging exterior doors shall be furnished with solid bronze or stainless steel, hinges with non-removable pins or security studs.

2.2.1.3 Interior doors with locksets shall be furnished with non-removable pins hinges.

2.2.1.4 Hinges shall be furnished in following quantities:

2.2.1.4.1 Doors up to 90 inches in height: 3 hinges

2.2.1.4.2 Doors over 90 inches in height: Add 1 hinge for every additional 30 inches

2.2.1.5 Furnish hinge sizes not less than as follows:

2.2.1.5.1 For 1-3/4inch Thick Doors: Standard weight

2.2.1.5.1.1 Doors up to 3 feet wide: 4 1/2 x 4 1/2 x 0.134 gauge

2.2.1.5.2 For 1 3/4" Thick Doors: Heavy weight

2.2.1.5.2.1 Doors up to 3 foot-6 inches wide: 4 1/2 x 4 1/2 x 0.180 gauge

2.2.1.5.2.2 Doors 4 feet wide: 5 x 4 1/2 x 0.190 gauge

2.2.1.6 Furnish hinges of sufficient throw where needed to clear trim or permit doors to swing 180 degrees.

2.2.1.7 Finishes: As selected by the Owner.

2.3 Locksets and Latchsets

2.3.1 General Requirements:

2.3.1.1 Shape of lever shall be easy to grasp with one hand and not require tight grasping, tight pinching, or twisting of wrist.

2.3.1.2 Locksets and latchsets shall not require more than 15 lbf to release latch. Locks shall not require use of a key, tool, or special knowledge for operation.

2.3.1.3 Provide manufacturer's standard wrought box strike for each latchset and lockset with curved lip extended to protect frame without catching clothing. Finish shall match hardware set.

2.3.1.4 Provide exterior doors with hi-security interchangeable core cylinders. Interior cylinders shall have an interchangeable core system compatible with exterior system but not hi-security type. Both systems shall be 6-pin tumbler with cylinder parts from brass/bronze, stainless steel or nickel silver.

2.3.2 Mortise Locksets and Latchsets:

2.3.2.1 Provide heavy duty mortise locksets and latchsets that comply to ANSI A156.13, Series 1000, Operational Grade 1 and Security Grade 1 with all standard trims.

2.3.2.2 Provide mortise locksets that comply with UL10C and UBC 7-2 positive pressure requirements.

2.3.2.3 Lock case shall be manufactured from fully wrapped, heavy 12-gauge steel to limit access to operating parts. Manufacturers utilizing an exposed edge case are not acceptable.

2.3.2.4 Lock components shall be manufactured from zinc dichromate plated steel. Manufacturers utilizing plastic parts, spacers, and/or bushings are not acceptable.

2.3.2.5 Locksets are to have a standard 2-3/4-inch backset with a full 3/4-inch throw latchbolt. Deadbolt shall be 1-3/4-inch total length with a full 1-inch throw, constructed of stainless steel with anti-saw roller insert.

2.3.2.6 Latchbolts are to be 2-piece anti-friction, manufactured from stainless steel. Solid latchbolts and/or plastic anti friction devices are not acceptable.

2.3.2.7 Lock shall be easily handed without opening the lock case.

2.3.2.8 Lever assembly (external) to be one-piece design attached by threaded bushing. Lever assembly (internal) shall be attached by screwless shank. Lever attachment by common tools (allen nuts and/or set screws) are not acceptable.

2.3.2.9 Lock trim shall be through-bolted to door to assure correct alignment a proper operation and positive interlock. Manufacturers utilizing a through the door spindle for attachment are not acceptable.

2.3.2.10 Hub blocking plate to be solid cast stainless steel. Manufacturers utilizing open hub.

2.3.3 Strikes to be non-handed and bridged to ensure dead latching. Manufacturers utilizing fillers of any kind for dead latch engagement are not acceptable.

2.3.4 Cylinders shall be secured by a cast stainless steel, dual retainer. Manufacturers utilizing screws and/or stamped retainers are not acceptable.

2.3.5 Finish: BHMA #626 (US26D)

2.3.6 Acceptable Manufacturers: Schlage

2.4 Exit Devices

2.4.1 Exit Devices: ANSI/ BHMA A156.3, Grade 1

2.4.1.1 Exit devices shall be listed by UL for accident and hazard. Devices shall conform to applicable requirements of NFPA 80 and NFPA 101.

2.4.1.2 Shape of lever shall be easy to grasp with one hand and not require tight grasping, tight pinching, or twisting of wrist.

2.4.1.3 Exit devices shall not require more than 15 lbf to release latch. Locks shall not require use of a key, tool, or special knowledge for operation.

2.4.1.4 Furnish filler plates and shim kits as needed for flush mounting of devices on doors.

2.4.1.5 Provide touch bars with return stroke hydraulic dampers and rubber bottoming dampers, plus anti-rattle devices for quiet operation.

2.4.1.6 Touch pad shall extend not less than one-half of door width. Touch pad height shall exceed height of mechanism case or rail assembly (T-Shaped) to eliminate pinch parts. If touch pad height does not exceed height of mechanism case/rail assembly, provide insert/filler on top and bottom of touch pad along mechanism case/rail to prevent pinch part. Provide stainless steel touch pads. Plastic touch pads shall not be acceptable.

2.4.1.7 End caps shall be of heavy-duty metal alloy construction and provide horizontal adjustment to provide flush alignment with device cover plate. When device end cap is installed, no raised edges will protrude.

2.4.1.8 Dogging mechanism shall be mechanical hook type. Manufacturers utilizing plastic dogging cams will not be accepted.

2.4.1.9 Surface strikes shall be roller type and come complete with a locking plate underneath to prevent movement. Devices shall have dead latching feature to prevent latchbolt tampering. “Anti-walking” type latches will not be accepted.

2.4.1.10 Devices shall not have exposed rivets or screws on back of device that could be visible through a glass light.

2.4.1.11 When removable mullions are listed provide type controlled by a key cylinder under masterkey system and from same manufacturer as exit device. Furnish stabilizers similar to Von Duprin 154 with removable mullions.

2.4.1.12 Surface vertical rod devices shall be UL labeled for fire door applications without the use of bottom rod assemblies. Where bottom rods are required for security applications, device shall be UL labeled for fire door applications with rod and latch guards by device manufacturer.

2.4.1.13 Outside trim shall be heavy-duty type fastened by means of concealed welded lugs and through-bolts from inside. Trim shall be forged brass with a minimum average thickness on escutcheon of 0.130-inch. Pull plate with trim shall be brass with minimum average thickness of 0.090-inch and have forged pulls.

2.4.1.14 Lever trim shall be designed with a breakaway feature to allow trim to freely rotate while remaining securely locked, preventing damage to internal lock components from vandalism by excessive force.

2.4.1.15 Latch bolts shall have a self-lubricating coating that reduces friction and wear. Plated latch bolts are unacceptable.

2.4.1.16 Devices shall utilize internal compression springs for longer life and better efficiency. Extension or torsion type springs will not be accepted.

2.4.2 Finish: As selected by the Owner.

2.4.3 Acceptable Manufacturers: Sargent, Von Duprin, Yale

2.5 Door Closers

2.5.1 General Requirements:

2.5.1.1 Closers shall be sealed and filled with all-weather fluid. Provide stable hydraulic fluid to withstand a temperature range of 120 degrees F to minus 30 degrees F.

2.5.1.2 Size closers in compliance with requirements for accessibility for handicapped and recommendations of manufacturer. Provide barrier free and delayed action features as needed. Comply with following maximum opening-force requirements:

2.5.1.2.1 Interior Hinged Doors: 5.0 lbs.

2.5.1.2.2 Exterior Hinged Doors: 8.5 lbs.

2.5.1.2.3 Fire Doors: Minimum opening force allowable by authorities having jurisdiction

2.5.2 Surface Closers: ANSI/ BHMA A156.4, Grade 1

2.5.2.1 Surface mounted closers shall be full rack-and-pinion type with cast iron body. Double heat-treated shaft, full complement bearings, single piece forged piston, chrome silicon steel spring, non-critical screw valves; back check, sweep and latch.

2.5.2.2 Furnish closers complete with rectangular, non-ferrous covers, necessary brackets and fasteners for top of door surface mounted units.

2.5.2.3 Closer products with any type of pressure relief valve system shall not be acceptable.

2.5.2.4 Closers shall be ISO 9000 certified. Units shall be stamped with date of manufacturer code.

2.5.2.5 Non-sized closer to be independent lab tested for 10,000,000 cycles.

2.5.2.6 Closers shall be non-sized, field adjustable from size 1 to 6.

2.5.2.7 Furnish non-sized closers with 1-1/2-inch diameter piston.

2.5.2.8 Locate closers on interior side of exterior doors and on non-public side of interior doors, unless otherwise specified.

2.5.2.9 Provide extra-duty arms (EDA) at doors scheduled with parallel arm applications.

2.5.2.10 Provide plates, brackets and special templates when needed for interface with particular header door and wall conditions and adjacent hardware.

2.5.2.11 Closers shall be tested to 100 hours of salt spray test in compliance with ASTM B117; furnish data on request.

2.5.2.12 Closer finish shall be powder coated for better corrosion resistance. Painted finishes will not be accepted.

2.5.2.13 Acceptable Manufacturers: Sargent, LCN, Norton

2.6 Flushbolts

2.6.1 Flushbolts: ANSI/ BHMA A156.16

2.6.1.1 Provide minimum 1/2-inch diameter rods of brass or stainless steel, with minimum 12-inch-long rods for doors up to 7 feet in height. Provide longer rods as needed for doors exceeding 7 feet in height.

2.6.1.2 Provide dustproof strikes for bottom flushbolt applications, except where special threshold construction provides non-recessed strike for bolt.

2.6.1.3 Finish: As selected by the Owner.

2.6.2 Automatic Flushbolts: ANSI/ BHMA A156.16

2.6.2.1 Provide automatic flushbolts for bottom of door and for top of door. When active leaf is opened bottom automatic flushbolts open.

2.6.2.2 Provide dust-proof strikes as scheduled for bottom flushbolt applications.

2.6.2.3 Provide coordinator as scheduled for proper door sequencing.

2.6.2.4 Finish: As selected by the Owner.

2.7 Kick Plates

2.7.1 General Requirements: ANSI/ BHMA A156.6

2.7.1.1 Provide concealed mounting where possible. Where exposed fasteners are used, they shall be countersunk.

2.7.1.2 Push plates shall be beveled on four edges.

2.7.1.3 Where applicable plates shall be prepared to receive cylinder locks or thumb turns as scheduled.

2.7.1.4 Finish: As selected by the Owner.

2.7.2 Push Plates:

2.7.2.1 Size: 4-inch x 16-inch

2.7.2.2 Thickness (US GA): 18 gauge; .050-inch

2.7.2.3 Acceptable Manufacturers: H.B. Ives; Rockwood; Hager

2.8 Seals and Gaskets

2.8.1 General Requirements: ANSI/ BHMA A156.22

2.8.2 Door Sweeps: Pemko or Equal

2.8.2.1 Weather-stripping:

2.8.2.1.1 Apply to head and jambs: Pemko or Equal

2.8.2.2 Meeting Stile Weather-stripping: Self Adhesive silicone seal

2.8.2.2.1 Equal to Pemko, NGP or Reese

2.9 Thresholds

2.9.1 General Requirements: ANSI/ BHMA A156.21

2.9.1.1 Except as otherwise indicated provide standard threshold units of type, size and profile as shown or scheduled.

2.9.1.2 Metal: Extruded aluminum; 6063-T5 alloy

2.9.1.2.1 Finish: Clear anodized; BHMA #628 (US27)

2.9.1.3 Provide thresholds with silicone or neoprene foot seals.

2.9.1.4 Provide thresholds that are 1” wider than depth of frame.

2.9.1.5 Acceptable Manufacturers:

2.9.1.5.1 NGP

2.9.1.5.2 Pemko

2.9.1.5.3 Reese

2.10 Auxiliary Hardware

2.10.1 Silencers: ANSI/ BHMA A156.16

2.10.1.1 Furnish tamper proof resilient cushions designed to absorb shock and noise at openings without gaskets.

2.10.1.2 Provide 3 silencers per single door, and 2 for pairs of doors.

2.10.2 Wall Bumpers: 2-1/2-inch diameter; 1-inch nominal projection

2.10.2.1 Finish: As selected by the Owner.

2.11 Cylinders, Keying Systems and Key Control

2.11.1 General Requirements:

2.11.1.1 Meet with Engineer and Owner to finalize keying requirements and obtain keying instructions in writing. Keying schedule shall be established in compliance with specific requirements determined in consultation with Owner.

2.11.1.2 Keys and key blanks shall be protected by one or more utility patents. This protection shall extend at least into year 2024.

2.11.1.2.1 Cylinders shall incorporate a dual mechanism to check for patented features on keys.

2.11.1.3 Cylinders shall be from the same manufacturer as locks

2.11.1.4 Provide temporary construction keying system during construction period. Permanent keys shall be furnished to Owner's Representative prior to occupancy. Owner or Owner's Security Agent will void operation of construction keys.

2.11.2 Cylinders:

2.11.2.1 Permanent cylinders shall be keyed by manufacturer and configured into sets or subsets, master keyed or great grand master keyed as directed by Owner.

2.11.2.2 Permanent keys and cylinders shall be marked with applicable blind code for identification. These visual key control marks or codes shall not include actual key cuts.

2.11.2.2.1 Key and cylinder identification stamping shall be approved by Engineer and Owner. Failure to properly comply with these requirements shall be cause for replacement of cylinders and keys involved at no additional cost to Owner.

2.11.2.3 Equip locks and cylinders with patent protected, full size interchangeable core cylinders. Provide a minimum of six pins

with nickel silver bottom pins. Cylinders shall allow for multiplex master keying, configured to Owner's instructions.

2.11.3 Key Material:

2.11.3.1 Provide manufacturer's standard embossed keys of nickel silver with a minimum thickness of 0.092-inch to ensure durability. Key Quantity: Furnish keys in following quantities:

2.11.3.1.1 Master Keys: 6 per master group

2.11.3.1.2 Change Keys:

2.11.3.1.2.1 Locks Keyed Alike: 4 per set

2.11.3.1.2.2 Locks Keyed Different: 3 per lock

2.11.3.1.3 Key Blanks: 6 per cylinder

2.11.3.1.4 Temporary Construction Master Keys: 12 total

2.11.3.1.5 Control Keys: 5 total

2.11.3.2 Deliver end user exclusive permanent key blanks and other security keys directly to Owner's representative from manufacturer by secure courier, return receipt requested. Failure to properly comply with these requirements shall be cause for replacement of cylinders and keys involved at no additional cost to Owner.

2.11.4 Acceptable Manufacturers:

2.11.4.1 Locks, Cylinders and Keys: Schlage - Everest Primus and Everest Open patented full size cylinders- No Substitutions.

3 EXECUTION

3.1 Examination

3.1.1 Site Verification of Conditions:

3.1.1.1 Examine doors and frames with Installer present for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

3.1.1.2 Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

3.1.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.1.1.4 Commencement of installation constitutes acceptance of conditions and responsibility for satisfactory performance.

3.2 Preparation

3.2.1 Surface Preparation:

3.2.1.1 Doors and Frames: Comply with DHI A115 Series

3.2.1.1.1 Surface-Applied Door Hardware: Drill and tap doors and frames in compliance with SDI 109.

3.3 INSTALLATION

3.3.1 General Requirements:

3.3.1.1 Install each door hardware item to comply with manufacturers' written instructions using manufacturers' supplied fasteners.

3.3.1.2 Securely install finish hardware items in compliance with accepted schedule and templates furnished with hardware.

3.3.1.3 Install mortised items flush with adjacent surfaces.

3.3.1.4 Install locksets, surface mounted closers, and trim after finishing of doors and frames is complete.

3.3.1.4.1 Where cutting and fitting is needed to install door hardware onto or into surfaces that are to be painted or finished in another way later, coordinate removal, storage, and reinstallation of door hardware with finishing work.

3.3.1.5 Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

3.3.1.6 Drill and countersink units not factory-prepared for anchorage fasteners. Space fasteners and anchors in compliance with industry standards.

3.3.2 Mounting Heights:

3.3.2.1 Mount door hardware units at heights indicated in following applicable publications, unless otherwise specifically indicated or required to comply with governing regulations:

3.3.2.1.1 Doors and Frames: ANSI A250.6

3.3.2.1.1.1 DHI Publication Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames.

3.3.2.1.1.2 DHI Publication Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames.

3.3.3 Door Stops:

3.3.3.1 Door stops shall be furnished for every door leaf. Install floor-mounted or wall-mounted stops, as scheduled. Overhead door holder shall be provided where floor or wall stops cannot be used.

3.3.3.2 Place door stops in such a position that they permit maximum door swing, but do not present a hazard or obstruction. Furnish floor strikes for floor holders of proper height to engage holders of doors.

3.3.3.3 Floor stops shall be installed with risers as needed to accommodate finish flooring materials for proper relationship to door.

3.3.4 Thresholds:

3.3.4.1 Set thresholds for exterior and acoustical doors in full bed of sealant in compliance with requirements specified in Division 7.

3.3.5 Key Control System:

3.3.5.1 Place keys on markers and hooks in key control system cabinet, as determined by final keying schedule.

3.4 Adjusting

3.4.1 Initial Adjustment:

3.4.1.1 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.

3.4.1.2 Adjust door closer sweep period so that from an open position of 70 degrees door will take at least 3 seconds to move to a point 3 inches from latch measured to leading edge of door.

3.4.2 Final Adjustment:

3.4.2.1 Return to Project during week prior to Substantial Completion and make final check and adjustment of hardware items.

3.4.2.2 Adjust hardware so doors operate in perfect order. Test and adjust hardware for quiet, smooth operation, free of sticking, binding, or rattling. Adjust closers for proper, smooth operation.

3.4.2.3 Adjust door control devices to compensate for final operation of heating and ventilating equipment.

3.4.3 Six Month Adjustment:

3.4.3.1 Approximately six months after Date of Substantial Completion, installer shall perform following:

3.4.3.1.1 Examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.4.3.1.2 Consult with, and instruct, Owner's personnel on recommended maintenance procedures.

3.4.3.1.3 Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation.

3.5 Cleaning

3.5.1 Exposed hardware shall be carefully cleaned by methods not injurious to finish, immediately preceding occupancy. Replace defective, damaged, or missing hardware.

3.5.2 Clean adjacent surfaces soiled by hardware installation.

3.5.3 Clean operating items as needed to restore proper function and finish.

3.6 Demonstration

3.6.1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.

3.7 Protection

3.7.1 Provide final protection and maintain conditions that ensure door hardware shall be without damage or deterioration at time of Substantial Completion.

3.7.2 Protect door hardware items from abuse, corrosion and other damage until Owner accepts Project as complete.

3.8 Door Hardware Schedule

3.8.1 General Requirements:

3.8.1.1 To define requirements for materials, size, and design specific products manufactured by certain manufacturers are indicated in door hardware sets. Materials specified herein are cited as minimum standard of quality that will be acceptable and shall not preclude consideration of equivalent or superior materials. Equivalent products by other acceptable manufacturers specified above may be provided.

3.8.1.1.1 Door hardware sets provide quantity, item, size, finish or color indicated and named manufacturer's product.

3.8.1.1.2 Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

End of Section

Section 09900
Painting

1 GENERAL

1.1. Related Documents

1.2. The General Conditions of the Construction Contract and Division 1, General Requirements are a part of this section.

1.3. Description of Work

1.3.1. The extent of painting work is as indicated on the drawings and schedules, and as herein specified.

1.3.2. The work includes the painting and finishing of all interior and exterior exposed items and surfaces throughout the project, as indicated.

1.3.3. Surface preparation, priming and coats of paint specified are in addition to shop priming and surface treatment specified under other sections of the work.

1.3.4. The work includes the field painting of concrete and masonry, exposed steel, and primed metal surfaces of doors and door frames.

1.3.5. The term "paint" as used herein means all coating systems materials, which includes primers, emulsions, enamels, stain, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

1.3.6. Paint all exposed surfaces whether or not colors are designated in any "schedule", except where the natural finish of the material is specifically noted a surface not to be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas. Colors will be selected by the Project Engineer from standard colors available for the materials systems specified.

1.4. Painting Not Included

1.4.1. The following categories of work are not included as part of the field-applied finish work, or are included in other sections of these specifications.

1.4.1.1. Shop Priming

1.4.1.1.1. Unless otherwise specified, shop priming of ferrous metal items is included under the various sections for structural steel, miscellaneous metal items, hollow metal work, and similar items. Also, for such fabricated components as shop-fabricated or factory-built mechanical and electrical equipment or accessories.

1.4.1.2. Pre-finished Items

1.4.1.2.1. Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) metal siding and roofing pre-finished partition systems, acoustic materials, architectural woodwork and casework, finished mechanical and electrical equipment including light fixtures and distribution cabinets, and equipment.

1.4.1.3. Concealed Surfaces

1.4.1.4. Unless otherwise indicated, painting is not required on wall or ceiling surfaces in concealed areas and generally inaccessible areas, such as foundation spaces, furred areas, pipe spaces, and duct shafts as applicable to this project.

1.4.1.5. Finished Metal Surfaces

1.4.1.5.1. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting, unless otherwise indicated.

1.4.1.6. Operating Parts and Labels

1.4.1.6.1. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, linkages, sensing devices, and motor and fan shafts will not require finish painting unless otherwise indicated.

1.4.1.6.2. Do not paint over any code-required label, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

1.5. Product Handling

1.5.1. Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label.

1.5.2. Store materials in location approved by the Owner Representative.

1.5.3. Provide paint manufacturers printed label on each container with the following information:

1.5.3.1. Name or title of material.

1.5.3.2. CSI Spec. number, if applicable.

1.5.3.3. Manufacturer's stock number.

1.5.3.4. Manufacturer's name.

1.5.3.5. Analysis of major pigment and vehicle constituents.

1.5.3.6. Thinning instructions.

1.5.3.7. Application instructions.

1.5.3.8. Color name and number.

1.5.3.9. Manufacturers recommended wet and dry film thickness in mils.

1.6. Job Conditions

1.6.1. Do not apply paint when the temperature of surfaces to be painted and the surrounding air temperatures are below 50 degrees F or above 90 degrees F, unless otherwise permitted by the paint manufacturer's printed instructions.

1.6.2. Do not apply paint in snow, rain, fog or mist; or when the relative humidity exceeds 85 percent; or to damp or wet surfaces. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

1.7. Submittals

1.7.1. Manufacturer's Data

1.7.1.1. For information only, submit copies of manufacturer's technical information, including paint label analysis and application instructions for each material proposed for use. Transmit a copy of each manufacturer's instructions to the paint applicator.

1.7.1.2. List each material and cross-reference to the specific paint and finish system and application. Identify by manufacturer's catalog number and general classifications.

1.7.2. Samples

1.7.2.1. Submit samples for Project Engineer's review of color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor. Provide a listing of the material and application for each coat of each finish sample.

1.8. Color Selection

1.8.1. Prior to beginning work; the Owner Representative will furnish a color schedule for surfaces requiring painting.

1.8.2. Proprietary names used to designate colors or materials are not intended to imply that products of the manufacturers are required to the exclusion of equivalent products of other manufacturers.

1.9. Paint Coordination

1.9.1. Provide finish coats which are compatible with prime paints used. Review other Sections of the Specifications in which prime coats are specified to ensure compatibility of total coatings system. Upon request, furnish information on characteristics of specified finish materials, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Project Engineer in writing of anticipated problems using specified coating systems with substrates specified to receive prime coats in other sections.

2 PRODUCTS

2.1. Materials

2.1.1. Provide the best quality grade of the scheduled types of coatings regularly manufactured by the acceptable paint manufacturers. Materials not displaying the manufacturer's identification as a standard, best grade product will not be acceptable.

2.1.2. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer, and use only within recommended limits.

2.1.3. Provide paints of durable and washable quality. Use paint materials which will withstand normal washing as required to remove pencil marks, ink, ordinary soil, without showing discoloration, loss of gloss, staining, or other damage.

2.1.4. Products produced by the following manufacturers are acceptable alternates.

2.1.4.1. Pittsburgh Paints.

2.1.4.2. Carboline Company.

2.1.4.3. Sherwin-Williams Co.

2.1.4.4. Tnemec Company, Inc.

2.1.4.5. Porter Paints.

2.1.4.6. Benjamin Moore.

2.1.4.7. Approved equal.

3 EXECUTION

3.1. Inspection

3.1.1. Examine the areas and conditions under which painting work is to be performed. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.1.2. Starting of painting work will be construed as acceptance of the surfaces within any particular area.

3.1.3. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film.

3.2. Surface Preparation

3.2.1. General

3.2.1.1. Perform all preparation and cleaning procedures in strict accordance with the manufacturer's instructions and as herein specified, for each particular substrate condition.

3.2.1.2. Remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items.

3.2.1.3. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program the cleaning and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.

3.2.2. Previously-Painted Surfaces

3.2.2.1. Totally remove existing paint when: Surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.

3.2.2.2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.

3.2.2.3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.

3.2.2.4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.

3.2.2.5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

3.2.3. Cementitious Materials

3.2.3.1. Prepare cementitious surfaces of concrete to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required remove glaze, concrete hardeners and form release compounds.

3.2.3.2. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, correct this condition before application of paint. Do not paint over surfaces where the moisture content exceeds limits permitted by the manufacturer's printed directions.

3.2.4. Ferrous Metals

3.2.4.1. Clean non-galvanized, ferrous surfaces that have not been shop-coated of all oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning, complying with SSPC recommendations.

3.2.4.2. Touch-up all shop-applied prime coats which have damaged, or bare areas, where required by other sections of the specifications. Wire brush, solvent clean, and touch-up with the same primer as the shop coat.

3.2.5. Oil and Grease

3.2.5.1. Remove by wiping clean with mineral spirits.

3.2.6. Mold or Mildew

3.2.6.1. Remove mold or mildew before painting. Scrub surface with stiff

brush and a solution of one quart of household bleach to three quarts of water. Allow solution to remain on surface for 10 minutes then thoroughly rinse with clean water. Allow to dry for 2 days before painting.

3.2.7. Dirt and Other Foreign Matter

3.2.7.1. Remove with stiff bristle brush and blow clean with air pressure or steam clean.

3.3. Mechanical and Electrical Work

3.3.1. Painting of piping: Uninsulated pipe as indicated shall be painted as follows:

3.3.1.1. Paint shall be the same color as adjacent work or as directed in the piping specification.

3.3.2. Mechanical items to be painted include, but are not limited to, the following:

3.3.2.1. Piping, pipe hangers, and pipe support system.

3.3.2.2. Accessory items.

3.4. Materials Preparation

3.4.1. Mix and prepare painting materials in accordance with manufacturer's directions.

3.4.2. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

3.4.3. Stir materials before application to produce a mixture of uniform density, and stir as required during the application of the materials. Do not stir surface film into the material. Remove the film and if necessary, strain the material before using.

3.5. Application

3.5.1. General

3.5.1.1. Apply paint by brush, roller or spray in accordance with the manufacturer's directions. Use brushes best suited for the type of material being applied. Use rollers of carpet, velvet back, or high pile sheep's wool as recommended by the paint manufacturer for material and texture required. Spray paint uniformly with suitable equipment.

3.5.1.2. Provide a non-slip skid resistant surface on all floors.

3.5.1.3. The number of coats and paint film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has completely dried. Sand between coat applications with fine sandpaper, or rub surfaces with pumice stone where required to produce an even, smooth surface in accordance with the coating manufacturer's directions.

3.5.1.4. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance.

3.5.1.5. "Exposed surfaces" shall mean areas visible when permanent or built-in fixtures, convector covers, grilles, and other items are in place in areas scheduled to be painted.

3.5.1.6. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only.

3.5.1.7. Paint the back sides of access panels, removable, or hinged covers to match the exposed surfaces.

3.5.1.8. Finish doors on tops, bottoms, and side edges the same as the faces.

3.5.1.9. Sand lightly between each succeeding enamel or varnish coat.

3.5.1.10. Omit the first coat (primer) on metal surfaces which have been shop-primed and touch-up painted.

3.5.2. Minimum Coating Thickness

3.5.2.1. Apply each material at not less than the manufacturer's recommended spreading rate, to provide a total wet and dry film thickness of not less than that indicated on the manufacturer's printed label.

3.5.3. Scheduled Painting

3.5.3.1. Apply the first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

3.5.3.2. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

3.5.4. Prime Coats

3.5.4.1. Before application of finish coats, apply a prime coat to material which is required to be painted or finished, and which has not been prime coated.

3.5.4.2. Recoat primed and sealed walls where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

3.5.5. Pigmented (Opaque) Finishes

3.5.5.1. Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.

3.5.6. Brush Application

3.5.6.1. Brush-out and work all brush coats onto the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable. Neatly draw all glass lines.

3.5.6.2. Brush apply all primer or first coats, unless use of mechanical applicators is permitted.

3.5.7. Mechanical Applications

3.5.7.1. Limit roller applications (generally) to interior wall finishes for second and third coats. Apply each roller coat to provide the equivalent hiding as brush-applied coats.

3.5.7.2. Confine spray application (generally) to metal framework, decking, wire mesh and similar surfaces where hand brush work would be inferior.

3.5.7.3. Wherever spray application is used, apply each coat to provide the equivalent hiding of brush-applied coats. Do not double back with spray equipment for the purpose of building up film thickness of 2 coats in one pass.

3.5.8. Completed Work

3.5.8.1. Match approved samples for color, texture and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

3.5.9. Protection

3.5.9.1. Protect work of other trades, whether to be painted or not, against damage by the painting and finishing work. Leave all such work undamaged. Correct any damaged by cleaning, repairing or replacing, and repainting, as acceptable to the Project Engineer.

3.5.9.2. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

3.5.10. Clean-up

3.5.10.1. During the progress of the work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.

3.5.10.2. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

3.5.10.3. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.6. Painting Schedule – See plans for Product Schedule and Coating finishes

3.7. Shop Priming Systems – Ferrous Metals

3.7.1. Shop prime ferrous metal products specified in other sections of the specifications in accordance with the requirements set forth herein.

3.7.1.1. Normal exposure, submerged and non-submerged

3.7.1.1.1. Surface preparation: SSPC SP-10 new white blast cleaning

3.7.1.1.2. Shop prime: Macropoxy 646 FC, 5.0 to 10 mils DFT

3.8. Field Quality Control

3.8.1. The Owner reserves the right to engage the services of an independent testing laboratory to sample the paint and material being used. Samples of the material on the project site shall be taken identified, sealed and certified in the presence of the contractor.

3.8.2. The testing laboratory shall perform appropriate tests for a variety of characteristics as required by the Owner.

3.8.3. If the tests results show the material being used does not comply with the specifications requirements, the contractor shall be directed to stop painting, remove the non-complying material, pay for the testing, repaint the surfaces

coated with the rejected material, and remove rejected material from the previously painted surfaces. An alternate, at the discretion of the Owner is to apply an additional coat of material on all surfaces.

End of Section

Section 092900
Gypsum Board

1 GENERAL

1.1 Summary

1.1.1 This Section includes the following:

1.1.1.1 Interior gypsum board.

1.1.1.2 Tile backing panels.

1.2 Submittals

1.2.1 Product Data: For each type of product indicated.

1.3 Quality Assurance

1.3.1 Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2 PRODUCTS

2.1 Interior Gypsum Board

2.1.1 General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

2.1.1.1 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:

2.1.1.1.1 American Gypsum Co.

2.1.1.1.2 G-P Gypsum.

2.1.1.1.3 National Gypsum Company.

2.1.1.1.4 USG Corporation.

2.1.2 Regular Type: Thickness 5/8-inch; Long Edges: Tapered.

2.1.3 Regular-type gypsum panels are also available in 1/4- and 3/8-inch (6.4- and 9.5-mm) thicknesses for limited applications.

2.1.4 Type X: Thickness 5/8-inch; Long Edges: Tapered.

2.1.5 Special fire-Type X gypsum board has fire-resistive capability greater than that of standard Type X. For rated assemblies, panels from different manufacturers cannot be intermixed because ratings apply only to assemblies identical in materials and construction to those tested. Design designations of independent testing agencies indicated on Drawings generally determine product requirements for special Type X gypsum board.

2.1.6 Flexible Type: Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness: Thickness 1/4-inch; Long Edges: Tapered.

2.1.7 Ceiling: Manufactured to have more sag resistance than regular-type gypsum board: Thickness: 1/2 inch; Long Edges: Tapered.

2.1.8 Foil-backed gypsum board is not recommended for use in hot, humid climates such as the Southern Atlantic and Gulf Coast areas of the U.S.

2.1.9 Examples of moisture- and mold-resistant panels include USG's "SHEETROCK Brand HUMITEK" panels and National Gypsum's "XP Wallboard," which are both paper faced and comply with ASTM C 36/C 36M; and G-P's "DensArmor Interior Guard" panels, which have coated glass-mat facings and comply with both ASTM C 36/C 36M and ASTM C 1177/C 1177M.

2.1.10 Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces: Core: 5/8-inch; Long Edges: Tapered.

2.1.11 Impact Resistant Gypsum Wallboard: Core ½’ long edges tapered.

2.2 Tile Backing Panels

2.2.1 Cementitious Backer Units: ANSI A108.1.

2.2.1.1 Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2.2.1.1.1 Custom Building Products; Wonderboard.

2.2.1.1.2 FinPan, Inc.; Util-A-Crete Concrete Backer Board.

2.2.1.1.3 USG Corporation; DUROCK Cement Board.

2.2.1.2 Thickness: 1/2 inch.

2.3 Trim Accessories

2.3.1 Interior Trim: ASTM C 1047.

2.3.1.1 Material: Galvanized steel sheet.

2.3.1.2 Shapes:

2.3.1.2.1 Cornerbead.

2.3.1.2.2 LC-Bead: J-shaped; exposed long flange receives joint compound.

2.3.1.2.3 L-Bead: L-shaped; exposed long flange receives joint compound.

2.3.1.2.4 U-Bead: J-shaped; exposed short flange does not receive joint compound.

2.3.1.2.5 Curved-Edge Cornerbead: With notched or flexible flanges.

2.3.2 Aluminum Trim: Extruded accessories of profiles and dimensions indicated. Located at exterior soffit at entry canopy.

2.3.2.1 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:

2.3.2.1.1 Fry Reglet Corp.

2.3.2.1.2 Gordon, Inc.

2.3.2.1.3 Pittcon Industries.

2.3.2.2 Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.

2.3.2.3 Finish: provide Class II anodic finishes and factory-painted, baked-enamel finishes.

2.4 Joint Treatment Materials

2.4.1 General: Comply with ASTM C 475/C 475M.

2.4.2 Joint Tape:

2.4.2.1 Interior Gypsum Wallboard: Paper.

2.4.2.2 Tile Backing Panels: As recommended by panel manufacturer.

2.4.3 Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.4.3.1 Prefilling

2.4.3.2 Embedding and First Coat

2.4.3.3 Fill Coat

2.4.3.4 Finish Coat

2.4.4 Joint Compound for Tile Backing Panels:

2.4.4.1 Cementitious Backer Units: As recommended by backer unit manufacturer.

2.5 Auxiliary Materials

2.5.1 General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

2.5.2 Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

2.5.2.1 Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5.3 Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

2.5.3.1 Delete subparagraph below if panels are not attached to cold-formed metal framing specified in Division 5.

2.5.3.2 Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

2.5.3.3 For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

3 EXECUTION

3.1 Applying and Finishing Panels, General

3.1.1 Comply with ASTM C 840.

3.1.2 Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

3.1.3 Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm) 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.

3.1.4 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.

3.2 Applying Interior Gypsum Board

3.2.1 Install interior gypsum board as indicated on partition tags on drawings

3.3 Applying Tile Backing Panels

3.3.1 Cementitious Backer Units: ANSI A108.1, at showers, tubs, and where indicated to receive tile.

3.4 Installing Trim Accessories

3.4.1 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.

3.4.2 Control Joints: Install control joints according to ASTM C 840 and as approved by Engineer.

3.4.3 Interior Trim: Install in the following locations:

3.4.3.1 Cornerbead: Use at outside corners, unless otherwise indicated.

3.4.3.2 U-Bead: Use at exposed panel edges.

3.4.4 Aluminum Trim: Install in locations indicated on Drawings.

3.5 Finishing Gypsum Board

3.5.1 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.

3.5.2 Prefill open joints and damaged surface areas.

3.5.3 Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

3.5.4 Gypsum Board Finish Levels: Finish panels to levels indicated below:

3.5.4.1 Level 1: Ceiling plenum areas, concealed areas, and where indicated.

3.5.4.2 Level 2: Panels that are substrate for acoustical tile.

3.5.4.3 Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.

3.5.5 Level 5 is suitable for surfaces receiving gloss and semigloss enamels and surfaces subject to severe lighting. It is considered a high-quality gypsum board finish.

3.5.6 Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.6 Protection

3.6.1 Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

3.6.2 Remove and replace panels that are wet, moisture damaged, and mold damaged.

3.6.2.1 Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

3.6.2.2 Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

End of Section

Section 142400
Hydraulic Passenger Elevators

1 GENERAL

1.1 Summary

1.1.1 Section includes: Hydraulic passenger elevators as shown and specified. Elevator work includes:

1.1.1.1 Pre-engineered hydraulic passenger elevators.

1.1.1.2 Elevator car enclosures, hoistway entrances and signal equipment.

1.1.1.3 Operation and control systems.

1.1.1.4 Jack(s).

1.1.1.5 Accessibility provisions for physically disabled persons.

1.1.1.6 Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.

1.1.1.7 Materials and accessories as required to complete the elevator installation.

1.1.2 Related Sections:

1.1.2.1 Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.

1.1.2.2 Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.

1.1.2.3 Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.

1.1.2.4 Division 5 Metals:

1.1.2.4.1 Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.

1.1.2.4.2 Providing steel angle sill supports and grouting hoistway entrance sills and frames.

1.1.2.5 Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.

1.1.2.6 Division 16 Sections:

1.1.2.6.1 Providing electrical service to elevators, including fused disconnect switches.

1.1.2.6.2 Emergency power supply, transfer switch and auxiliary contacts.

1.1.2.6.3 Heat and smoke sensing devices.

1.1.2.6.4 Convenience outlets and illumination in control room, hoistway and pit.

1.1.2.7 Division 22 Plumbing

1.1.2.7.1 Sump pit and oil interceptor.

1.1.2.8 Division 23 Heating, Ventilation and Air Conditioning

1.1.2.8.1 Heating and ventilating hoistways and/or control room.

1.1.3 General contractor shall provide the following in accordance with the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Part 3 for hydraulic elevators. State or local requirements must be used if more stringent.

1.1.3.1 Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.

1.1.3.2 Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.

1.1.3.3 Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point.

1.1.3.4 Elevator hoistways shall have barricades, as required.

1.1.3.5 Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.

1.1.3.6 Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.

1.1.3.7 Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.

1.1.3.8 Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.

1.1.3.9 Machine room to be enclosed and protected.

1.1.3.10 Machine Room temperature must be maintained between 55º and 90º F.

1.1.3.11 If machine room is remote from the elevator hoistway, clear access must be available above the ceiling or metal/concrete raceways in floor for oil line and wiring duct from machine room.

1.1.3.12 Access to the machinery space and machine room must be in accordance with the governing authority or code.

1.1.3.13 Provide an 8” x 16” cutout through machine room wall, for oil line and wiring duct, coordinated with elevator contractor at the building site.

1.1.3.14 All wire and conduit should run remote from the hoistways.

1.1.3.15 When heat, smoke or combustion sensing devices are required, connect to elevator control cabinet terminals. Contacts on the sensors should be sided for 12 volt D.C.

1.1.3.16 Install and furnish finished flooring in elevator cab.

1.1.3.17 Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening

size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.

1.1.3.18 Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.

1.1.3.19 Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.

1.1.3.20 To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.

1.1.3.21 The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.

1.1.3.22 General Contractor shall fill and grout around entrances, as required.

1.1.3.23 Elevator sill supports shall be provided at each opening.

1.1.3.24 All walls and sill supports must be plumb where openings occur.

1.1.3.25 For applications with jack hole, free and clear access to the elevator pit area for the jack hole-drilling rig is required.

1.1.3.26 Where jack hole is required, remove all spoils from jack hole drilling.

1.1.3.27 Jack hole shall accommodate the jack unit. The jack hole is to be provided in strict accordance with the elevator contractor's shop drawings.

1.1.3.28 Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.

1.1.3.29 A light switch and fused disconnect switch for each elevator should be located inside the machine room adjacent to the door, where practical, per the National Electrical Code (NFPA No. 70).

1.1.3.30 For signal systems and power operated door: provide ground and branch wiring circuits, including main line switch.

1.1.3.31 For car light and fan: provide a feeder and branch wiring circuits, including main line switch.

1.1.3.32 Wall thickness may increase when fixtures are mounted in drywall. These requirements must be coordinated between the general contractor and the elevator contractor.

1.1.3.33 Provide supports, patching and recesses to accommodate hall button boxes, signal fixtures, etc.

1.1.3.34 Locate telephone and convenience outlet on control panel.

1.2 Submittals

1.2.1 Product data: When requested, the elevator contractor shall provide standard cab, entrance and signal fixture data to describe product for approval.

1.2.2 Shop drawings:

1.2.2.1 Show equipment arrangement in the corridor, pit, and hoistway and/or optional control room. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.

1.2.2.2 Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.

1.2.2.3 Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.

1.2.2.4 Indicate electrical power requirements and branch circuit protection device recommendations.

1.2.3 Powder Coat paint selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

1.2.4 Plastic laminate selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

1.2.5 Metal Finishes: Upon request, standard metal samples provided.

1.2.6 Operation and maintenance data. Include the following:

1.2.6.1 Owner's manuals and wiring diagrams.

1.2.6.2 Parts list, with recommended parts inventory.

1.3 Quality Assurance

1.3.1 Manufacturer Qualifications: An approved manufacturer with minimum 15 years of experience in manufacturing, installing, and servicing elevators of the type required for the project.

1.3.1.1 The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment.

1.3.1.1.1 The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system.

1.3.1.2 The manufacturer shall have a documented, on-going quality assurance program.

1.3.1.3 ISO-9001:2000 Manufacturer Certified

1.3.1.4 ISO-14001:2004 Environmental Management System Certified

1.3.1.5 LEED Gold certified elevator manufacturing facility.

1.3.2 Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.

1.3.3 Regulatory Requirements:

1.3.3.1 ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.

1.3.3.2 Building Code: National.

1.3.3.3 NFPA 70 National Electrical Code.

1.3.3.4 NFPA 80 Fire Doors and Windows.

1.3.3.5 Americans with Disabilities Act - Accessibility Guidelines (ADAAG)

1.3.3.6 Section 407 in ICC A117.1, when required by local authorities

1.3.3.7 CAN/CSA C22.1 Canadian Electrical Code

1.3.3.8 CAN/CSA B44 Safety Code for Elevators and Escalators.

1.3.3.9 California Department of Public Health Standard Method V1.1–2010, CA Section 01350

1.3.4 Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).

1.3.5 Inspection and testing:

1.3.5.1 Contractor shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.

1.3.5.2 Arrange for inspections and make required tests.

1.3.5.3 Deliver to the Owner upon completion and acceptance of elevator work.

1.3.6 Sustainable Product Qualifications:

1.3.6.1 Environmental Product Declaration:

1.3.6.1.1 GOOD: If Product Category Rules (PCR) are not available, produce a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate scope.

1.3.6.1.2 BEST: If Product Category Rules (PCR) are available, produce and publish an Environmental Product Declaration (EPD) based on a critically reviewed life-cycle assessment conforming to ISO 14044, with external verification recognized by the EPD program operator.

1.3.6.2 Material Transparency:

1.3.6.2.1 GOOD: Provide Health Product Declaration at any level

1.3.6.2.2 BETTER: Provide Health Product Declaration (HPD v2 or later). Complete, published declaration with full disclosure of known hazards, prepared using the Health Product Declaration Collaborative's "HPD builder" on-line tool.

1.3.6.2.3 BEST: Cradle to Cradle Material Health Certificate v3, Bronze level or higher.

1.3.6.3 LEED v4 – Provide documentation for all Building Product Disclosure AND Optimization credits in LEED v4 for product specified.

1.3.6.4 Living Building Challenge Projects: Provide Declare label for products specified.

1.4 Delivery, Storage And Handling

1.4.1 Manufacturing shall deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

1.5 Project Conditions

1.5.1 Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the Owner.

1.5.2 Provide the hole for the jack unit digging and a casing if required to retain the walls of the hole. General contractor shall remove excavation spoils deposited in the elevator pit.

1.5.2.1 If a physical obstruction or hindrance is encountered below the ground surface, including boulders, rock, gravel, wood, metal, pilings, sand, water, quick sand, caves, public utilities or any other foreign material, obtain written authorization to proceed with excavating using special excavation equipment.

1.5.2.2 Maintain a daily log of time and material costs involved.

1.6 Warranty

1.6.1 Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months after final acceptance.

1.7 Maintenance

1.7.1 Furnish maintenance and call back service for a period of 12 months for each

elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.

1.7.1.1 Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.

1.7.1.2 Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.

1.7.1.3 Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

2 PRODUCTS

2.1 Manufacturers

2.1.1 Manufacturer: Manufacturer shall be TK Elevator's Endura hydraulic elevator or approved equivalent.

2.2 Materials, General

2.2.1 All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD, and shall meet the California Department of Public Health Standard Method V1.1-2010, CA Section 01350 as mentioned in 1.03.9 of this specification.

2.2.2 Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.

2.2.3 Steel:

2.2.3.1 Shapes and bars: Carbon.

2.2.3.2 Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.

2.2.3.3 Finish: Factory-applied powder coat for structural and architectural parts. Color selection must be based on elevator manufacture's standard selections.

2.3.4 Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050" thickness. Laminate

selection must be based on elevator manufacture's standard selections.

2.3.5 Provide decorative flooring as approved by the Engineer.

2.3 Hoistway Equipment

2.3.1 Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.

2.3.2 Sling: Steel stiles bolted or welded to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.

2.3.3 Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.

2.3.4 Guides: Slide guides shall be mounted on top and bottom of the car.

2.3.5 Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.

2.3.6 Jack: A jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to ensure adequate strength and freedom from leakage Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless telescopic 3-stage. Two jacks piped together, mounted one on each side of the car with each having three telescopic sections designed to extend in a synchronized manner when oil is pumped into the Assembly. Each jack section will be guided from within the casing or the plunger assembly used to house the section. Each plunger shall have a high pressure sealing system which will not allow for seal movement or displacement during the course of operation. A follower guide shall be furnished for the top of the lower two plungers and be guided by rollers running inside a steel guide channel which is firmly attached to the guide rail system. This plunger guide system shall maintain a stabilized support for the plunger sections. Each Jack Assembly shall have check valves built into the assembly to allow for automatically re-syncing the three plunger sections by moving the jack to its fully contracted position.

2.3.7. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to

automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.

2.3.8 Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit. Provide proper grade inherently biodegradable oil as specified by the manufacturer of the power unit (see Power Unit section 2.04.G for further details)

2.4 Power Unit

2.4.1 Power Unit (Oil Pumping and Control Mechanism): A self-contained unit consisting of the following items:

2.4.1.1 An oil reservoir with tank cover.

2.4.1.2 An oil hydraulic pump.

2.4.1.3 An electric motor.

2.4.1.4 An oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.

2.4.2 Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.

2.4.3 Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating shall be selected for specified speed and load.

2.4.4 Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.

2.4.4.1 Relief valve shall be adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that

required to barely open the valve.

2.4.4.2 Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.

2.4.4.3 Check valve shall be designed to close quietly without permitting any perceptible reverse flow.

2.4.4.4 Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.

2.4.4.5 Provided with constant speed regulation in both up and down direction. Feature to compensate for load changes, oil temperature, and viscosity changes.

2.4.4.6 Solid State Starting: Provide an electronic starter featuring adjustable starting currents.

2.4.4.7 Oil Type: Provide a zinc free, inherently biodegradable lubricant formulated with premium base stocks to provide outstanding protection for demanding hydraulic systems, especially those operating in environmentally sensitive areas.

2.5 Hoistway Entrances

2.5.1 Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction. Doors shall have shatter proof glass windows that allow interior of elevator car to be viewed from outside.

2.5.1.1 Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware.

2.5.1.2 Main landing door & frame finish: ASTM A1008 steel panels, factory applied powder coat finish with factory-applied powder coat finish entrance frame.

2.5.1.3 Typical door & frame finish: ASTM A366 steel panels, factory applied powder coat enamel finish with factory-applied powder coat finish entrance frame.

2.5.2 Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.

2.5.3 Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.

2.5.3.1 Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.

2.5.3.2 Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.

2.5.3.3 Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

2.5.4 Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.6 Passenger Elevator Car Enclosure

2.6.1 Car Enclosure:

2.6.1.1 Walls: Cab type TKAP, reinforced cold-rolled steel with two coats factory applied baked enamel finish, with applied vertical wood core panels covered on both sides with stainless steel: ASTM A 167, stainless steel panels, No. 4 satin finish.

2.6.1.2 Reveals and frieze: a. Reveals and frieze: Stainless steel, no. 4 brushed finish

2.6.1.3 Canopy: Cold-rolled steel with hinged exit.

2.6.1.4 Ceiling: Downlight type, metal pans with suspended LED downlights and dimmer switch. Number of downlights shall be dependent on platform size with a minimum of six. The metal pans shall be finished with a stainless steel, no. 4 brushed finish.

2.6.1.5 Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel

2.6.1.6 Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides. Doors shall have shatter proof glass windows that allow interior of elevator car to be viewed from outside.

2.6.1.6.1 Door Finish: Stainless steel panels: No. 4 brushed finish.

2.6.1.6.2 Cab Sills: Extruded aluminum, mill finish.

2.6.1.7 Handrail: Provide 1.5' diameter cylindrical metal on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.

2.6.1.8 Ventilation: Manufacturer's standard exhaust fan, mounted on the car top.

2.6.2 Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection" switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.7 Door Operation

2.7.1 Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.

2.7.1.1 No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.

2.7.1.2 Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.

2.7.1.3 Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel shall reverse and the door shall reopen to answer the other call.

2.7.1.4 Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.

2.7.1.5 Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.

2.7.1.6 Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.

2.7.1.7 Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.

2.7.1.8 Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

2.7.2 Door Protection Device: Provide a door protection system using microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.8 Car Operating Station

2.8.1 Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Wrap return shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED's shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.

2.8.2 Emergency Communications System: Integral phone system provided to ensure compatibility with Voice over Internet Protocol (VoIP) compatibility for connecting to Town Segra Phone System.

2.8.3 Auxiliary Operating Panel: Not Required

2.8.4 Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.

2.9 Control Systems

2.9.1 Controller: The elevator control system shall be microprocessor based and software oriented. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.

2.9.2 Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.

2.9.3 Emergency Power Operation: (10-DOA) Upon loss of the normal power supply, building-supplied standby power is available on the same wires as the normal power

supply. Once the loss of normal power is detected and standby power is available, the elevator is lowered to a pre-designated landing and the doors are opened. After passengers have exited the elevator, the doors are closed and the car is shut down. When normal power is restored, the elevator automatically resumes operation.

2.10 Hall Stations

2.10.1 Hall Stations, General: Vandal resistant buttons with center jewels which illuminate to indicate that a call has been registered at that floor for the indicated direction. Each button shall be provided with an internal automatic stop to prevent damage of switches that register the call. Provide 1 set of pushbutton risers. All fixtures shall be vandal resistant type.

2.10.1.1 Provide one pushbutton riser with faceplates having a brushed stainless steel finish.

2.10.1.1.1 Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.

2.10.2 Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

2.11 Miscellaneous Elevator Components

2.11.1 Oil Hydraulic Silencer: Install multiple oil hydraulic silencers (muffler device) at the power unit location. The silencers shall contain pulsation absorbing material inserted in a blowout proof housing.

3 EXECUTION

3.1 Examination

3.1.1 Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.1.2 Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.2 Installation

3.2.1 Install elevator systems components and coordinate installation of hoistway wall

construction.

3.2.1.1 Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.

3.2.1.2 Comply with the National Electrical Code for electrical work required during installation.

3.2.2 Jack unit excavation: Drill or otherwise excavate below elevator pit construction as required to install the jack unit.

3.2.2.1 Install casing for jack unit.

3.2.2.2 Provide HDPE jack protection system for all in ground jacks.

3.2.2.3 Set casing for jack unit assembly plumb, and partially fill with water settled sand, eliminating voids. Back fill depth shall be sufficient to hold the bottom of the jack in place over time.

3.2.3 Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.

3.2.4 Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.

3.2.5 Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.

3.2.6 Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.

3.2.7 Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.

3.2.8 Alignment: Coordinate installation of hoistway entrances with installation of elevator

guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.

3.2.9 Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.

3.2.10 Lubricate operating parts of system, where recommended by manufacturer.

3.3 Field Quality Control

3.3.1 Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.

3.3.2 Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.4 Adjusting

3.4.1 Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.5 Cleaning

3.5.1 Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.

3.5.2 At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.

3.5.2.1 Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

3.6 Protection

3.6.1 At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.7 Demonstration

3.7.1 Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Provide 2 - 8 hour man days of manufacturer training in the operation and maintenance of the elevator. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

3.7.2 Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.8 Elevator Schedule

3.8.1 Elevator Qty. 2 (East and West Towers)

3.8.1.1 Elevator Model: Endura Twinpost above-ground 3-stage

3.8.1.2 Elevator Type: Hydraulic Passenger

3.8.1.3 Rated Capacity: 3500 lbs.

3.8.1.4 Rated Speed: 125 ft./min.

3.8.1.5 Operation System: TAC32H

3.8.1.6 Travel: 27'-6"

3.8.1.7 Landings: 2 total

3.8.1.8 Openings:

3.8.1.8.1 Front: 2

3.8.1.8.2 Rear: 0

3.8.1.9 Clear Car Inside: 6'-8" wide x 5'-5" deep

3.8.1.10 Inside clear height: 8'-4" standard

3.8.1.11 Door clear height: 7'-0" standard

3.8.1.12 Hoistway Entrance Size: 3'-6" wide x 7'-0" high

3.8.1.13 Door Type: One-speed Center opening

3.8.1.14 Power Characteristics: 208 volts, 3 Phase, 60 Hz.

3.8.1.15 Seismic Requirements: No

3.8.1.16 Hoistway Dimensions: 8'-8" wide x 6'-11" deep

3.8.1.17 Pit Depth: 4'-0"

3.8.1.18 Button & Fixture Style: Vandal Resistant Signal Fixtures

End of Section

Section 260500
Common Work Results for Electrical

1 GENERAL

1.1 Section Requirements

1.1.1 Submittals:

1.1.1.1 Product Data: For raceways, conductors, and grounding materials.

2 PRODUCTS

2.1 Raceways

2.1.1 Raceways:

2.1.1.1 EMT: ANSI C80.3, zinc-coated steel, with compression fittings.

2.1.1.2 LFMC: Zinc-coated, flexible steel with sunlight-resistant and mineral-oil-resistant plastic jacket.

2.1.1.3 RNC: NEMA Type EPC-80-PVC, with NEMA TC3 fittings.

2.1.1.4 RSC: Rigid Steel Conduit, ANSI C80.1 threaded fittings.

2.1.1.5 PVC coated RSC: Where specified and where indicated on the construction drawings.

2.1.1.6 Raceway Fittings: Specifically designed for raceway type used in Project.

2.2 Conductors And Cables

2.2.1 Conductors:

2.2.1.1 Conductors, No. 10 AWG and Smaller: Solid copper.

2.2.1.2 Conductors, Larger than No. 10 AWG: Stranded copper.

2.2.1.3 Insulation: Thermoplastic, rated at 75 deg C minimum.

2.2.1.4 Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

2.3 Grounding Materials

2.3.1 Conductors: Solid for No. 8 AWG and smaller, and stranded for No. 6 AWG and larger unless otherwise indicated.

2.3.1.1 Insulated Conductors: Tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

2.3.1.2 Bare, Solid-Copper Conductors: Comply with ASTM B 3.

2.3.1.3 Bare, Stranded-Copper Conductors: Comply with ASTM B 8.

2.3.2 Ground Rods: Copper-clad steel, sectional type; 3/4 by 96 inches in diameter, unless otherwise indicated.

2.4 Electrical Identification Materials

2.4.1 Raceway Identification Materials: Self-adhesive, color-coding vinyl tape; flexible, preprinted, self-adhesive vinyl.

2.4.2 Conductor Identification Materials: Color-Coding Conductor Tape: Self-adhesive vinyl tape 1 to 2 inches wide.

2.4.3 Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, polyethylene tape with continuous metallic strip or core.

2.4.4 Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with circuit identification legend machine printed by thermal transfer or equivalent process.

2.4.5 Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

2.4.6 Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.

2.4.7 Equipment Identification Labels: Engraved, laminated acrylic or melamine label; punched or drilled for screw mounting. White letters on a dark-gray background; red letters for emergency systems.

2.4.8 Fasteners: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.5 Support And Anchorage Components

2.5.1 Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.

2.5.2 Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly, and provide finish suitable for the environment in which installed.

2.5.2.1 Channel Dimensions: Selected for structural loading.

2.5.3 Raceway and Cable Supports: As described in NECA 1.

2.5.4 Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and fittings.

2.5.5 Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded malleable-iron body and insulating wedging.

2.5.6 Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

2.5.7 Mounting, Anchoring, and Attachment Components:

2.5.7.1 Powder-Actuated Fasteners: Threaded-steel stud.

2.5.7.2 Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete.

2.5.7.3 Concrete Inserts: Steel or malleable-iron, slotted-support-system units similar to MSS Type 18; complying with MFMA-3 or MSS SP-58.

2.5.7.4 Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

2.5.7.5 Through Bolts: Structural type, hex head, high strength; complying with ASTM A 325.

2.5.7.6 Toggle Bolts: All-steel springhead type.

2.5.7.7 Hanger Rods: Threaded steel.

2.6 Sleeves For Raceways And Cables

2.6.1 Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.6.2 Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

2.7 Grout

2.7.1 Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

3 EXECUTION

3.1 General Electrical Equipment Installation Requirements

3.1.1 Install electrical equipment to allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

3.1.2 Install electrical equipment to provide for ease of disconnecting the equipment with minimum interference to other installations.

3.1.3 Install electrical equipment to allow right of way for piping and conduit installed at required slope.

3.1.4 Install electrical equipment to ensure that connecting raceways, cables, wireways, cable trays, and busways are clear of obstructions and of the working and access space of other equipment.

3.1.5 Install required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

3.1.6 Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

3.1.7 Install sleeve and sleeve seals of type and number required for sealing electrical service penetrations of exterior walls.

3.1.8 Comply with NECA 1.

3.2 Raceway And Cable Installation

3.2.1 Outdoor Raceways Applications:

3.2.1.1 Exposed or Concealed: PVC Coated RSC.

3.2.1.2 Underground and Beneath Roadways: Concrete-encased RNC.

3.2.1.3 Connection to Vibrating Equipment: LFMC.

3.2.1.4 Boxes and Enclosures: Metallic, NEMA 250, Type 4X.

3.2.1.5 Underground and Not Subject to Vehicular Traffic: Direct-buried RNC.

3.2.2 Indoor Raceways Applications:

3.2.2.1 Exposed: PVC Coated RSC.

3.2.2.2 Concealed within Masonry Walls: EMT.

3.2.2.3 Connection to Vibrating Equipment: LFMC; in wet or damp locations, use LFMC.

3.2.2.4 Damp or Wet Locations: PVC Coated RSC.

3.2.2.5 Boxes and Enclosures: Cast Metal, unless otherwise indicated.

3.2.2.6 Embedded in Slabs: RNC.

3.2.3 Install raceways and cables at least 6 inches above hot-water pipes. Locate horizontal raceway runs above water piping.

3.2.4 Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1-inch- thick concrete cover.

3.2.4.1 Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

3.2.4.2 Space raceways laterally to prevent voids in concrete.

3.2.4.3 Install conduit larger than 1-inch trade size, parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.

3.2.4.4 Transition from RNC to PVC coated RSC before rising above floor; above the floor transition to RAC.

3.2.5 Raceways Embedded in Slabs:

3.2.5.1 Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

3.2.5.2 Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3.2.6 Install pull wires in all empty raceways.

3.2.7 Connect motors and equipment subject to vibration, noise transmission, or movement with a 72-inch maximum length of flexible conduit.

3.3 Wiring Methods

3.3.1 Service Entrance including Power from Generator to Transfer Switch: Type XHHW-2, single conductors in raceway.

3.3.2 Exposed Feeders, Branch Circuits, and Class 1 Control Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

3.3.3 Feeders and Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and underground: Type XHHW-2, single conductors in raceway.

3.3.4 Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.4 Grounding

3.4.1 Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade.

3.4.2 Pipe and Equipment Grounding Conductor Terminations: Bolted.

3.4.3 Underground Connections: Welded.

3.4.4 Install grounding conductors routed along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

3.4.5 Install ground rods driven into ground until tops are 2 inches below finished floor or final grade unless otherwise indicated.

3.4.6 Make connections without exposing steel or damaging coating, if any.

3.4.7 Install bonding straps and jumpers in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

3.4.8 Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

3.4.9 Bond to equipment mounted on vibration isolation hangers and supports so vibration is not transmitted to rigidly mounted equipment.

3.5 Identification

3.5.1 Power-Circuit Conductor Identification: For No. 3 AWG conductors and larger, at each location where observable, identify phase using color-coding conductor tape.

3.5.2 Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring.

3.5.3 Warning Labels for Enclosures for Power and Lighting: Comply with 29 CFR 1910.145; identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

3.5.4 Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Ungrounded service, feeder, and branch-circuit conductors.

3.5.4.1 Colors for 480/277-V 3P/4W Circuits:

3.5.4.1.1 Phase A: Brown.

3.5.4.1.2 Phase B: Orange.

3.5.4.1.3 Phase C: Yellow

3.5.4.2 Colors for 208/120-V Circuits:

3.5.4.2.1 Phase A: Black.

3.5.4.2.2 Phase B: Red.

3.5.4.2.3 Phase C: Blue.

3.5.4.3 Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points.

3.5.5 Underground-Line Warning Tape: Continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade.

3.6 Installation Of Hangers And Supports

3.6.1 Fasten hangers and supports securely in place, with provisions for thermal and structural movement. Install with concealed fasteners unless otherwise indicated.

3.6.2 Separate dissimilar metals and metal products from contact with wood or cementitious materials, by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.

3.6.3 Raceway Support Methods: In addition to methods described in NECA 1,RAC may be supported by openings through structure members, as permitted in NFPA 70.

3.6.4 Multiple Raceways or Cables: Install on trapeze-type supports fabricated with steel slotted channel.

3.6.5 Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.6.6 Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods, unless otherwise indicated or required by Code:

3.6.6.1 To Wood: Fasten with lag screws or through bolts.

3.6.6.2 To New Concrete: Bolt to concrete inserts.

3.6.6.3 To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

3.6.6.4 To Existing Concrete: Expansion anchor fasteners.

3.6.6.5 To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.

3.6.6.6 To Light Steel: Sheet metal screws.

3.6.6.7 Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount on slotted-channel racks attached to substrate.

3.6.7 Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.7 Sleeve And Sleeve Seals Installation

3.7.1 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.

3.7.2 Cut sleeves to length for mounting flush with both wall surfaces.

3.7.3 Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable.

3.7.4 Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

3.7.5 Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint.

3.7.6 Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.8 Firestopping

3.8.1 Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.9 Installation Of Direct-Buried Conduit

3.9.1 Excavation of Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of conduit. Shape subgrade to provide continuous support for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

3.9.1.1 Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.9.2 Backfill and Compaction:

3.9.2.1 Place backfill on subgrades free of mud, frost, snow, or ice.

3.9.2.2 Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for joints, fittings, and bodies of conduits.

3.9.2.3 Backfill trenches excavated under footings and within 18 inches of bottom of footings with #57 stone; fill with concrete to elevation of bottom of footings.

3.9.2.4 Place and compact initial backfill of #57 stone to a height of 12 inches over the conduit.

3.9.2.4.1 Carefully compact initial backfill up on both sides and along the full length of conduit to avoid damage or displacement. Firmly hand-tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction to 85%.

3.9.3 Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.

3.9.4 Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

3.9.4.1 Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.

3.9.4.2 For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.9.5 Warning Tape: Bury underground warning tape approximately 12 inches above direct-buried conduits. Align tape along the width and along the centerline of conduit.

3.10 Installation of Concrete-Encased Conduit

3.10.1 Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches 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.

3.10.2 Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

3.10.2.1 Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.

3.10.2.2 If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.

3.10.3 Pouring Concrete: 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.

3.10.4 Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.

3.10.5 After placing concrete, place and compact initial backfill of #57 stone to a height of 12 inches over the concrete. After placing controlled backfill to within 12 inches of finished grade, complete backfilling with normal compaction to 85%.

3.10.6 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.

3.10.7 Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.

3.10.8 Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.

3.10.9 Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

3.10.9.1 Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.

3.10.9.2 Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.

3.10.10 Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

End of Section

Section 260526
Grounding and Bonding for Electrical Systems

1 GENERAL

1.1 Summary

1.1.1 Section includes grounding and bonding systems and equipment.

1.2 Closeout Submittals

1.2.1 Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

2 PRODUCTS

2.1 Manufacturers

2.1.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2.1.1.1 Burndy; Part of Hubbell Electrical Systems.

2.1.1.2 Dossert; AFL Telecommunications LLC.

2.1.1.3 ERICO International Corporation.

2.1.1.4 Fushi Copperweld Inc.

2.1.1.5 Galvan Industries, Inc.; Electrical Products Division, LLC.

2.1.1.6 Harger Lightning & Grounding.

2.1.1.7 ILSCO.

2.1.1.8 O-Z/Gedney; a brand of Emerson Industrial Automation.

2.1.1.9 Robbins Lightning, Inc.

2.2 System Description

2.2.1 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.

2.2.2 Comply with UL 467 for grounding and bonding materials and equipment.

2.3 Conductors

2.3.1 Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

2.3.2 Bare Copper Conductors:

2.3.2.1 Solid Conductors: ASTM B 3.

2.3.2.2 Stranded Conductors: ASTM B 8.

2.3.2.3 Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.

2.3.2.4 Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

2.3.2.5 Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.4 Connectors

2.4.1 Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

2.4.2 Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

2.4.3 Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4.4 Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 Grounding Electrodes

2.5.1 Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

3 EXECUTION

3.1 Applications

3.1.1 Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.

3.1.2 Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

3.1.2.1 Bury at least 24 inches below grade.

3.1.3 Conductor Terminations and Connections:

3.1.3.1 Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

3.1.3.2 Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3.1.3.3 Connections to Ground Rods at Test Wells: Bolted connectors.

3.1.3.4 Connections to Structural Steel: Welded connectors.

3.2 Grounding Underground Distribution System Components

3.2.1 Comply with IEEE C2 grounding requirements.

3.2.2 Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.3 Equipment Grounding

3.3.1 Install insulated equipment grounding conductors with all feeders and branch circuits.

3.4 Installation

3.4.1 Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

3.4.2 Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

3.4.2.1 Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

3.4.3 Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

3.4.3.1 Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

3.4.3.2 Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3.4.3.3 Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

3.5 Field Quality Control

3.5.1 Tests and Inspections:

3.5.1.1 After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

3.5.1.2 Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3.5.1.3 Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

3.5.1.3.1 Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

3.5.1.3.2 Perform tests by fall-of-potential method according to IEEE 81.

3.5.2 Grounding system will be considered defective if it does not pass tests and inspections.

3.5.3 Prepare test and inspection reports.

3.5.4 Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

End of Section

Section 260529
Hangers and Supports for Electrical Systems

1 GENERAL

1.1 Summary

1.1.1 Section Includes:

1.1.1.1 Hangers and supports for electrical equipment and systems.

1.1.1.2 Construction requirements for concrete bases.

1.2 Quality Assurance

1.2.1 Welding Qualifications: Qualify procedures and personnel according to the following:

1.2.1.1 AWS D1.1/D1.1M.

1.2.1.2 AWS D1.2/D1.2M.

2 PRODUCTS

2.1 Support, Anchorage, And Attachment Components

2.1.1 Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.

2.1.1.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2.1.1.1.1 Allied Tube & Conduit; a part of Atkore International.

2.1.1.1.2 Cooper B-Line, Inc.; a division of Cooper Industries.

2.1.1.1.3 ERICO International Corporation.

2.1.1.1.4 Flex-Strut Inc.

2.1.1.1.5 GS Metals Corp.

2.1.1.1.6 G-Strut.

2.1.1.1.7 Haydon Corporation.

2.1.1.1.8 Metal Ties Innovation.

2.1.1.1.9 Thomas & Betts Corporation, A Member of the ABB Group.

2.1.1.1.10 Unistrut; an Atkore International company.

2.1.1.1.11 Wesanco, Inc.

2.1.1.2 Material: Galvanized steel or Stainless Steel, Type 316.

2.1.1.3 Channel Width: 1-5/8 inches.

2.1.1.4 Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

2.1.1.5 Channel Dimensions: Selected for applicable load criteria.

2.1.2 Aluminum Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.

2.1.2.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2.1.2.1.1 Cooper Industries, Inc.

2.1.2.1.2 Flex-Strut Inc.

2.1.2.1.3 Haydon Corporation.

2.1.2.1.4 MKT Metal Manufacturing, Inc.

2.1.2.1.5 Thomas & Betts Corporation, A Member of the ABB Group.

2.1.2.1.6 Unistrut; an Atkore International company.

2.1.2.2 Channel Width: 1-5/8 inches.

2.1.2.3 Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

2.1.2.4 Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.1.2.5 Channel Dimensions: Selected for applicable load criteria.

2.1.3 Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c., in at least one surface.

2.1.3.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2.1.3.1.1 Allied Tube & Conduit; a part of Atkore International.

2.1.3.1.2 Cooper B-Line, Inc.; a division of Cooper Industries.

2.1.3.1.3 Fabco Plastics Wholesale Limited.

2.1.3.1.4 G-Strut.

2.1.3.1.5 Haydon Corporation.

2.1.3.1.6 Seasafe, In.; AMICO; a Gibraltar Industries Company.

2.1.3.2 Channel Width: 1-5/8 inches.

2.1.3.3 Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.

2.1.3.4 Fitting and Accessory Materials: Same as those for channels and angles.

2.1.3.5 Rated Strength: Selected to suit applicable load criteria.

2.1.3.6 Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.1.4 Conduit and Cable Support Devices: Stainless-steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

2.1.5 Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

2.1.6 Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

2.1.7 Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

2.1.7.1 Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2.1.7.1.1 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:

2.1.7.1.1.1 Hilti, Inc.

2.1.7.1.1.2 ITW Ramset/Red Head; Illinois Tool Works, Inc.

2.1.7.1.1.3 MKT Fastening, LLC.

2.1.7.1.1.4 Simpson Strong-Tie Co., Inc.

2.1.7.2 Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2.1.7.2.1 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:

2.1.7.2.1.1 Cooper B-Line, Inc.; a division of Cooper Industries.

2.1.7.2.1.2 Empire Tool and Manufacturing Co., Inc.

2.1.7.2.1.3 Hilti, Inc.

2.1.7.2.1.4 ITW Ramset/Red Head; Illinois Tool Works, Inc.

2.1.7.2.1.5 MKT Fastening, LLC.

2.1.7.3 Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.

2.1.7.4 Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

2.1.7.5 Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

2.1.7.6 Toggle Bolts: Stainless-steel springhead type.

2.1.7.7 Hanger Rods: Threaded steel.

2.2 Fabricated Metal Equipment Support Assemblies

2.2.1 Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

3 EXECUTION

3.1 Application

3.1.1 Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.

3.1.2 Comply with requirements for raceways and boxes specified in Section 260533 “Raceways and Boxes for Electrical Systems.”

3.1.3 Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

3.1.4 Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

3.1.4.1 Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 Support Installation

3.2.1 Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

3.2.2 Raceway Support Methods: In addition to methods described in NECA 1, RMCs may be supported by openings through structure members, according to NFPA 70.

3.2.3 Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2.4 Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

3.2.4.1 To Wood: Fasten with lag screws or through bolts.

3.2.4.2 To New Concrete: Bolt to concrete inserts.

3.2.4.3 To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

3.2.4.4 To Existing Concrete: Expansion anchor fasteners.

3.2.4.5 Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.

3.2.4.6 To Light Steel: Sheet metal screws.

3.2.4.7 Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

3.2.5 Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 Installation Of Fabricated Metal Supports

3.3.1 Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.3.2 Field Welding: Comply with AWS D1.1/D1.1M.

3.4 Concrete Bases

3.4.1 Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

3.4.2 Use 3000-psi, 28-day compressive-strength concrete.

3.4.3 Anchor equipment to concrete base as follows:

3.4.3.1 Place and secure anchorage devices. Use supported equipment manufacturer’s setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.4.3.2 Install anchor bolts to elevations required for proper attachment to supported equipment.

3.4.3.3 Install anchor bolts according to anchor-bolt manufacturer’s written instructions.

3.5 Painting

3.5.1 Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

3.5.1.1 Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

3.5.2 Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

End of Section

Section 260533
Raceways and Boxes for Electrical Systems

1 GENERAL

1.1 Summary

1.1.1 Section Includes:

1.1.1.1 Metal conduits, tubing, and fittings.

1.1.1.2 PVC Coated RSC and fittings.

1.1.1.3 Nonmetal conduits, tubing, and fittings.

1.1.1.4 Metal wireways and auxiliary gutters.

1.1.1.5 Boxes, enclosures, and cabinets.

1.1.1.6 Handholes and boxes for exterior underground cabling.

1.1.2 Related Requirements:

1.1.2.1 Section 260543 “Underground Ducts and Raceways for Electrical Systems” for exterior ductbanks, manholes, and underground utility construction.

1.2 Definitions

1.2.1 GRSC or RSC: Galvanized Rigid Steel Conduit.

1.2.2 PVC RSC: Poly Vinyl Coated Rigid Steel Conduit.

1.2.3 EMT: Electric Metallic Tubing.

1.2.4 ARC: Aluminum Rigid Conduit.

1.3 Action Submittals

1.3.1 Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.3.2 Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

2 PRODUCTS

2.1 Metal Conduits, Tubing, And Fittings

2.1.1 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:

2.1.1.1 AFC Cable Systems, Inc.

2.1.1.2 Allied Tube & Conduit; a part of Atkore International.

2.1.1.3 Anamet Electrical, Inc.

2.1.1.4 Electri-Flex Company.

2.1.1.5 O-Z/Gedney; a brand of Emerson Industrial Automation.

2.1.1.6 Picoma Industries, Inc.

2.1.1.7 Republic Conduit.

2.1.1.8 Robroy Industries.

2.1.1.9 Southwire Company.

2.1.1.10 Thomas & Betts Corporation, A Member of the ABB Group.

2.1.1.11 Western Tube and Conduit Corporation.

2.1.1.12 Wheatland Tube Company.

2.1.2 Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.1.3 GRC: Comply with ANSI C80.1 and UL 6.

2.1.4 PVC Coated RSC: UL6 and ANSI C80.1

2.1.5 ARC: Comply with ANSI C80.5 and UL 6A.

2.1.6 EMT: Comply with ANSI C80.3.

2.1.7 Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

2.1.8 Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 Metal Wireways and Auxiliary Gutters

2.2.1 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:

2.2.1.1 Cooper B-Line, Inc.; a division of Cooper Industries.

2.2.1.2 Hoffman; a brand of Pentair Equipment Protection.

2.2.1.3 Mono-Systems, Inc.

2.2.1.4 Square D.

2.2.2 Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 4, Type 12 unless otherwise indicated, and sized according to NFPA 70.

2.2.2.1 Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2.3 Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.2.4 Wireway Covers: Flanged-and-gasketed type unless otherwise indicated.

2.2.5 Finish: Manufacturer's standard enamel finish.

2.3 Boxes, Enclosures, And Cabinets

2.3.1 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:

2.3.1.1 Adalet.

2.3.1.2 Cooper Technologies Company.

2.3.1.3 EGS/Appleton Electric.

2.3.1.4 Erickson Electrical Equipment Company.

2.3.1.5 FSR Inc.

2.3.1.6 Hoffman; a brand of Pentair Equipment Protection.

2.3.1.7 Hubbell Incorporated.

2.3.1.8 Kraloy.

2.3.1.9 Milbank Manufacturing Co.

2.3.1.10 MonoSystems, Inc.

2.3.1.11 O-Z/Gedney; a brand of Emerson Industrial Automation.

2.3.1.12 RACO; Hubbell.

2.3.1.13 Robroy Industries.

2.3.1.14 Spring City Electrical Manufacturing Company.

2.3.1.15 Stahlin Non-Metallic Enclosures.

2.3.1.16 Thomas & Betts Corporation, A Member of the ABB Group.

2.3.1.17 Wiremold / Legrand.

2.3.2 General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

2.3.3 Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.

2.3.3.1 Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2.3.3.2 Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

2.3.4 Cabinets:

2.3.4.1 NEMA 250, Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2.3.4.2 Hinged door in front cover with flush latch and concealed hinge.

2.3.4.3 Key latch to match panelboards.

2.3.4.4 Metal barriers to separate wiring of different systems and voltage.

2.3.4.5 Accessory feet where required for freestanding equipment.

2.3.4.6 Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3 EXECUTION

3.1 Raceway Application

3.1.1 Outdoors: Apply raceway products as specified below unless otherwise indicated:

3.1.1.1 Exposed Conduit: PVC Coated RSC.

3.1.1.2 Underground Conduit: RNC, Type EPC-80-PVC.

3.1.1.3 Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.

3.1.1.4 Boxes and Enclosures, Aboveground: NEMA 250, Type 4X.

3.1.2 Indoors: Apply raceway products as specified below unless otherwise indicated:

3.1.2.1 Interior conduits, concealed within masonry walls, EMT.

3.1.2.2 Exposed: PVC coated RSC.

3.1.2.3 Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

3.1.2.4 Damp or Wet Locations: PVC coated RSC.

3.1.2.5 Boxes and Enclosures: NEMA 250, except use NEMA 250, Type 4X stainless steel for damp or wet locations.

3.1.3 Minimum Raceway Size: 3/4-inch trade size.

3.1.4 Raceway Fittings: Compatible with raceways and suitable for use and location.

3.1.4.1 Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

3.1.4.2 EMT: Compression fittings.

3.1.5 Install surface raceways only where indicated on Drawings.

3.2 Installation

3.2.1 Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

3.2.2 Keep raceways at least 6 inches away from parallel runs of flues or hot-water pipes. Install horizontal raceway runs above water and steam piping.

3.2.3 Complete raceway installation before starting conductor installation.

3.2.4 Comply with requirements in Section 260529 “Hangers and Supports for Electrical Systems” for hangers and supports.

3.2.5 Arrange stub-ups so curved portions of bends are not visible above finished slab.

3.2.6 Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

3.2.7 Install conduits parallel or perpendicular to building lines.

3.2.8 Support conduit within 12 inches of enclosures to which attached.

3.2.9 Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer’s written instructions.

3.2.10 Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

3.2.11 Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts.

3.2.12 Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

3.2.13 Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

3.2.14 Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

3.2.15 Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

End of Section

Section 260923
Lighting Control Devices

1 GENERAL

1.1 Related Documents

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

1.2 Summary

1.2.1 Section Includes:

1.2.1.1 Time switches.

1.2.1.2 Motion/Occupancy sensors.

1.2.1.3 Lighting contactors.

1.3 Action Submittals

1.3.1 Product Data: For each type of product.

1.3.2 Shop Drawings: Show installation details for occupancy and light-level sensors.

1.3.2.1 Interconnection diagrams showing field-installed wiring.

1.3.2.2 Include diagrams for power, signal, and control wiring.

1.4 Informational Submittals

1.4.1 Field quality-control reports.

1.5 Closeout Submittals

1.5.1 Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

2 PRODUCTS

2.1 Time Switches – Exterior and Site Lighting

2.1.1 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:

2.1.1.1 Cooper Industries, Inc.

2.1.1.2 Intermatic, Inc.

2.1.1.3 Invensys Controls.

2.1.1.4 Leviton Manufacturing Co., Inc.

2.1.1.5 NSi Industries LLC.

2.1.2 Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

2.1.2.1 Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.1.2.2 Contact Configuration: Four (4) sets of DPST.

2.1.2.3 Contact Rating: 30-A inductive or resistive, 240-V ac.

2.1.2.4 Programs: Four channels; each channel is individually programmable with two on-off set points on a 24-hour schedule, allowing different set points for each day of the week.

2.1.2.5 Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.

2.1.2.6 Astronomic Time: All channels.

2.1.2.7 Automatic daylight savings time changeover.

2.1.2.8 Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 Indoor Occupancy Sensors

2.2.1 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:

2.2.1.1 Bryant Electric.

2.2.1.2 Cooper Industries, Inc.

2.2.1.3 Hubbell Building Automation, Inc.

2.2.1.4 Leviton Manufacturing Co., Inc.

2.2.1.5 Lithonia Lighting; Acuity Brands Lighting, Inc.

2.2.1.6 Lutron Electronics Co., Inc.

2.2.1.7 NSi Industries LLC.

2.2.1.8 Philips Lighting Controls.

2.2.1.9 RAB Lighting.

2.2.1.10 Sensor Switch, Inc.

2.2.1.11 Square D.

2.2.2 Ceiling Mounted Occupancy Sensors:

2.2.2.1 Dual technology type (passive infrared and ultrasonic), 120/277 V, adjustable time delay up to 30 minutes, 360-degree field of view, with a minimum coverage area of 1,200 SF.

2.2.2.2 Sensor to operate at line voltage without the need for external power racks or relays.

2.2.2.3 Sensor to include concealed "OFF" time delay selector with settings between 5 minutes and 30 minutes.

2.2.2.4 Sensor settings shall be adjustable at the sensor without the need for specialized tools or programmers.

2.2.2.5 Switch Rating: Two sets of contacts, each located rated for 800-W LED load at 120 VAC

2.3 Switchbox-Mounted Occupancy Sensors

2.3.1 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:

2.3.1.1 Bryant Electric.

2.3.1.2 Cooper Industries, Inc.

2.3.1.3 Hubbell Building Automation, Inc.

2.3.1.4 Leviton Manufacturing Co., Inc.

2.3.1.5 Lithonia Lighting; Acuity Brands Lighting, Inc.

2.3.1.6 Lutron Electronics Co., Inc.

2.3.1.7 NSi Industries LLC.

2.3.1.8 Philips Lighting Controls.

2.3.1.9 RAB Lighting.

2.3.1.10 Sensor Switch, Inc.

2.3.1.11 Square D.

2.3.2 Wall Occupancy Sensors:

2.3.2.1 Dual technology type (passive infrared and ultrasonic), 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 1,000 SF.

2.3.2.2 Provide control positions for “OFF”, “ON”, and “AUTO”.

2.3.2.3 Sensor to operate at line voltage without the need for external power racks or relays.

2.3.2.4 Sensor to include concealed “OFF” time delay selector with settings between 5 minutes and 30 minutes.

2.3.2.5 Sensor settings shall be adjustable at the sensor without the need for specialized tools or programmers.

2.3.2.6 Switch Rating: Two sets of contacts, each located rated for 800-W LED load at 120 VAC.

2.4 Time Switches – Interior Lighting

2.4.1 Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

2.4.1.1 Listed and labeled as defined in NFPA 70 and marked for intended location and application.

2.4.1.2 Contact Configuration: SPDT.

2.4.1.3 Contact Rating: 20-A ballast load, 120-/240-V ac.

2.4.1.4 Programs: Eight on-off set points on a 24-hour schedule.

2.4.1.5 Switchbox mounted.

2.4.1.6 Two-hour override capability.

2.5 Lighting Contactors

2.5.1 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:

2.5.1.1 Allen-Bradley/Rockwell Automation.

2.5.1.2 ASCO Power Technologies, LP; a business of Emerson Network Power.

2.5.1.3 Eaton Corporation.

2.5.1.4 General Electric Company.

2.5.2 Description: Electrically operated and mechanically held, combination-type lighting contactors with non-fused disconnect, complying with NEMA ICS 2 and UL 508.

2.5.2.1 Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).

2.5.2.2 Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.

2.5.2.3 Enclosure: Comply with NEMA 250.

2.5.2.4 Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.6 Conductors And Cables

2.6.1 Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260500 "Common Work Results for Electrical."

3 EXECUTION

3.1 Sensor Installation

3.1.1 Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

3.1.2 Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 Contactor Installation

3.2.1 Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 Wiring Installation

3.3.1 Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

3.3.2 Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

3.3.3 Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 Identification

3.4.1 Identify components and power and control wiring according to Section 260500 "Common Work Results for Electrical."

3.4.1.1 Identify controlled circuits in lighting contactors.

3.4.1.2 Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

3.4.2 Label time switches and contactors with a unique designation.

3.5 Field Quality Control

3.5.1 Testing Agency: Owner will engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

3.5.2 Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

3.5.3 Perform the following tests and inspections:

3.5.3.1 Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

3.5.3.2 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5.4 Lighting control devices will be considered defective if they do not pass tests and inspections.

3.5.5 Prepare test and inspection reports.

3.6 Adjusting

3.6.1 Occupancy Adjustments: Provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6.1.1 For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

3.6.1.2 For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3.6.1.3 Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.6.1.4 For timers, adjust setpoints and schedules to suit Owner’s operations.

3.7 Demonstration

3.7.1 Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

End of Section

Section 262416
Panelboards

1 GENERAL

1.1 Section Requirements

1.1.1 Submittals: Product Data.

2 PRODUCTS

2.1 Performance Requirements

2.1.1 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.

2.1.2 Comply with NEMA PB 1.

2.2 General Requirements For Panelboards

2.2.1 Indoor Enclosures: Surface-mounted cabinets; NEMA 250, Type 1 with door-within-door - hinged front cover.

2.2.2 Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

2.2.3 Panelboard Short-Circuit Current Rating: Fully rated for system.

2.3 Panelboards

2.3.1 Mains: Circuit breaker.

2.3.2 Branch Overcurrent Protective Devices: Bolt-on circuit breakers.

2.4 Disconnecting And Overcurrent Protective Devices

2.4.1 Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

2.4.1.1 Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

2.4.1.2 GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

3 EXECUTION

3.1 Installation

3.1.1 Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.

3.1.2 Comply with mounting and anchoring requirements specified in Section 260500 "Common Work Results for Electrical."

3.1.3 Mount top of trim 90 inches above finished floor unless otherwise indicated.

3.1.4 Arrange conductors into groups; bundle and wrap with wire ties.

3.1.5 Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory.

End of Section

Section 262726
Wiring Devices

1 GENERAL

1.1 Section Requirements

1.1.1 Submittals: Product Data and color palette for multi-outlet assemblies.

2 PRODUCTS

2.1 Performance Requirements

2.1.1 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.

2.1.2 Comply with NFPA 70.

2.2 Commercial-Grade Devices

2.2.1 Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

2.2.1.1 Connectors shall comply with UL 2459 and shall be made with stranding building wire.

2.2.1.2 Devices shall comply with the requirements in this Section.

2.2.2 Device Color:

2.2.2.1 White unless otherwise indicated or required by NFPA 70 or device listing.

2.2.3 Convenience Receptacles: NEMA WD 1, NEMA WD 6, Configuration 5-20R, and UL 498.

2.2.3.1 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:

2.2.3.1.1 Eaton (Arrow Hart).

2.2.3.1.2 Hubbell Incorporated; Wiring Device-Kellems.

2.2.3.1.3 Leviton Manufacturing Co., Inc.

2.2.3.1.4 Or Approved Equal.

2.2.4 Duplex Ground-Fault Circuit-Interrupter (GFCI) Convenience Receptacles: 125-V, 20-A, straight blade, non-feed-through type. NEMA WD 1,

NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

2.2.4.1 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:

2.2.4.1.1 Eaton (Arrow Hart).

2.2.4.1.2 Hubbell Incorporated; Wiring Device-Kellems.

2.2.4.1.3 Leviton Manufacturing Co., Inc.

2.2.4.1.4 Or Approved Equal.

2.2.5 Toggle Switches: NEMA WD 1 and UL 20. Single-pole, 120/277 V, 20 A.

2.2.5.1 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:

2.2.5.1.1 Eaton (Arrow Hart).

2.2.5.1.2 Hubbell Incorporated; Wiring Device-Kellems.

2.2.5.1.3 Leviton Manufacturing Co., Inc.

2.2.5.1.4 Or Approved Equal.

2.2.6 Pilot-Light Switches, 20 A: Single pole, with neon-lighted handle, illuminated when switch is "off."

2.2.6.1 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:

2.2.6.1.1 Eaton (Arrow Hart).

2.2.6.1.2 Hubbell Incorporated; Wiring Device-Kellems.

2.2.6.1.3 Leviton Manufacturing Co., Inc.

2.2.6.1.4 Or Approved Equal.

2.3 Wall Plates

2.3.1 Wall Plates, Finished Areas: Stainless steel, fastened with metal screws having heads matching plate color.

2.3.2 Wall Plates, Unfinished Areas: Galvanized steel with metal screws.

2.3.3 Wall Plates, Damp Locations: Cast aluminum with metal weather resistant covers, listed and labeled for use in damp locations.

2.3.4 Wall Plates, Wet Locations: Cast aluminum with metal weatherproof-while-in-use cover, listed and labeled for use in wet locations.

2.4 Floor Service Fittings

2.4.1 Modular, flap-type, dual-service units suitable for wiring method used.

2.4.2 Compartments: Barrier separates power from voice and data communication cabling.

2.4.3 Service Plate: Rectangular, die-cast aluminum with satin finish.

2.4.4 Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.

2.4.5 Voice and Data Communication Outlet: Blank cover with bushed cable opening.

2.5 Prefabricated, Multioutlet Assemblies

2.5.1 Components produced by a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles. Metal, with manufacturer's standard finish raceway with No. 12 AWG wire. One receptacle per 6 inches. Provide samples of the full range of manufacture’s colors for color selection during the submittal process.

3 EXECUTION

3.1 Installation

3.1.1 Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

3.1.2 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.

3.1.3 Mount devices flush, with long dimension vertical, and grounding terminal of receptacles on top unless otherwise indicated. Group adjacent devices under single, multi-gang wall plates.

End of Section

Section 262816
Enclosed Switches and Circuit Breakers

1 GENERAL

1.1 Section Requirements

1.1.1 Submittals: Product Data.

2 PRODUCTS

2.1 Performance Requirements

2.1.1 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.

2.2 Fusible and Non-fusible Switches

2.2.1 Fusible Switches, 600 A and Smaller: UL 98 and NEMA KS 1, Type HD, that accommodate specified fuses, and with lockable handle interlocked with cover in closed position.

2.2.2 Non-fusible Switches, 600 A and Smaller: UL 98 and NEMA KS 1, Type HD, with lockable handle interlocked with cover in closed position.

2.3 Molded-Case Circuit Breakers

2.3.1 Description: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to meet available fault currents.

2.3.1.1 Thermal-Magnetic Circuit Breakers: Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2.3.1.2 Electronic Trip Circuit Breakers: Field-replaceable rating plug, RMS sensing, with field-adjustable instantaneous trip settings.

2.4 Enclosures

2.4.1 NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

2.4.1.1 Outdoor Locations: NEMA 250, Type 4X.

3 EXECUTION

3.1 Installation

3.1.1 Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

3.1.2 Comply with mounting and anchoring requirements specified in Section 260529 “Hangers and Supports for Electrical Systems.”

3.1.3 Install fuses in fusible devices.

3.1.4 Comply with NECA 1.

3.2 Field Quality Control

3.2.1 Perform the following field tests and inspections and prepare test reports:

3.2.1.1 Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

End of Section

263213
Packaged Engine Generator

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 includes packaged engine-generator sets for emergency power supply with the following features:

1. Diesel engine.

2. Unit-mounted cooling system.

3. Unit-mounted control and monitoring.

4. Weather-Proof, Sound Attenuated Outdoor enclosure.

B. Related Sections include the following:

1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 SUBMITTALS

A. Product Data: For each packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.

2. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. Include the following:

1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

C. 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.

D. Comply with ASME B15.1.

E. Comply with NFPA 37.

F. Comply with NFPA 70.

G. Comply with NFPA 110 requirements for Level 2 emergency power supply system.

H. Comply with UL 2200.

I. Engine Exhaust Emissions: Comply with applicable federal, state, and local government requirements.

1.5 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 15 to plus 40 deg C.

2. Relative Humidity: 0 to 95 percent.

3. Altitude: Sea level to 1000 feet.

B. Provide access stairs and work platforms where specified on the drawings and specifications.

1.6 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five (5) years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months of full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Generac, Basis of Design

2. Caterpillar; Engine Div.

3. Cummins Power Generation; Industrial Business Group.

4. Kohler

5. Or Approved Equal

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

C. Capacities and Characteristics:

1. Output Connections: As indicated.

2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of components.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.

2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.

3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.

6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.

2.3 ENGINE

A. Fuel: Fuel oil, Grade DF-2.

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.

2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.

3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:

1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.

2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system.

G. Governor: Electronic.

H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.

3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and non-collapsible under vacuum.

b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

5. Radiator to have vertical air discharge.

I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.

J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

K. Starting System: 12-V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.

2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.

3. Cranking Cycle: 60 seconds.

4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.

5. Battery Cable: Size as recommended by engine manufacturer. Include required interconnecting conductors and connection accessories.

6. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 20-A minimum continuous rating.

7. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

a. Operation: Equalizing-charging rate of 20-A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.

c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.

e. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

f. Powered by 120V, 20A, single-phase circuit.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Base-Mounted Fuel Oil Tank: Comply with UL 142, freestanding, factory-fabricated fuel tank assembly, with the following features:

1. Containment: Integral rupture basin with a capacity of 150 percent of nominal capacity of tank.

a. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of leak.

2. Low-Level Alarm Sensor: Liquid-level device operates alarm contacts at 25 percent of normal fuel level.

3. Piping Connections: Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent and tank drain line.

4. Tank level indicator.

5. Capacity: Fuel for a minimum of Fifty (50) hours continuous operation at 100 percent rated power output.

6. Vandal-resistant fill cap.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

C. Indicating and Protective Devices and Controls:

1. AC voltmeter.

2. AC ammeter.

3. AC frequency meter.

4. DC voltmeter (alternator battery charging monitored through generator control panel).

5. Engine-coolant temperature gage.

6. Engine lubricating-oil pressure gage.

7. Running-time meter.

8. Ammeter-voltmeter, phase-selector switch(es).

9. Generator-voltage adjusting rheostat.

10. Start-stop switch.

11. Overspeed shutdown device.

12. Coolant high-temperature shutdown device.

13. Coolant low-level shutdown device.

14. Oil low-pressure shutdown device.

15. Fuel tank derangement alarm.

D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

E. Common Remote Alarm: Signal the occurrence of any events listed below without differentiating between event types through a factory-wired set of Form C dry contacts. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

1. Battery-charger malfunction alarm.

2. Battery low-voltage alarm.

3. Engine high-temperature shutdown.

4. Lube-oil, low-pressure shutdown.

5. Overspeed shutdown.

6. Remote emergency-stop shutdown.

7. Engine high temperature pre-alarm.

8. Lube-oil, low-pressure prealarm.

9. Fuel tank, low-fuel level.

10. Low coolant level.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breakers: Provide two (2) Molded-case, thermal-magnetic type with LSI functions, 100 percent rated; complying with NEMA AB 1 and UL 489. One breaker will feed the load and the second is for connection of load bank testing and serve as a spare is the load breaker fails.

1. Tripping Characteristic: Designed specifically for generator protection.

2. Trip Rating: Matched to generator rating.

3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.

4. Mounting: Adjacent to or integrated with control and monitoring panel.

5. Provide load cable space to meet the NEC requirements as a minimum.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Dripproof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

J. Subtransient Reactance: 12 percent, maximum.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, sound attenuating, weatherproof aluminum housing with a dBA rating of 76 dBA at 23 feet under 100% load and wind resistant up to 186 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow. Radiator discharge is through a vertical plenum.

C. Provide factory mounted LED type, 50K, gasketed light fixtures, two (2) minimum with 3-way control switches on both sides of the generator.

D. Convenience Outlets: two (2) Factory wired, GFCI.

2.9 VIBRATION ISOLATION DEVICES

A. Restrained Spring Isolators: Integral to unit, open-spring isolators with seismic restraint or manufacturer’s equivalent integral linear type.

2.10 FINISHES

A. Outdoor Enclosures, Fuel Tank and Components: Manufacturer's Standard color, Electrostatically applied Rhino Coat finish over corrosion-resistant pretreatment and compatible primer.

2.11 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Common Work Results for Electrical."

B. Connect wiring according to Division 26 Section "Common Work Results for Electrical."

C. Use liquid-tight flexible metal conduit for final electrical connections to generator.

3.4 IDENTIFICATION

A. Identify system components according to Division 26 Section "Common Work Results for Electrical."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection (except those indicated to be optional) for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. NFPA 110 Acceptance Tests: Perform single-step full-load pickup test using a 100% rated load bank.

3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.

    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.

    c. Verify acceptance of charge for each element of the battery after discharge.

    d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.

6. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases and verify that performance is as specified.

7. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

8. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest / reinspect as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

B. Coordinate training with that required for automatic transfer switch.

C. Provide a minimum of two (2) hours of training for each generator.

3.7 FUELING

A. Provide all fuel for testing and commissioning. Generator tank shall be 100% full after Substantial Completion and Testing.

End of Section

Section 263600
Transfer Switches

1 GENERAL

1.1 Related Documents

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

1.2 Summary

1.2.1 This Section includes transfer switches rated 600 V and less, including the following:

1.2.1.1 Automatic transfer switches.

1.3 Submittals

1.3.1 Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

1.3.2 Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1.3.2.1 Single-Line Diagram: Show connections between transfer switch, power sources, and load.

1.3.3 Field quality-control test reports.

1.3.4 Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include the following:

1.3.4.1 Features and operating sequences, both automatic and manual.

1.3.4.2 List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 Quality Assurance

1.4.1 Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

1.4.2 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.

1.4.3 Comply with NEMA ICS 1.

1.4.4 Comply with NFPA 70.

1.4.5 Comply with NFPA 110.

1.4.6 Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 Warranty

1.5.1 Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of Automatic Transfer Switch that fail in materials or workmanship within specified warranty period.

1.5.1.1 Warranty Period: Five (5) years from date of Substantial Completion.

2 PRODUCTS

2.1 Manufacturers

2.1.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2.1.1.1 Contactor Transfer Switches:

2.1.1.1.1 Kohler, Basis of Design

2.1.1.1.2 Caterpillar; Engine Div.

2.1.1.1.3 Emerson; ASCO Power Technologies, LP.

2.1.1.1.4 Onan/Cummins Power Generation; Industrial Business Group.

2.2 General Transfer-Switch Product Requirements

2.2.1 Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

2.2.2 Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

2.2.3 Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

2.2.4 Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested

according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

2.2.5 Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

2.2.5.1 Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.

2.2.5.2 Switch Action: Double throw; mechanically held in both directions.

2.2.5.3 Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

2.2.6 Neutral Terminal: Solid and fully rated, unless otherwise indicated to be switched.

2.2.7 Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Common Work Results for Electrical."

2.2.7.1 Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.

2.2.7.2 Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.

2.2.7.3 Control Wiring: Equipped with lugs suitable for connection to terminal strips.

2.2.8 Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 Automatic Transfer Switches

2.3.1 Comply with Level 2 equipment according to NFPA 110.

2.3.2 Electrical Operation: Accomplish by a non-fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

2.3.3 Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

2.3.4 Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

2.3.5 In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

2.3.6 Automatic Transfer-Switch Features:

2.3.6.1 Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

2.3.6.2 Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

2.3.6.3 Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

2.3.6.4 Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

2.3.6.5 Test Switch: Simulate normal-source failure.

2.3.6.6 Switch-Position Pilot Lights: Indicate source to which load is connected.

2.3.6.7 Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

2.3.6.7.1 Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

2.3.6.7.2 Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

2.3.6.8 Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

2.3.6.9 Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

2.3.6.10 Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

2.3.6.11 Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

2.3.6.12 Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

2.3.6.12.1 Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.

2.3.6.12.2 Push-button programming control with digital display of settings.

2.3.6.12.3 Integral battery operation of time switch when normal control power is not available.

2.4 Source Quality Control

2.4.1 Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

3 EXECUTION

3.1 Installation

3.1.1 Identify components according to Division 26 Section "Common Work Results for Electrical."

3.1.2 Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 Connections

3.2.1 Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

3.2.2 Ground equipment according to Division 26 Section "Common Work Results for Electrical."

3.2.3 Connect wiring according to Division 26 Section "Common Work Results for Electrical."

3.3 Field Quality Control

3.3.1 Perform tests and inspections and prepare test reports.

3.3.1.1 Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.

3.3.1.2 After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

3.3.1.3 Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3.3.1.4 Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

3.3.1.4.1 Check for electrical continuity of circuits and for short circuits.

3.3.1.4.2 Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

3.3.1.4.3 Verify that manual transfer warnings are properly placed.

3.3.1.4.4 Perform manual transfer operation.

3.3.1.5 After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

3.3.1.5.1 Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

3.3.1.5.2 Simulate loss of phase-to-ground voltage for each phase of normal source.

3.3.1.5.3 Verify time-delay settings.

3.3.1.5.4 Verify pickup and dropout voltages by data readout or inspection of control settings.

3.3.1.5.5 Test bypass/isolation unit functional modes and related automatic transfer-switch operations.

3.3.1.5.6 Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

3.3.2 Coordinate tests with tests of generator and run them concurrently.

3.3.3 Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.3.4 Remove and replace malfunctioning units and retest as specified above.

3.4 Demonstration

3.4.1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below.

3.4.2 Coordinate this training with that for generator equipment.

3.4.3 Provide a minimum of two (2) hours of automatic transfer switch training.

End of Section

Section 264313
Surge Protection Devices

1 GENERAL

1.1 Section Requirements

1.1.1 Submittals: Product Data.

1.1.2 Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

1.1.3 Comply with UL 1449.

2 PRODUCTS

2.1 Performance Requirements

2.1.1 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.

2.2 Service Entrance Suppressors

2.2.1 Surge Protective Devices: Field-mounted, complying with UL 1449 Type 1.

2.2.1.1 Comply with IEEE C62.41 Category C, 200-kA short-circuit current rating.

2.2.1.2 Non-modular type with the following features and accessories:

2.2.1.2.1 Integral disconnect switch.

2.2.1.2.2 LED indicator lights for power and protection status.

2.2.2 Protection modes and UL 1449 Vpk for grounded wye circuits with 480Y/277 V and 120/240 V, single-phase, three-wire circuits shall be as follows:

2.2.2.1 Line to Neutral: 600 V for 120/240 V.

2.2.2.2 Line to Ground: 1000 V for 120/240 V.

2.2.2.3 Line to Line: 1000 V for 120/240 V.

2.2.3 Protection modes and UL 1449 Vpk for 120/240 V, single-phase, three-wire circuits shall be as follows:

2.2.3.1 Line to Neutral: 600 V.

2.2.3.2 Line to Ground: 1000 V.

2.2.3.3 Line to Line: 1000 V.

2.3 Panelboard Suppressors

2.3.1 Surge Protective Devices: Field-mounted, complying with UL 1449 Type 1.

2.3.1.1 Comply with IEEE C62.41 Category C, 200-kA short-circuit current rating.

2.3.1.2 Non-modular type with the following features and accessories:

a. Integral disconnect switch.

b. LED indicator lights for power and protection status.

2.3.2 Protection modes and UL 1449 Vpk for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits shall be as follows:

2.3.2.1 Line to Neutral: 600 V for 120/240 V.

2.3.2.2 Line to Ground: 1000 V for 120/240 V.

2.3.2.3 Neutral to Ground: 600 V for120/240 V.

2.3.2.4 Line to Line: 1000 V for 120/240 V.

2.3.3 Protection modes and UL 1449 Vpk for 120/240-V, single-phase, three-wire circuits shall be as follows:

2.3.3.1 Line to Neutral: 600 V.

2.3.3.2 Line to Ground: 1000 V.

2.3.3.3 Neutral to Ground: 600 V.

2.3.3.4 Line to Line: 1000 V.

2.4 Enclosures

2.4.1 Indoor Enclosures: NEMA 250, Type 12.

3 EXECUTION

3.1 Installation

3.1.1 Do not energize or connect electrical equipment to their sources until TVSS devices are installed and connected.

End of Section

Section 265000
Lighting

1 GENERAL

1.1 Summary

1.1.1 Section Includes:

1.1.1.1 Solid state luminaires that use LED technology.

1.1.1.2 Light fixture supports.

1.1.1.3 Emergency lighting units.

1.1.1.4 Exit signs.

1.2 Section Requirements

1.2.1 Submittals: Product Data for each luminaire, including lamps.

1.3 Delivery, Storage, And Handling

1.3.1 Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.4 Warranty

1.4.1 Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1.4.2 Warranty Period: Five year(s) from date of Substantial Completion.

2 PRODUCTS

2.1 Performance Requirements

2.1.1 Fixtures, Emergency Lighting Units, 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.

2.2 Lighting Fixtures And Components, General Requirements

2.2.1 Exterior Luminaires: Comply with UL 1598, and listed and labeled for installation in wet locations by a Nationally Recognized Testing Laboratory acceptable to authorities having jurisdiction.

2.2.2 Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

2.2.3 Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2.3 Lamps

2.3.1 With characteristics as indicated.

2.4 Luminaire Fixture Support Components

2.4.1 Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

2.4.2 Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

2.4.3 Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

2.4.4 Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

2.4.5 Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

2.5 Exit Signs

2.5.1 Internally Lighted Signs: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

2.5.1.1 Lamps for AC Operation: LEDs, 70,000 hours minimum of rated lamp life.

2.6 Emergency Lighting Units

2.6.1 Description: Self-contained units complying with UL 924.

2.6.1.1 Battery: Sealed, maintenance-free, lead-acid type.

2.6.1.2 Charger: Fully automatic, solid-state type with sealed transfer relay.

2.6.1.3 Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

2.6.1.4 LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

3 EXECUTION

3.1 Examination

3.1.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

3.1.2 Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

3.2.1 Comply with NECA 1.

3.2.2 Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

3.2.3 Install lamps in each luminaire.

3.2.4 Supports:

3.2.4.1 Sized and rated for luminaire weight.

3.2.4.2 Able to maintain luminaire position after cleaning and relamping.

3.2.4.3 Provide support for luminaire without causing deflection of ceiling or wall.

3.2.4.4 Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

3.2.5 Wall-Mounted Luminaire Support:

3.2.5.1 Attached to structural members in walls.

3.2.5.2 Do not attach luminaires directly to gypsum board.

3.2.6 Ceiling-Mounted Luminaire Support:

3.2.6.1 Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.

3.2.7 Suspended Luminaire Support:

3.2.7.1 Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

3.2.7.2 Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

3.2.7.3 Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.

3.2.7.4 Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

3.2.8 Ceiling-Mounted Luminaires:

3.2.8.1 Secure to any required outlet box.

3.3 Field Quality Control

3.3.1 Perform the following tests and inspections:

3.3.1.1 Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

3.3.1.2 Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

3.3.2 Luminaire will be considered defective if it does not pass operation tests and inspections.

3.3.3 Prepare test and inspection reports.

End of Section

Section 265613
Lighting Poles and Standards

1 GENERAL

1.1 Related Documents

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

1.2 Summary

1.2.1 Section Includes:

1.2.1.1 Poles and accessories for support of luminaires.

1.3 Definitions

1.3.1 EPA: Equivalent projected area.

1.3.2 Luminaire: Complete lighting fixture.

1.3.3 Pole: Luminaire-supporting structure, including tower used for large-area illumination.

1.3.4 Standard: See "Pole."

1.4 Action Submittals

1.4.1 Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.

1.4.1.1 Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.

1.4.1.2 Include finishes for lighting poles and luminaire-supporting devices.

1.4.1.3 Anchor bolts.

1.4.1.4 Manufactured pole foundations.

1.4.2 Shop Drawings:

1.4.2.1 Include plans, elevations, sections, and mounting and details.

1.4.2.2 Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.4.2.3 Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.

1.4.2.4 Anchor bolt templates keyed to specific poles and certified by manufacturer.

1.4.2.5 Method and procedure of pole installation. Include manufacturer's written installations.

1.5 Informational Submittals

1.5.1 Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.

1.5.2 Material Test Reports:

1.5.2.1 For each foundation component, by a qualified testing agency.

1.5.2.2 For each pole, by a qualified testing agency.

1.5.3 Source quality-control reports.

1.5.4 Field quality-control reports.

1.5.5 Sample Warranty: Manufacturer's standard warranty.

1.6 Closeout Submittals

1.6.1 Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.

1.6.1.1 In addition to items specified in Section 017823 "Operation and Maintenance Data," include pole inspection and repair procedures.

1.7 Maintenance Material Submittals

1.7.1 Pole repair materials.

1.8 Quality Assurance

1.8.1 Testing Agency Qualifications: Qualified according to ASTM C 1093 for foundation testing.

1.9 Delivery, Storage, And Handling

1.9.1 Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

1.9.2 Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.10 Warranty

1.10.1 Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1.10.1.1 Warranty Period: Five years from date of Substantial Completion.

1.10.1.2 Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.

1.10.1.3 Warranty Period for Color Retention: Five years from date of Substantial Completion.

2 PRODUCTS

2.1 Performance Requirements

2.1.1 Structural Characteristics: Comply with AASHTO LTS-6-M.

2.1.2 Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.

2.1.3 Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.

2.1.4 Ice Load: Load of 3 lbf/sq. ft., applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.

2.1.5 Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.

2.1.5.1 Basic wind speed of 115 mph.

2.1.5.1.1 Minimum Design Life: 25 years.

2.1.5.1.2 Velocity Conversion Factor: 1.0.

2.1.6 Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.

2.1.7 Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 Steel Poles

2.2.1 Source Limitations: Obtain poles from single manufacturer or producer.

2.2.2 Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2.3 Poles: Comply with ASTM A 500/A 500M, Grade B carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.

2.2.3.1 Shape: Square, straight.

2.2.3.2 Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

2.2.4 Steel Mast Arms: Single-arm type, continuously welded to pole attachment plate. Material and finish same as plate.

2.2.5 Brackets for Luminaires: Detachable, cantilever, without underbrace.

2.2.5.1 Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless-steel bolts.

2.2.5.2 Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

2.2.6 Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

2.2.7 Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

2.2.7.1 Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.

2.2.7.2 Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

2.2.8 Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260500 "Common Work Results for Electrical," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.

2.2.9 Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

2.2.10 Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

2.2.11 Galvanized Finish: After fabrication, hot-dip galvanize according to ASTM A 123/A 123M.

2.2.12 Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

2.2.12.1 Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.

2.2.12.2 Powder Coat: Comply with AAMA 2604.

2.2.12.2.1 Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.

2.2.12.2.2 Color: Black.

2.3 Pole Accessories

2.3.1 Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

2.4 Mounting Hardware

2.4.1 Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi.

2.4.1.1 Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

2.4.1.2 Bent rods length per drawings.

2.4.1.3 Threading: Uniform National Coarse, Class 2A.

2.4.2 Nuts: ASTM A 563, Grade A, Heavy-Hex

2.4.2.1 Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

2.4.2.2 Two nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.

2.4.3 Washers: ASTM F 436, Type 1.

2.4.3.1 Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

2.4.3.2 One washers provided per anchor bolt.

2.5 General Finish Requirements

2.5.1 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.5.2 Appearance of Finished Work: Noticeable variations in same piece are unacceptable. 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.

3 EXECUTION

3.1 Examination

3.1.1 Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

3.1.2 Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

3.1.3 Examine roughing-in for foundation and conduit to verify actual locations of installation.

3.1.4 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Pole Foundation

3.2.1 Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories.

3.2.2 Anchor Bolts: Install plumb using manufacturer-supplied steel template, uniformly spaced.

3.3 Pole Installation

3.3.1 Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.

3.3.2 Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features:

3.3.2.1 Fire Hydrants and Water Piping: 60 inches.

3.3.2.2 Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.

3.3.2.3 Trees: 15 feet from tree trunk.

3.3.3 Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are indicated on drawings.

3.3.4 Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.

3.3.5 Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 Corrosion Prevention

3.4.1 Steel Conduits: Comply with requirements in Section 260500 "Common Work Results for Electrical." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.5 Grounding

3.5.1 Ground Metal Poles and Support Structures: Comply with requirements in Section 260500 "Common Work Results for Electrical."

3.5.1.1 Install grounding electrode for each pole.

3.5.1.2 Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.6 Identification

3.6.1 Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260500 "Common Work Results for Electrical."

3.7 Field Quality Control

3.7.1 Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

3.7.1.1 Inspect poles for nicks, mars, dents, scratches, and other damage.

3.7.1.2 System function tests.

End of Section

Section 265619
LED Exterior Lighting

1 GENERAL

1.1 Related Documents

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

1.2 Summary

1.2.1 Section Includes:

1.2.1.1 Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.

1.2.1.2 Luminaire supports.

1.2.2 Related Requirements:

1.2.2.1 Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.3 Definitions

1.3.1 CCT: Correlated color temperature.

1.3.2 CRI: Color rendering index.

1.3.3 Fixture: See "Luminaire."

1.3.4 IP: International Protection or Ingress Protection Rating.

1.3.5 Lumen: Measured output of lamp and luminaire, or both.

1.3.6 Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 Action Submittals

1.4.1 Product Data: For each type of luminaire.

1.4.1.1 Arrange in order of luminaire designation.

1.4.1.2 Include data on features, accessories, and finishes.

1.4.1.3 Include physical description and dimensions of luminaire.

1.4.1.4 Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.

1.4.1.5 Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

1.4.1.5.1 Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.

1.4.1.5.2 Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

1.4.1.6 Wiring diagrams for power, control, and signal wiring.

1.4.1.7 Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

1.4.2 Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4.3 Delegated-Design Submittal: For luminaire supports.

1.4.3.1 Include design calculations for luminaire supports.

1.5 Informational Submittals

1.5.1 Product Certificates: For each type of the following:

1.5.1.1 Luminaire.

1.5.2 Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5.3 Source quality-control reports.

1.5.4 Sample warranty.

1.6 Closeout Submittals

1.6.1 Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.

1.6.1.1 Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.

1.6.1.2 Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 Maintenance Material Submittals

1.7.1 Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.7.1.1 Lamps: Two for each type and rating installed.

1.7.1.2 Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: Two for f each type and rating installed.

1.7.1.3 Diffusers and Lenses: Two of each type and rating installed.

1.7.1.4 Globes and Guards: Two of each type and rating installed.

1.8 Quality Assurance

1.8.1 Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

1.8.2 Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

1.8.3 Provide luminaires from a single manufacturer for each luminaire type.

1.8.4 Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.8.5 Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 Delivery, Storage, And Handling

1.9.1 Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 Field Conditions

1.10.1 Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

1.11 Warranty

1.11.1 Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1.11.1.1 Failures include, but are not limited to, the following:

1.11.1.1.1 Structural failures, including luminaire support components.

1.11.1.1.2 Faulty operation of luminaires and accessories.

1.11.1.1.3 Deterioration of metals, metal finishes, and other materials beyond normal weathering.

1.11.1.2 Warranty Period: 5 year(s) from date of Substantial Completion.

2 PRODUCTS

2.1 Luminaire Requirements

2.1.1 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.

2.1.2 UL Compliance: Comply with UL 1598 and listed for wet location.

2.1.3 Lamp base complying with ANSI C81.61.

2.1.4 Bulb shape complying with ANSI C79.1.

2.1.5 CRI of 70. CCT of 4100 K.

2.1.6 L70 lamp life of 35,000 hours.

2.1.7 Lamps dimmable from 100 percent to 0 percent of maximum light output.

2.1.8 Internal driver.

2.1.9 Nominal Operating Voltage: 240 V ac.

2.1.10 In-line Fusing: On the primary for each luminaire.

2.1.11 Lamp Rating: Lamp marked for outdoor use.

2.1.12 Source Limitations: Obtain luminaires from single source from a single manufacturer.

2.1.13 Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 Luminaire Types

2.2.1 Area and Site:

2.2.1.1 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:

2.2.1.1.1 Architectural Area Lighting.

2.2.1.1.2 Atlas Lighting Products.

2.2.1.1.3 Cooper Lighting, an Eaton business.

2.2.1.1.4 Deco Lighting.

2.2.1.1.5 Gallium Lighting, LLC.

2.2.1.1.6 GE Lighting Solutions.

2.2.1.1.7 H.E. Williams.

2.2.1.1.8 Howard Lighting Products.

2.2.1.1.9 Juno Lighting Group by Schneider Electric.

2.2.1.1.10 KIM Lighting.

2.2.1.1.11 Lightolier; a Philips group brand.

2.2.1.1.12 Lithonia Lighting; Acuity Brands Lighting, Inc.

2.2.1.1.13 Luraline Lighting.

2.2.1.1.14 OSRAM SYLVANIA.

2.2.1.1.15 RAB Lighting.

2.2.1.1.16 Or Approved Equal.

2.2.1.2 Luminaire Shape: Square.

2.2.1.3 Mounting: Pole with extruded-aluminum rectangular arm, 11 inchesin length.

2.2.1.4 Luminaire-Mounting Height: 25 feet.

2.2.1.5 Distribution: Per schedule.

2.2.1.6 Housings:

2.2.1.6.1 Extruded-aluminum housing and heat sink.

2.2.1.6.2 Anodized finish.

2.3 Materials

2.3.1 Metal Parts: Free of burrs and sharp corners and edges.

2.3.2 Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

2.3.3 Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

2.3.4 Diffusers and Globes:

2.3.4.1 Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2.3.4.2 Glass: Annealed crystal glass unless otherwise indicated.

2.3.4.3 Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

2.3.5 Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

2.3.6 Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

2.3.6.1 White Surfaces: 85 percent.

2.3.6.2 Specular Surfaces: 83 percent.

2.3.6.3 Diffusing Specular Surfaces: 75 percent.

2.3.7 Housings:

2.3.7.1 Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.

2.3.7.2 Provide filter/breather for enclosed luminaires.

2.3.8 Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

2.3.8.1 Label shall include the following lamp characteristics:

2.3.8.1.1 "USE ONLY" and include specific lamp type.

2.3.8.1.2 Lamp diameter, shape, size, wattage and coating.

2.3.8.1.3 CCT and CRI for all luminaires.

2.4 Finishes

2.4.1 Variations in Finishes: Noticeable variations in same piece are unacceptable. 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.

2.4.2 Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

2.4.3 Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electronically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

2.4.3.1.1 Color: Black.

2.5 Luminaire Support Components

2.5.1 Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

3 EXECUTION

3.1 Examination

3.1.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

3.1.2 Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 General Installation Requirements

3.2.1 Comply with NECA 1.

3.2.2 Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

3.2.3 Install lamps in each luminaire.

3.2.4 Fasten luminaire to structural support.

3.2.5 Supports:

3.2.5.1 Sized and rated for luminaire weight.

3.2.5.2 Able to maintain luminaire position after cleaning and relamping.

3.2.5.3 Support luminaires without causing deflection of finished surface.

3.2.5.4 Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

3.2.6 Wall-Mounted Luminaire Support:

3.2.6.1 Attached to structural members in walls.

3.2.7 Wiring Method: Install cables in raceways. Conceal raceways and cables.

3.2.8 Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height indicated on Drawings.

3.2.9 Coordinate layout and installation of luminaires with other construction.

3.2.10 Comply with requirements in Section 260500 “Common Work Results for Electrical” wiring connections and wiring methods.

3.3 Corrosion Prevention

3.3.1 Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

3.3.2 Steel Conduits: Comply with Section 260500 “Common Work Results for Electrical” in concrete foundations, wrap conduit with 0.010-inch thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 Identification

3.4.1 Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260500 “Common Work Results for Electrical.”

3.5 Field Quality Control

3.5.1 Inspect each installed luminaire for damage. Replace damaged luminaires and components.

3.5.2 Perform the following tests and inspections:

3.5.2.1 Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

3.5.2.2 Verify operation of photoelectric controls.

3.5.3 Illumination Tests:

3.5.3.1 Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):

3.5.3.1.1 IES LM-5.

3.5.3.1.2 IES LM-50.

3.5.3.1.3 IES LM-52.

3.5.3.1.4 IES LM-64.

3.5.3.1.5 IES LM-72.

3.5.3.2 Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

3.5.4 Luminaire will be considered defective if it does not pass tests and inspections.

3.5.5 Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

End of Section

Section 284621.11
Addressable Fire-Alarm Systems

1 GENERAL

1.1 Related Documents

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

1.1.2 Section 260500 covers general installation and wiring methods.

1.2 Summary

1.2.1 Section Includes:

1.2.1.1 Fire-alarm control unit.

1.2.1.2 Manual fire-alarm boxes.

1.2.1.3 Smoke detectors

1.2.1.4 Notification appliances.

1.2.1.5 Addressable interface device.

1.2.1.6 Digital alarm communicator transmitter.

1.2.1.7 Fire Alarm wiring requirements.

1.3 Definitions

1.3.1 EMT: Electrical Metallic Tubing.

1.3.2 NICET: National Institute for Certification in Engineering Technologies.

1.4 Action Submittals

1.4.1 Product Data: For each type of product, including furnished options and accessories.

1.4.1.1 Include construction details, material descriptions, dimensions, profiles, and finishes.

1.4.1.2 Include rated capacities, operating characteristics, and electrical characteristics.

1.4.2 Shop Drawings: For fire-alarm system.

1.4.2.1 Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

1.4.2.2 Include plans, elevations, sections, details, and attachments to other work.

1.4.2.3 Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.

1.4.2.4 Detail assembly and support requirements.

1.4.2.5 Include voltage drop calculations for notification-appliance circuits.

1.4.2.6 Include battery-size calculations.

1.4.2.7 Include input/output matrix.

1.4.2.8 Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.

1.4.2.9 Include performance parameters and installation details for each detector.

1.4.2.10 Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

1.4.2.11 Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

1.4.3 General Submittal Requirements:

1.4.3.1 Submittals shall be approved/reviewed by the A/E.

1.4.3.2 Shop Drawings shall be prepared by persons with the following qualifications:

1.4.3.2.1 Trained and certified by manufacturer in fire-alarm system design.

1.4.3.2.2 NICET-certified, fire-alarm technician; Level III minimum.

1.4.3.2.3 Licensed or certified by authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS

1.5.1 Qualification Data: For Installer.

1.5.2 Field quality-control reports.

1.1 Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

1.6.1 Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1.6.1.1 In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1.6.1.1.1 Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

1.6.1.1.2 Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

1.6.1.1.3 Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.

1.6.1.1.4 Riser diagram.

1.6.1.1.5 Device addresses.

1.6.1.1.6 Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.

1.6.1.1.7 Record copy of site-specific software.

1.6.1.1.8 Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1.6.1.1.8.1 Equipment tested.

1.6.1.1.8.2 Frequency of testing of installed components.

1.6.1.1.8.3 Frequency of inspection of installed components.

1.6.1.1.8.4 Requirements and recommendations related to results of maintenance.

1.6.1.1.8.5 Manufacturer's user training manuals.

1.6.1.1.9 Manufacturer's required maintenance related to system warranty requirements.

1.6.1.1.10 Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.6.2 Software and Firmware Operational Documentation:

1.6.2.1 Software operating and upgrade manuals.

1.6.2.2 Program Software Backup: Provide software backup on USB pocket drive.

1.6.2.3 Device address list.

1.6.2.4 Printout of software application and graphic screens.

1.7 Maintenance Material Submittals

1.7.1 Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.7.1.1 Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.

1.7.1.2 Smoke Detectors, Heat Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.

1.7.1.3 Keys and Tools: One extra set for access to locked or tamper proofed components.

1.7.1.4 Audible and Visual Notification Appliances: One of each type installed.

1.7.1.5 Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.8 Quality Assurance

1.8.1 Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

1.8.2 Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician minimum.

1.8.3 Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

1.8.4 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.

1.8.5 NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.9 Warranty

1.9.1 Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1.9.1.1 Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.

1.9.1.2 Warranty Period: Five years material and labor from date of Substantial Completion.

2 PRODUCTS

2.1 System Description

2.1.1 Noncoded, UL-certified FM Global-placarded addressable system, with multiplexed signal transmission and voice/strobe evacuation.

2.1.2 Automatic sensitivity control of certain smoke detectors.

2.1.3 All components provided shall be listed for use with the selected system.

2.1.4 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.

2.1.5 Fire Alarm Control Units shall have the ability to be networked.

2.2 Systems Operational Description

2.2.1 Fire-alarm signal initiation shall be by one or more of the following devices and systems:

2.2.1.1 Manual stations.

2.2.1.2 Smoke detectors.

2.2.2 Fire-alarm signal shall initiate the following actions:

2.2.2.1 Continuously operate alarm notification appliances including voice evacuation notices.

2.2.2.2 Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.

2.2.2.3 Transmit an alarm signal to the remote alarm receiving station.

2.2.2.4 Recall elevators to primary or alternate recall floors.

2.2.2.5 Record events in the system memory.

2.2.2.6 Activate voice/alarm communication system to E911 system using Town VoIP Segra Phone System.

2.2.3 Supervisory signal initiation shall be by one or more of the following devices and actions:

2.2.3.1 User disabling of zones or individual devices.

2.2.3.2 Loss of communication with any panel on the network.

2.2.3.3 Activation of duct smoke detector.

2.2.4 System supervisory signal actions:

2.2.4.1 Identify specific device initiating the event at fire-alarm control unit and fire-alarm remote annunciator.

2.2.4.2 After a time delay of 200 seconds, transmit a supervisory signal to the remote alarm receiving station.

2.2.5 System trouble signal initiation shall be by one or more of the following devices and actions:

2.2.5.1 Open circuits, shorts, and grounds in designated circuits.

2.2.5.2 Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.

2.2.5.3 Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.

2.2.5.4 Loss of primary power at fire-alarm control unit.

2.2.5.5 Ground or a single break in internal circuits of fire-alarm control unit.

2.2.5.6 Abnormal ac voltage at fire-alarm control unit.

2.2.5.7 Break in standby battery circuitry.

2.2.5.8 Failure of battery charging.

2.2.5.9 Abnormal position of any switch at fire-alarm control unit or annunciator.

2.2.5.10 Voice signal amplifier failure.

2.2.6 System Trouble Signal Actions:

2.2.6.1 Identify specific device initiating the event at fire-alarm control unit and fire-alarm remote annunciators.

2.2.6.2 After a time, delay of 200 seconds, transmit a trouble signal to the remote alarm receiving station.

2.3 Fire-Alarm Control Unit

2.3.1 Manufacturers: Subject to compliance with requirements, provide products by the following provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2.3.1.1 Fire-Lite Alarms, Inc.; a Honeywell International company.

2.3.1.2 Gamewell - FCI by Honeywell.

2.3.1.3 Notifier.

2.3.1.4 Siemens Industry, Inc.; Fire Safety Division.

2.3.1.5 SimplexGrinnell LP.

2.3.2 General Requirements for Fire-Alarm Control Unit:

2.3.2.1 Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

2.3.2.1.1 System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.

2.3.2.1.2 Include a real-time clock for time annotation of events on the event recorder and printer.

2.3.2.1.3 Provide communication between the FACU and remote circuit interface panels, annunciators, and displays.

2.3.2.1.4 The FACU shall be listed for connection to a central station signaling system service.

2.3.2.1.5 Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACU shall provide a minimum 500-event history log.

2.3.2.2 Addressable Initiation Device Circuits: The FACU shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.

2.3.2.3 Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACU shall be listed for releasing service.

2.3.3 Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

2.3.3.1 Annunciator and Display: Liquid-crystal type, three line(s) of 80 characters, minimum.

2.3.3.2 Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

2.3.4 Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

2.3.4.1 Pathway Class Designations: NFPA 72, Class A.

2.3.4.2 Pathway Survivability: Level 0.

2.3.4.3 Install no more than 50 addressable devices on each signaling-line circuit.

2.3.4.4 Serial Interfaces:

2.3.4.4.1 One dedicated RS 485 port for remote central-station operation using point ID DACT.

2.3.4.4.2 One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).

2.3.4.4.3 One USB port for PC configuration.

2.3.5 Notification-Appliance Circuit:

2.3.5.1 Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.

2.3.5.2 Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.

2.3.5.3 Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

2.3.6 Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory and print out the final adjusted values on system printer.

2.3.7 Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

2.3.8 Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and digital alarm radio transmitters shall be powered by 24-V dc source.

2.3.8.1 Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

2.3.9 Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

2.3.9.1 Batteries: Sealed lead calcium.

2.3.10 Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.3.11 Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.

2.3.11.1 Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for

manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.

2.3.11.1.1 Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.

2.3.11.1.2 Programmable tone and message sequence selection.

2.3.11.1.3 Standard digitally recorded messages for "Evacuation" and "All Clear."

2.3.11.1.4 Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.

2.3.11.2 Status Annunciator: Indicate the status of various voice/alarm speaker zones.

2.3.11.3 Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

2.4 Manual Fire-Alarm Boxes

2.4.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2.4.1.1 Fire-Lite Alarms, Inc.; a Honeywell International company.

2.4.1.2 Gamewell - FCI by Honeywell.

2.4.1.3 Notifier.

2.4.1.4 Siemens Industry, Inc.; Fire Safety Division.

2.4.1.5 Silent Knight.

2.4.1.6 SimplexGrinnell LP.

2.4.2 General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

2.4.2.1 Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.

2.4.2.2 Station Reset: Key- or wrench-operated switch.

2.4.2.3 Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 System Smoke Detectors

2.5.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2.5.1.1 Fire-Lite Alarms, Inc.; a Honeywell International company.

2.5.1.2 Gamewell - FCI by Honeywell.

2.5.1.3 Notifier.

2.5.1.4 Siemens Industry, Inc.; Fire Safety Division.

2.5.1.5 Silent Knight.

2.5.1.6 SimplexGrinnell LP.

2.5.2 General Requirements for System Smoke Detectors:

2.5.2.1 Comply with UL 268; operating at 24-V dc, nominal.

2.5.2.2 Detectors shall be two-wire type.

2.5.2.3 Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.5.2.4 Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

2.5.2.5 Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

2.5.2.6 Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.

2.5.2.7 Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

2.5.2.7.1 Multiple levels of detection sensitivity for each sensor.

2.6 Notification Appliances

2.6.1 Manufacturers: Subject to compliance with requirements, provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2.6.1.1 Siemens Industry, Inc.; Fire Safety Division.

2.6.1.2 SimplexGrinnell LP.

2.6.1.3 System Sensor.

2.6.1.4 Wheelock; a brand of Eaton.

2.6.2 General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

2.6.2.1 Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

2.6.3 Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

2.6.4 Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.

2.6.4.1 Rated Light Output:

2.6.4.1.1 15/30/75/110 cd, selectable in the field.

2.6.4.2 Mounting: Wall mounted unless otherwise indicated.

2.6.4.3 For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.

2.6.4.4 Flashing shall be in a temporal pattern, synchronized with other units.

2.6.4.5 Strobe Leads: Factory connected to screw terminals.

2.6.4.6 Mounting Faceplate: Factory finished, red.

2.6.5 Voice/Tone Notification Appliances:

2.6.5.1 Comply with UL 1480.

2.6.5.2 Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.

2.6.5.3 High-Range Units: Rated 2 to 15 W.

2.6.5.4 Low-Range Units: Rated 1 to 2 W.

2.6.5.5 Mounting: surface mounted and bidirectional.

2.6.5.6 Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.6.6 Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.7 Addressable Interface Device

2.7.1 General:

2.7.1.1 Include address-setting means on the module.

2.7.1.2 Store an internal identifying code for control panel use to identify the module type.

2.7.1.3 Listed for controlling HVAC fan motor controllers.

2.7.2 Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.

2.7.2.1 Allow the control panel to switch the relay contacts on command.

2.7.2.2 Have a minimum of two normally open and two normally closed contacts available for field wiring.

2.8 Network Communication System

2.8.1 Network loop fiber optic media modules shall be acceptable to the remote central station and shall comply with UL 864.

2.8.2 Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and transmitted to the remote central station. Fiber optic links are point-to-point continuous (unswitched) connections between fire alarm network nodes. If a node goes "off-line" or if the connection between nodes either shorts, opens, or has any other form of communication problem, the nodes will isolate that section of wiring. Nodes that cannot retransmit onto the next node of the network will transmit back to the previous node to maintain communications and to notify the network

of the node status. In the event of multiple wiring problems, the remaining nodes will effectively "regroup" and establish new, smaller "sub-networks" that will maintain communications among the active nodes. Local functions and display at the media module transmitter shall include the following:

2.8.2.1 Verification that both network loops are available.

2.8.2.2 Programming device.

2.8.2.3 LED display.

2.8.2.4 Manual test report function and manual transmission clear indication.

2.8.2.5 Communications failure with the central station or fire-alarm control unit.

2.8.3 Digital data transmission shall include the following:

2.8.3.1 Address of the alarm-initiating device.

2.8.3.2 Address of the trouble-initiating device.

2.8.3.3 Loss of ac supply.

2.8.3.4 Loss of power.

2.8.3.5 Low battery.

2.8.3.6 Abnormal test signal.

2.8.3.7 Communication bus failure.

2.8.4 Secondary Power: Integral rechargeable battery and automatic charger.

2.8.5 Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.9 Wire And Cable

2.9.1 Wire and cable for the fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

2.9.2 Power-Limited Circuits: Solid-copper conductors with 300-V rated, 75 deg C color-coded insulation.

2.9.2.1 Minimum Conductor Size: No. 18 AWG.

2.9.2.2 NFPA 70 Multiconductor Type FPLP, copper drain wire, plenum rated, UL listed for fire alarm and cable tray insulation, and listed

as having adequate fire-resistant and low smoke-producing capabilities.

2.9.3 Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C color-coded insulation.

2.9.3.1 Low Voltage Circuits: No. 16 AWG, minimum.

2.9.3.2 Line Voltage Circuits: No. 12 AWG, minimum.

2.9.3.3 NFPA 70 Multiconductor Type NPLFP, copper drain wire, plenum rated, UL listed for fire alarm and cable tray insulation, and listed as having adequate fire-resistant and low smoke-producing capabilities.

2.9.4 Fiber optic cable: Single mode, Nominal 9/125 µm.

3 EXECUTION

3.1 Examination

3.1.1 Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

3.1.1.1 Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed before installation begins.

3.1.2 Examine roughing-in for electrical connections to verify actual locations of connections before installation.

3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Equipment Installation

3.2.1 Comply with NFPA 72, requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

3.2.1.1 Devices placed in service before all other trades have completed cleanup shall be replaced.

3.2.1.2 Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

3.2.2 Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

3.2.3 Manual Fire-Alarm Boxes:

3.2.3.1 Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.

3.2.3.2 Mount manual fire-alarm box on a background of a contrasting color.

3.2.3.3 The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

3.2.4 Smoke Detector Spacing:

3.2.4.1 Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.

3.2.4.2 Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.

3.2.4.3 Smooth ceiling spacing shall not exceed 30 feet.

3.2.4.4 Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex Bin NFPA 72.

3.2.4.5 HVAC: Locate detectors not closer than 36 inches 60 inches from air-supply diffuser or return-air opening.

3.2.4.6 Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

3.2.5 Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

3.2.6 Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

3.2.7 Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

3.3 Pathways

3.3.1 Pathways shall be installed in EMT concealed in all conditions.

3.4 Connections

3.4.1.1 Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

3.4.2 Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

3.4.2.1 Alarm-initiating connection to elevator recall system and components.

3.5 Identification

3.5.1 Identify system components, wiring, cabling, and terminals.

3.5.2 Install framed instructions in a location visible from fire-alarm control unit.

3.6 Grounding

3.6.1 Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.6.2 Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 Field Quality Control

3.7.1 Field tests shall be witnessed by Engineer and authorities having jurisdiction.

3.7.2 Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

3.7.3 Perform tests and inspections.

3.7.4 Perform the following tests and inspections with the assistance of a factory-authorized service representative:

3.7.4.1 Visual Inspection: Conduct visual inspection prior to testing.

3.7.4.1.1 Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

3.7.4.1.2 Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

3.7.4.2 System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.7.4.3 Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

3.7.4.4 Test audible appliances for the private operating mode according to manufacturer's written instructions.

3.7.4.5 Test visible appliances for the public operating mode according to manufacturer's written instructions.

3.7.4.6 Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.7.5 Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

3.7.6 Fire-alarm system will be considered defective if it does not pass tests and inspections.

3.7.7 Prepare test and inspection reports.

3.7.8 Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

3.7.9 Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 Maintenance Service

3.8.1 Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective

components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.8.1.1 Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.8.1.2 Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.8.1.3 Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 Software Service Agreement

3.9.1 Comply with UL 864.

3.9.2 Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

3.9.3 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.

3.9.3.1 Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 Demonstration

3.10.1 Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

End of Section

Section 316316
Auger Cast Grout Piles

1 GENERAL

1.1 Summary

1.1.1 Section includes auger cast grout piles.

1.2 Preinstallation Meetings

1.2.1 Preinstallation Conference: Conduct conference at Project site.

1.3 Action Submittals

1.3.1 Product Data: For each type of product.

1.3.2 Design Mixtures: For each grout mixture.

1.3.3 Shop Drawings: For auger cast grout piles, prepared by or under the supervision of a qualified professional engineer.

1.4 Informational Submittals

1.4.1 Welding certificates.

1.4.2 Material certificates.

1.4.3 Equipment Data: Description of drilling and grout-pumping equipment.

1.4.4 Pile inspection reports.

1.4.5 Field quality-control reports.

1.5 Quality Assurance

1.5.1 Welding Qualifications: Qualify procedures and personnel according to the following:

1.5.1.1 AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5.1.2 AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

2 PRODUCTS

2.1 Performance Requirements

2.1.1 Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design piles, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2.1.1.1 Design Loads: As indicated on Drawings.

2.2 Steel Reinforcement

2.2.1 Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

2.2.2 Single Bar Reinforcing: ASTM A722/A722M, high strength, threaded.

2.2.2.1 Mechanical Couplings: Screw-on type, capable of supporting the minimum ultimate tensile strength of the coupled bars.

2.2.3 Centralizers: Devices to center steel reinforcement in excavation; spaced not less than 20 feet o.c. for vertical piles and 10 feet o.c. for battered piles.

2.3 Concrete Materials

2.3.1 Portland Cement: ASTM C150/C150M, Type I/II. Supplement with the following**:**

2.3.1.1 Fly Ash: ASTM C618, Class C.

2.3.2 Fine Aggregate: ASTM C33/C33M with 100 percent passing a No. 8 sieve, free of materials with deleterious reactivity to alkali in cement. Provide aggregate from single source.

2.3.3 Water: ASTM C94/C94M and potable.

2.3.4 Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures. Do not use calcium chloride or admixtures containing calcium chloride.

2.3.4.1 Water-Reducing Admixture: ASTM C494/C494M, Type A.

2.3.4.2 Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.

2.3.4.3 High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.

2.3.4.4 Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

2.3.4.5 Fluidifier: ASTM C937, with expansion of less than 4 percent.

2.4 Related Materials

2.4.1 Pile-Top Forms: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes.

2.5 Grout Mixtures

2.5.1 Proportion grout mixture as follows:

2.5.1.1 Minimum Compressive Strength: 5000 psi at 28 days; ASTM C109/C109M with cube specimens restrained from expansion according to ASTM C942.

2.5.1.2 Maximum Water-Cementitious Materials Ratio: 0.43.

2.5.1.3 Grout Flow: 10 to 25 seconds >; ASTM C939 and ASTM C109/C109M using a flow cone with 0.75-inch opening.

2.6 Fabricating Reinforcement

2.6.1 Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.7 Grout Mixing

2.7.1 Ready-Mixed Grout: Measure, batch, mix, and deliver according to ASTM C94/C94M, and furnish batch ticket information.

3 EXECUTION

3.1 Drilling And Pumping Equipment

3.1.1 Drilling Rig: Capable of advancing hollow-stem, continuous-flight augers of design diameters to depths 20 percent greater than design depths; with stabilizing arm at bottom of leads to prevent rotation, and middle guide for augers greater than 40 feet in length.

3.1.2 Hollow-Stem Auger: Continuous auger flighting without gaps or breaks, of diameter no more than 3 percent less than pile diameter; with grout pumping hole at bottom of auger head below cutting teeth. Seal grout-pumping hole with temporary tip plug to be fully opened by grout pressure or reinforcing bar during grout installation.

3.1.2.1 Hollow Shaft Diameter: Minimum 1-1/4-inch clear ID.

3.1.3 Grout Pump: Positive-displacement pump with a known volume per stroke. Minimum displacement pressure at pump of 350 lbf/sq. in.

3.1.4 Automated Monitoring Equipment: Capable of measuring auger depth, penetration rate, and grout volume pumped per unit depth increment and of printing results.

3.2 Excavation

3.2.1 Excavate piles to elevations indicated or auger refusal. Establish and maintain axial alignment of leads and shaft before and during driving.

3.2.1.1 Auger Refusal: Rate of less than 1 fpm.

3.2.2 Drilling Tolerances:

3.2.2.1 Location: Pile centers maximum 3 inches from locations indicated.

3.2.2.2 Plumb: Within 2 percent from vertical.

3.2.2.3 Batter Angle: Within 4 percent from required angle.

3.3 Installation

3.3.1 Grout Placement: Place grout in continuous operation.

3.3.1.1 Lift auger 6 to 12 inches at start of grout pumping to facilitate tip plug removal, then return to previously established tip elevation.

3.3.1.2 Develop an initial grout head of 60 inches before start of auger withdrawal and maintain during extraction.

3.3.1.3 Monitor pumped grout volumes using automated monitoring equipment.

3.3.1.4 Volume of placed grout is at least 115 percent of theoretical volume. If less than required volume is placed for any given 60-inch segment, lower auger a minimum of 60 inches, or to bottom of pile if less than 60 inches available, and restart withdrawal.

3.3.1.5 If grout pumping is interrupted during placement, lower auger a minimum of 60 inches, or to bottom of pile if less than 60 inches available, and restart withdrawal.

3.3.2 Steel Reinforcement Installation, General: Comply with recommendations in CRSI's "Manual of Standard Practice."

3.3.3 Reinforcing Cages: Install immediately after grout placement and support at ground surface until initial set. Allow cages to fall into shaft freely under their own weight; do not force by vibrating or pushing with mechanical equipment.

3.3.4 Adjacent Piles: Do not install piles within 3 pile helix diameters of piles grouted within the previous 12 hours.

3.3.5 If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit corrective construction proposals to Architect for review before proceeding.

3.4 Field Quality Control

3.4.1 Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

3.4.1.1 Pile excavation, placement, and testing.

3.4.1.2 Steel reinforcement welding.

3.4.2 Testing Agency: Engage a qualified testing agency to perform tests and inspections.

3.4.3 Grout Tests: Testing of samples of fresh grout obtained according to ASTM C172/C172M shall be performed according to the following requirements:

3.4.3.1 Flow Rate: ASTM C939 and ASTM C109/C109M using a flow cone with 0.75-inch opening.

3.4.3.2 Compressive Strength: ASTM C109/C109M with cube specimens restrained from expansion according to ASTM C942.

3.4.3.2.1 Testing Frequency: Obtain six 2-inch cubes for each 50 cu. yd. or fraction thereof of grout placed, but not less than one set for each day's pour. Obtain an additional set of cubes from each truck during test pile placement.

3.4.3.2.2 Strength of each grout mixture is 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.

3.4.4 Pile Inspection Reports: Prepare inspection reports for each auger cast grout pile.

End of Section

APPENDIX

REFERENCE DOCUMENTS

underhill ENGINEERING
geotechnical | geodesign | geoconstruction

GEOTECHNICAL ENGINEERING REPORT

Culpeper Station Railroad Pedestrian Bridge
111 S. Commerce Street
Town of Culpeper, Virginia

Underhill Project No. 21069
September 27, 2021

434.771.0234 | underhillengineering.com
1001 East Market St. STE 100, Charlottesville, VA 22902-5381

underhill ENGINEERING
geotechnical | geodesign | geoconstruction

September 27, 2021

Mr. Herbert White III, PE
WW Associates, Inc.
958 Olympia Drive, Suite 1
Charlottesville, VA 22911

Geotechnical Engineering Report, Culpeper Station Railroad Pedestrian Bridge, 111 S. Commerce Street, Town of Culpeper, Virginia, (Underhill Engineering Project No. 21069)

Dear Mr. White:

Underhill Engineering, LLC (Underhill) is pleased to present this Geotechnical Engineering Report for the project. The geotechnical engineering services for this project are provided in accordance with Underhill Engineering's agreement with WW Associates accepted August 6, 2021.

Thank you for the opportunity to provide our services. If you have any questions or require additional information, please do not hesitate to contact the undersigned.

Sincerely,

UNDERHILL ENGINEERING, LLC

Susan E. Ray, P.E., G.I.T.
Susan E. Ray, PE, GIT
Geotechnical Engineer

O. Christopher Webster, PE, F ASCE
Principal

COMMONWEALTH OF VIRGINIA
O. CHRISTOPHER WEBSTER
Lic. No. 019910
PROFESSIONAL ENGINEER

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References, Figures, and Appendices

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Appendix A

Appendix B

1.0 Executive Summary

This report presents the results of the subsurface exploration, soil laboratory testing, and geotechnical engineering analysis for the project site.

- Underhill's subsurface exploration, consisting of three mechanically advanced test borings, revealed the Newark Supergroup Formation (commonly conglomerate and greenstone clasts) overlain by Residuum (commonly elastic silts). The borings revealed the Residuum to be overlain by existing fill.
- Fill (Stratum F) is present to depths of 2.5 to 5.5 feet below the ground surface as revealed by the test borings. These soils consist of silt (ML) FILL and silty sand (SM) FILL. Boring B-3 encountered concrete and base course on top of the fill. Portions of the Stratum F fill contain concentrations of roots.
- Soil laboratory testing revealed the ELASTIC SILT (MH) residuum (Stratum B) to have a *Low to Medium Potential* for Moisture-Related Volume Change.
- A design bearing pressure of **3,000 PSF** should be considered for the bridge abutment footings, when footings are founded in competent Residuum at a bottom of footing bearing grade at least **6.5 feet** below the ground surface.
- A design bearing pressure of **2,000 PSF** should be considered for the restroom building footings, when footings are founded in competent Residuum at a bottom of footing bearing grade at least **3 feet** below the ground surface.
- Select Compacted Structural Fill should consist of **VDOT No. 21A**, placed and compacted as recommended herein.

Underhill is providing this Executive Summary solely as an overview of the findings and recommendations. Any party that relies of this report must read the full report since the Executive Summary omits several details, including those that are important to the proper interpretation and application of the report.

2.0 Scope of Services

Underhill's agreement accepted August 6, 2021, defines the scope of services for this project. The scope is limited to the Geotechnical Engineering Services as presented therein.

3.0 Site Information

3.1 Site Description

The project consists of a proposed pedestrian bridge that extends across the Amtrak railroad tracks, with bridge abutments located on the north side and directly across the tracks from the existing Culpeper Station at 111 S. Commerce Street in the Town of Culpeper, Virginia. The site is east of the town center and is designated as Tax Map Parcel (TMP) 41A2-1H2-18A and 41A2-1H2-19 on the Town of Culpeper GIS, comprising about 0.9 and 3.67 acres, respectively.

The portion of the site on the west side of the tracks, north of the Culpeper Station building, is occupied by an outdoor patio area with stamped concrete pavement surface. Park benches and three large trees occupy this area.

The portion of the site east of the station (TMP 41H2-1H2-19) has been cleared recently and is now generally open. The terrain is rugged from clearing but is generally flat and covered with grass. Several partially demolished concrete pads and a small concrete structure are situated in this area along with piles of stumps and old building debris.

The topographic data from Sheet C-2 of the 3/5/2021 Concept Plan indicates gently western-sloping ground surface grades varying from EL 405 to EL 408 on the west side of the railroad tracks (the station side). The cleared area on the east side of the railroad tracks slopes gently east from EL 404 to EL 400. A Site Vicinity Map is included as **Figure 1**.

3.2 Proposed Construction

The proposed construction consists of a pedestrian bridge across the railroad tracks with an elevator and stairs on each side and a restroom on the west (station) side. The bridge span is approximately 61 feet long with the bottom of the bridge deck proposed at EL 432. Comparing the proposed grades to the existing grades, minimal cuts and fills will be needed to grade the abutment areas.

Underhill understands that the proposed restroom building will be designed following the 2015 Virginia Construction Code, Part I of the Virginia Uniform Statewide Building Code (VUSBC) criteria. The bridge structure is anticipated to be designed following AASHTO criteria. The proposed scope of services considers that the designer will use a Seismic Site Class of D for the structures unless on-site conditions indicate otherwise.

4.0 Field Services

4.1 Subsurface Exploration Program

Underhill's geotechnical engineering study included a subsurface exploration program consisting of three mechanically advanced test borings. The subsurface exploration program was performed to evaluate the subsurface conditions and develop generalized stratigraphy at the test hole locations. The evaluation of the soils' characteristics included visual and limited laboratory classification and evaluation of density or stiffness based on the results of the Standard Penetration Test (SPT) N values obtained.

Underhill's subcontractor, Ayers and Ayers, Inc., drilled the test borings on August 11, 2021, under the observation of Underhill's personnel. The test boring logs are included in Appendix A. Soil samples retrieved from the subsurface exploration program will be held for 45 days unless the Client requests other disposition.

4.2 Location Control

The boring locations were staked in the field by Underhill. Underhill obtained LAT/LNG coordinates at the boring locations, as indicated on the respective logs, referencing Google Earth. The elevations at the test boring locations were referenced to Sheet C-2 of the 3/5/2021 topographic Concept Plan provided by the Client. A Boring Location Plan is included as **Figure 2**, following the text of this report. The locations and elevations should be considered no more accurate that the methods and means used to obtain them.

5.0 Site Geology, Subsurface Conditions, and Soil Laboratory Testing

5.1 Site Geology

Underhill's review of the available geologic data, including the state geological map of Virginia, indicates the site geology consists of the Upper Triassic Newark Supergroup, which features conglomerate and greenstone clasts. A fault of unknown displacement extends generally southwest to northeast approximately 0.5 mile west of the site. The site's overburden consists of residuum (commonly silts, sands, and disintegrated rock) overlying the parent material. The subsurface exploration revealed existing fill soils overlying the residuum.

5.2 Generalized Subsurface Stratigraphy

Underhill developed the following generalized subsurface stratigraphy based on the results of the subsurface exploration program, the soil laboratory test results, and review of the local geology:

Asphalt and Aggregate Base Course:

- Boring B-3 encountered concrete and aggregate base course to 8.5 inches below the surface. Measurements of the concrete and the underlying base-course at the boring location revealed 2.5 inches of concrete and 6 inches of aggregate. Near-surface soils underlying the base course were identified as existing fill (Stratum F as described below).

Stratum F (Existing Fills):

- The coarse-grained portion of Stratum F generally consists of medium dense silty sand (SM) FILL.
- The fine-grained portion of Stratum F generally consists of stiff sandy silt (ML) FILL.
- Portion of Stratum F contain varying amounts of roots and mica.
- Borings revealed Stratum F to depths of 2.5 to 5.5 feet below the ground surface.
- Standard Penetration Test (SPT) N values = 15 to 60.

Stratum B (Fine-Grained Residuum):

- Stratum B consists of generally medium stiff to stiff ELASTIC SILT (MH), containing varying amounts of sand, mica, and pyrrhotite.
- The borings revealed Stratum B below Stratum F to the maximum test boring depth in Boring B-3 and to 18.5 and 24.5 feet in Boring B-1 and B-2, respectively.
- Standard Penetration Test (SPT) N values = 6 to 26.
- Natural Water Content (W) values = 37.0 to 53.6% (six samples tested).

Stratum C (Disintegrated Rock):

- Stratum C consists of hard DISINTEGRATED ROCK.
- Borings B-1 and B-2 revealed Stratum C below Stratum B to the maximum test boring depths of 18.7 and 33.9 feet, respectively.
- Standard Penetration Test (SPT) N values = 50/5" to 50/2" (i.e., equivalent to an SPT N value > 100).

Note that Stratum A, commonly noting Alluvium, was not observed in the test borings drilled for the project.

5.3 Groundwater

Groundwater was not encountered during drilling. The borings caved dry at the depths between 11.7 to 32.7 feet, following removal of the augers.

A Water Observation Well (W.O.W.) was installed to 18.7 feet in Boring B-1. The W.O.W. measurement taken after drilling did not reveal groundwater. The long term W.O.W. measurement taken 31 days following the subsurface exploration did not reveal groundwater. Fluctuations in the hydrostatic water table should be expected to occur over time, depending on variations in precipitation, surface runoff, pumping, flooding, evaporation, stream levels, and similar factors.

5.4 Laboratory Testing

Selected specimens were retrieved from the subsurface exploration program for soil laboratory testing. Soil laboratory testing assigned by Underhill consisted of the following:

- Six Natural Water Content tests (ASTM D2216).
- Two Atterberg Limits (ASTM D4318).
- Two Mechanical Sieve Tests (ASTM D422/D6913).

Soil laboratory testing was performed to aid in the classification of the soils encountered in the subsurface exploration and to provide index test values for use in the development of design recommendations. Natural water content values of the specimens tested are presented in the respective logs. A summary of the soil laboratory test results is presented in Appendix B.

Soil laboratory index testing indicated the following for the samples retrieved from Stratum B:

<u>B-1: 7.0 – 8.5 FT and B-3: 9.0 – 10.5 FT:</u>

- ASTM Classification: ELASTIC SILT (MH)
- Liquid Limit values, LL = 61 to 69
- Plasticity Index values, PI = 14 to 16
- Plasticity of the Whole Sample (PI multiplied by the Percent Passing the No. 40 Sieve): 12 to 15
- The natural water content values of the specimens were within 1 percent of their Plastic Limit values.
- Moisture-related Volume Change Potential (shrink-swell) (NAVFAC DM-7): **Low to Medium**.

6.0 Geotechnical Recommendations

6.1 Discussion

The test borings revealed existing fill soils (Stratum F) to depths of about 2.5 to 5.5 feet within the proposed abutment footprints, and to about 3 feet below the ground surface in the proposed restroom footprint. Portions of the Stratum F existing fill contains deleterious material such as root fragments. These existing fill soils are considered unsuitable for support of the proposed bridge abutment foundations and the proposed restroom building. Therefore, the Stratum F soils will need to be removed where these soils are encountered during the foundation excavations to expose the underlying competent residuum.

6.2 Foundations

6.2.1 Bridge Abutments

A Design Footing Bearing Pressure of **3,000 PSF**, may be used for the proposed bridge abutments, provided that footings are founded as follows:

- The bridge abutment footings should be founded in competent Residuum (Strata B and C) at least **6.5 feet** below existing grades. This recommended bearing grade is also considered adequate for frost protection.
- The excavated footing subgrades should be evaluated by the Geotechnical Engineer prior to concrete placement.
- Where undercut is recommended, the undercut excavation should be backfilled with Select Compacted Structural Fill as recommended in Section 6.4.2 or with 4,000-PSI concrete.

6.2.2 Restroom Building

A Design Footing Bearing Pressure of **2,000 PSF**, may be used for the proposed restroom building provided that footings are founded as follows:

- The restroom building footings should be founded in competent Residuum (Strata B and C) at least **3 feet** below existing grades. This recommended bearing grade is also considered adequate for frost protection.
- The excavated footing subgrades should be evaluated by the Geotechnical Engineer prior to concrete placement.
- Where undercut is recommended, the undercut excavation should be backfilled with Select Compacted Structural Fill as recommended in Section 6.4.2 or with 4,000-PSI concrete.

The restroom building footing design should consider minimum column and wall footing widths of 24 and 16 inches, respectively, to address shear failure considerations. Where turn-down slabs are planned the base of the turn-down should be at least 12 inches wide.

6.2.3 General

The recommended bearing pressures as presented above provide factors of safety of at least **3.0** against general shear failure. Select fill should meet the requirements outlined in Section 6.4.2 for Select Compacted Structural Fill.

Note the recommended bearing pressures may be increased by **33 percent** for wind and seismic loads only when used in conjunction with load combinations defined in IBC Section 1605.3.2, Alternate Basic Load Combinations for use with allowable stress design or other applicable code exceptions.

Settlements of shallow spread footings founded as described above are not expected to exceed **1 inch**. Differential settlements between similarly loaded footings are not expected to exceed **½ inch**.

6.3 Seismic Site Class and Site Coefficients

Underhill evaluated the Seismic Site Class and Seismic Site Coefficients for this project according to IBC Section 1613 (2015). Based on our review of the subsurface conditions, the structural design may use the following seismic criteria:

- Seismic Site Class: D
- Site Coefficient, Fa: 1.6
- Site Coefficient, Fv: 2.4

The Site Class was evaluated based on Standard Penetration Test N values terminating in hard Disintegrated Rock.

6.4 Earthwork

6.4.1 Stripping and Grading

The Contractor should remove existing concrete, aggregate, and Stratum F fill from subgrades in the area of Boring B-3 for the proposed restroom building support. Based on the measurements of these materials, a stripping depth of 36 inches is recommended for project planning purposes. The Contractor should also remove existing topsoil and Stratum F fill in the proposed bridge abutment areas to the recommended depths as indicated in Section 6.2. Test pits may be performed at the start of the earthwork construction to provide additional data regarding stripping/undercut depths.

The Geotechnical Engineer should evaluate the subgrade soils for suitability. Evaluation techniques may include probing with a penetrometer, observing proofrolls of a loaded dump truck where practical, drilling hand augers, observing test pits, or a combination of these methods. The Contractor should excavate areas deemed unsuitable by the Geotechnical Engineer and replace these areas with additional compacted structural fill.

Underhill recommends that undercut volumes by measured using cross sectioning survey methods. Other methods of calculating volumes of undercut, such as counting trucks, are less accurate and generally result in additional expense. If truck counts are used, we recommend that the method of payment be in accordance with Section 109 of the Virginia Department of Transportation (VDOT) Road and Bridge Specifications.

Excavation activities may encounter buried foundations and other associated debris. Existing foundations should be completely removed where encountered from within the proposed foundation areas. Existing utilities and drainage structures within the proposed foundation areas should be removed and replaced with new compacted structural fill.

6.4.2 Compacted Structural Fill

The existing fill soils of Stratum F contain root fragments and are considered unsuitable for use as compacted structural fill. Therefore, Stratum F soils should be removed to expose the underlying competent Residuum and the undercut Stratum F soils removed from the site. Project planning should consider the need for importing select off-site borrow (i.e., VDOT No. 21A as referenced below).

Off-site borrow material used as Select Compacted Structural Fill should meet the following criteria:

- Classification: **VDOT No. 21A Dense-Graded Aggregate.**
- Maximum loose lift thickness: 8 inches.
- Compaction Criteria: **95% of Maximum Dry Density** (ASTM D698, Standard Proctor).
- The Contractor should place the compacted structural fill in horizontal lifts.
- Compacted structural fill should extend laterally at least 5 feet beyond the foundation limits, and slope as needed to meet existing grades.
- Slopes constructed of Compacted Structural Fill should not be designed and built steeper than 3H:1V.

6.5 Floor Slab

The proposed floor slab should be supported as follows:

- The floor slab should be supported on competent Strata B material as evaluated by the Geotechnical Engineer, or on Compacted Structural Fill as described in Section 6.4.2.
- The slab on grade may be designed using a modulus of subgrade reaction value, **k= 100 PCI**.
- The Contractor should recompact floor slab subgrades immediately before placing moisture barrier materials to repair any disturbance that may occur due to construction.
- Utility excavations should be backfilled with Compacted Structural Fill.
- A 4-inch-thick layer of crushed stone or washed gravel capillary moisture barrier should underlie the floor slab on grade. Moisture barrier material should consist of VDOT No. 57 size aggregate. The Contractor should compact the stone in place by making at least two passes by suitable vibratory compaction equipment.
- The moisture barrier should be overlain with a 10-mil vapor barrier.

7.0 Construction Considerations

7.1 Site Grading and Earthwork

The on-site soils at exposed subgrade levels are susceptible to moisture changes and will be easily disturbed under wet weather conditions. Drying and reworking of the subgrade soil is unlikely and where these soils are disturbed, they should be removed to expose the underlying competent, undisturbed soils as recommended by the Geotechnical Engineer. Therefore, it will be important that the project be performed during the warmer, drier times of the year to limit the potential for disturbance of on-site soils or where these conditions are not possible, the subgrades should be protected by the Contractor.

Foot traffic on excavated / undercut subgrades should be limited to reduce disturbance. The Contractor should provide site drainage to maintain subgrades free of water and to avoid saturation and disturbance of the subgrade soils. This 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. Note that unreinforced concrete working mats (i.e., "mud mats") may be needed where inclement weather is anticipated.

Earthwork activities may encounter excess water runoff (i.e., perched water conditions) during excavation to grade, especially during times of heavy precipitation. Therefore, the Contractor may need to provide temporary dewatering such as trenching and/or pumping from sumps to control the water.

7.2 Foundations

The Contractor should exercise care during excavation for foundations 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. Underhill's Engineer should observe actual foundation subgrades during construction to evaluate whether subgrade soils meet the requirements as recommended in this report.

Footing subgrades needing undercut may be concreted at the elevation of undercut or backfilled with Select Compacted Structural Fill as recommended in Section 6.3. Concrete placement should take place the same day as excavation of the foundations.

7.3 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 the subsurface exploration. The nature and extent of variations between borings may not become evident until during construction. To account for this variability, Underhill should provide professional observation and testing of subsurface conditions revealed during construction as an extension of our design phase engineering services. These services will also help in evaluating the Contractor's conformance with the plans and specifications.

8.0 General Specification Recommendations

The Project Construction Documents should include an allowance for possible additional costs that may be required to construct the foundations, as recommended in this report. Costs may be incurred for a variety of reasons including variation of soil between borings, additional helical pier lengths, greater than anticipated unsuitable soils, need for borrow fill material, wet on-site soils, obstructions, rock excavation, temporary dewatering, etc.

The project documents should indicate the Contractor's responsibility for providing adequate site drainage during construction. Inadequate drainage can lead to disturbance of soils by construction traffic and increased volume of undercut. The project documents should also delegate the Contractor responsible for reworking of subgrades and compacted fill initially considered suitable, but later disturbed by equipment and/or weather.

This report may be made available to prospective bidders for informational purposes. The project specifications are recommended contain the following statement:

> *Underhill 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 conducted. 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.

9.0 Limitations

The analyses and recommendations submitted in this report are based on the information revealed by the subsurface exploration. This report attempts to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during construction.

Underhill has prepared this study to aid in the evaluation of the site. It is intended for use concerning this specific project and should not be used for other purposes. The recommendations provided within are based on information on the site and proposed construction as described in this report. Changes regarding existing conditions or changes in loads, locations, or grades should be brought to Underhill's attention so that recommendations can be modified as needed. Underhill would appreciate an opportunity to review the plans and specifications as they pertain to the recommendations contained in this report, and to submit comments to you based on this review.

Underhill would be glad to provide the Special Inspections testing including the Geotechnical-Related Construction Phase Services (CPS) as an extension of the Design Phase Services (DPS). If the Client elects to proceed without Underhill providing Geotechnical-Related CPS, then Underhill's Services will be deemed "complete" upon completion of the DPS. Note that if Underhill's Services under this Agreement do not include Observation and Review of the Work, or any other CPS related to the Project's Geotechnical Aspects, then the Owner and its Third Parties assume all responsibility for interpretation of the Project's Geotechnical Aspects during the Construction Phase of the Project.

Underhill has 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.

References

Evans, Nick H. (1989) Contributions to Virginia Geology – VI, Publication 88, Virginia Division of Mineral Resources, Charlottesville, Virginia.

Evans, Nick H. and Rader, E.K. (1993) Geological Map of Virginia, Virginia Division of Mineral Resources, Charlottesville, Virginia.

Johnson, David W. (1999) The Culpeper Basin, Virginia Minerals, Vol. 45 No. 4, Virginia Division of Mineral Resources, Charlottesville, Virginia.

Lindholm, R. C., J. M. Hazlett, S. W. Fagin (2006) Petrology of Triassic – Jurassic Conglomerates in the Culpeper Basin, Virginia, American Geological Institute, Alexandria, Virginia.

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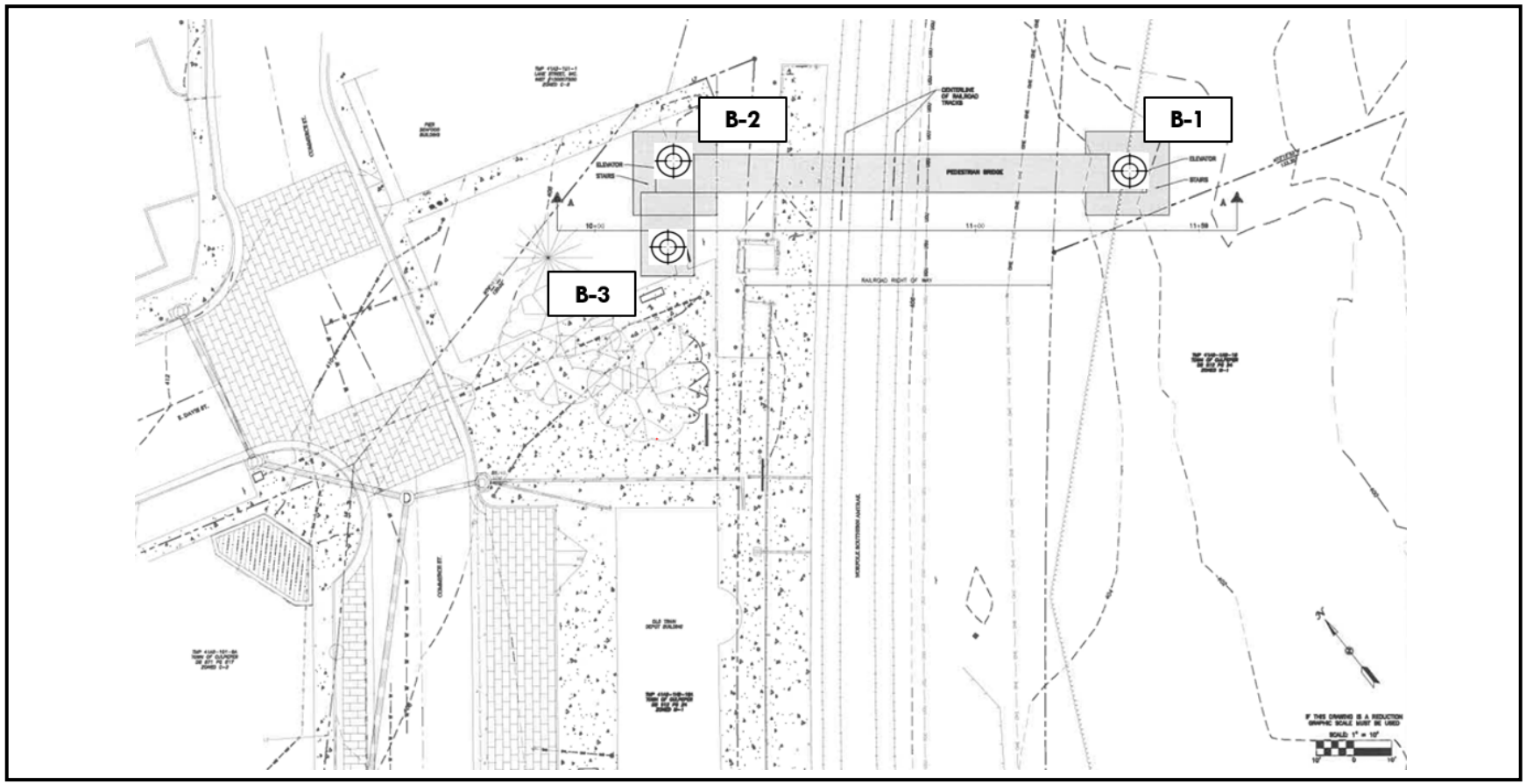
Figure 1: Site Vicinity Map

Image from Google Earth

No Scale

NORTH

Figure 2: Location Plan



APPROXIMATE TEST BORING LOCATION

Note: Base drawing provided by WW Associates, Inc.

Appendix A: Subsurface Exploration Procedures

Test Borings – Hollow Stem Augers (HSA)

The borings are advanced by turning a continuous flight auger with a center opening of 2¼ or 4¼ inches. A plug device blocks off the center opening while the augers are advanced. 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 after removal of the plug. 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." Note also that driving of the split-spoon sampler is terminal when a blow count of 50 over 6-inches or less is reached. The SPT is conducted according to ASTM D1586.

Many correlations with SPT N-values are used in the development of our Geotechnical Engineering recommendations. These correlations are usually based on SPT N-values obtained using a Safety Hammer. The SPTs for this project were performed used an Automatic Trip Hammer (ATH). The energy applied to the split-spoon sampler using the ATH is about 30 percent greater than that applied using a Safety Hammer. The hammer blows shown on the boring logs are uncorrected for high energy. However, these SPT N values are corrected for the higher energy purposes for analysis.

Soil Classification Criteria

The group symbols on the logs represent the Unified Soil Classification System Group Symbols (ASTM D2487) based on the 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.

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.

Water Observation Wells

Temporary water observation wells (W.O.W's), when installed, are constructed using hand-slotted or screened, PVC pipe in the bore hole. The pipe is capped and the area surrounding the pipe backfilled with cuttings from the boring.

Piezometers

Piezometers are similar to temporary water observation wells but are constructed using screened PVC pipe in the bore hole. The screened portion of the pipe is surrounded by clean sand and a plug of bentonite

pellets installed above the sand. The remaining portion of the well is backfilled with cuttings from the boring or backfilled with cement-bentonite grout.

Boring & Test Pit Log Key

	Rock Core (NQ)	**WOH**	Weight of Hammer
	Standard Penetration Split Spoon Sampler (SPT)	**WOR**	Weight of Rods
	Stabilized Groundwater		Groundwater at time of drilling
	Shelby Tube	WC	Water Content
WOW	Water Observation Well	PP	Pocket Penetrometer
GP	Geostick Penetrometer	DCP	Dynamic Cone Penetrometer

Appendix A: Key to Logging and Soil Classification

Particle Size and Proportion

Descriptions are assigned to each soil sample or stratum based on estimates of the particle size of each component of the soil and the percentage of each component in the soil.

Particle Size Descriptive Terms		Proportion Descriptive Terms		
Soil Component	Particle Size	Component	Term	Percentage
Boulder	> 12 inches	Major	Uppercase Letters	> 50%
Cobble	3 - 12 inches		(e.g., SAND, SILT)	
Gravel-Coarse	¾ - 3 inch			
-Fine	#4 - ¾ inch	Secondary	Adjective	20% - 50%
Sand-Coarse	#10 - #4		(e.g., sandy, clayey)	
-Medium	#40 - #10			
-Fine	#200 - #10	Minor	With	15% - 20%
Silt	< #200		Trace	< 15%
Clay	< #200		Contains	presence of

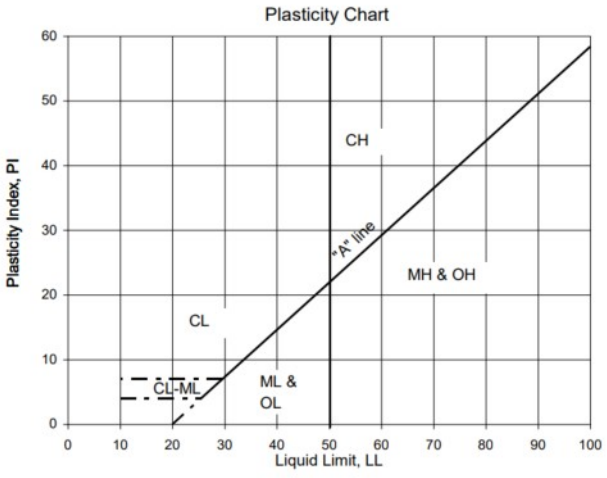
Density or Consistency

The Standard Penetration Test values (N-values) are used when soil test borings are performed, to describe the density of coarse-grained soils (gravel, sand) or the consistency of fine-grained soils (silt, clay). Sandy silts of low plasticity may be assigned a density instead of a consistency.

DENSITY		CONSISTENCY	
Term	N-value	Term	N-Value
Very Loose	0-4	Very Soft	0-2
Loose	5-10	Soft	3-4
Medium Dense	11-30	Medium Stiff	5-8
Dense	31-50	Stiff	9-16
Very Dense	>51	Very Stiff	17-32
		Hard	>33

Notes:
1. The N-value is the number of blows of a 140-lb. hammer (falling 30 inches) required to drive a standard split-spoon sampler (2.0 in. O.D., 1-3/8 in. I.D.) 12 inches into the soil after properly seating the sampler six inches.
2. When encountered, gravel may increase the N-value of the SPT and may not accurately represent the in-situ density or consistency of the soil sampled.

Appendix A: Unified Soil Classification System (ASTM D-2487)

Major Divisions			Group Symbols	Typical Names	Laboratory Classification Criteria		
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 Sieve), coarse-grained soils are classified as follows: Less than 5 per cent GW, GP, SW, SP More than 12 per cent GM, GC, SM, SC 5 to 12 per cent Borderline cases requiring dual symbols	$C_U = D_{60}/D_{10}$ greater than 4; $C_C = (D_{30})^2/(D_{10} \times D_{60})$ between 1 and 3	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits below "A" line or PI greater than 7	
	Sands (More than half of coarse fraction is smaller than No.4 sieve size)	Clean sands (little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines		$C_U = D_{60}/D_{10}$ greater than 6; $C_C = (D_{30})^2/(D_{10} \times D_{60})$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures		Atterberg limits above "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line or PI greater than 7	
Fine-grained soils (More than half material is smaller than No. 200 sieve	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity			
	Highly organic soils		Pt	Peat and other highly organic soils			

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Boring Number : B-1
Project Number : 21069
Project : Culpeper Station Bridge
Location : Culpeper, VA

X Coordinate : 38.472390
Y Coordinate : -77.992501
Elevation : 403 FT
Boring Depth : 18.7 FT
Start Date : 8/11/2021
End Date : 8/11/2021

Drilling Contractor : Ayers & Ayers
Foreman : M. White
Drill Rig Type : CME-45
Drilling Method : 2-1/4 HSA
Hammer Type: Safety Hammer
Logged by : S. Ray

GROUNDWATER OBSERVATIONS

	Date	Time	Depth	Remarks
Encountered	8/11/2021	---	---	---
Completion	8/11/2021	12:00 PM	Dry	---
Casing Pulled	8/11/2021	12:09 PM	Dry	WOW to 18.7 FT
Long-Term	---	---	---	---

DEPTH (FT)	LITHOLOGY: STRATUM	LITHOLOGY: LITHOLOGIC SYMBOL	LITHOLOGY: GEOLOGIC DESCRIPTION OF SOIL AND ROCK STRATA	LITHOLOGY: USCS	LITHOLOGY: ELEVATION	TEST DATA: SAMPLE NUMBER	TEST DATA: SAMPLE TYPE	TEST DATA: SAMPLING DATA	TEST DATA: SPT VALUE	TEST DATA: TESTS	REMARKS
0.0	F		Fine sandy silt FILL, trace root fragments, dry - red and orange	ML	403.0	P-1		9+8+9+14	17		FILL
			do, red			P-2		5+6+9+15	15		
						P-3		5+6+6+11	12	W=37.8%	
5.5	B		Fine sandy ELASTIC SILT, trace pyrrhotite and mica, moist - red and black	MH	397.5						Relict structure at 5.5 FT
			do, with sand, orange, red, and black			P-4		8+3+3	6	W=46.1%	
			do, orange, tan, and purple			P-5		4+5+13	18		RESIDUUM
						P-6		7+10+13	23		Augers grinding at 13.5 FT
						P-7		50/2"	50+		Auger refusal at 18.5 FT
18.7			Boring Terminated at 18.7 FT		384.3						

Notes : 1. Boring elevations obtained from Sheet C-2 of the 3/5/2021 Concept Plan by WW Associates.
2. Water observation well installed to 18.7 FT.

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Boring Number : B-2
Project Number : 21069
Project : Culpeper Station Bridge
Location : Culpeper, VA

X Coordinate : 38.472631
Y Coordinate : -77.993043
Elevation : 406 FT
Boring Depth : 33.9 FT
Start Date : 8/11/2021
End Date : 8/11/2021

Drilling Contractor : Ayers & Ayers
Foreman : M. White
Drill Rig Type : CME-45
Drilling Method : 2-1/4 HSA
Hammer Type: Safety Hammer
Logged by : S. Ray

GROUNDWATER OBSERVATIONS

	Date	Time	Depth	Remarks
Encountered	8/11/2021	---	---	---
Completion	8/11/2021	10:15 AM	Dry	---
Casing Pulled	8/11/2021	10:24 AM	Dry	Caved at 32.7 FT
Long-Term	9/10/2021	9:45 AM	Dry	---

DEPTH (FT)	STRATUM	LITHOLOGIC SYMBOL	GEOLOGIC DESCRIPTION OF SOIL AND ROCK STRATA	USCS	ELEVATION	SAMPLE NUMBER	SAMPLE TYPE	SAMPLING DATA	SPT VALUE	TESTS	REMARKS
0			Topsoil		406						
0.3	F		Fine silty sand FILL, trace mica, dry - brown	SM	405.3	P-1		22+15+45+7	60		FILL
			do, contains crushed stone and PVC fragments								
2.5			Fine sandy ELASTIC SILT, trace pyrrhotite and mica, moist - red, brown, and black		403.5	P-2		6+6+7+8	13	W=430.%	Relict structure at 2.5 FT
						P-3		4+7+7	14	W=37.0%	
			do, with sand								
						P-4		5+8+14	22		
			do, red, tan, brown, and black			P-5		5+8+11	19		
	B			MH							RESIDUUM
						P-6		6+9+11	20		Augers grinding at 15.5 FT
						P-7		6+11+12	23		
24.5			DISINTEGRATED ROCK, moist - red, tan, brown, and black		381.5	P-8		16+26+50/5"	50+		
	C		do, red, tan, gray, and black			P-9		42+50/4"	50+		
						P-10		50/5"	50+		
33.9			Boring Terminated at 33.9 FT		372.1						

Notes : 1. Boring elevations obtained from Sheet C-2 of the 3/5/2021 Concept Plan by WW Associates.
2. Boring backfilled upon completion.

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Boring Number : B-3
Project Number : 21069
Project : Culpeper Station Bridge
Location : Culpeper, VA

X Coordinate : 38.472531
Y Coordinate : -77.993100
Elevation : 407 FT
Boring Depth : 15 FT
Start Date : 8/11/2021
End Date : 8/11/2021

Drilling Contractor : Ayers & Ayers
Foreman : M. White
Drill Rig Type : CME-45
Drilling Method : 2-1/4 HSA
Hammer Type: Safety Hammer
Logged by : S. Ray

GROUNDWATER OBSERVATIONS

	Date	Time	Depth	Remarks
Encountered	8/11/2021	---	---	---
Completion	8/11/2021	11:13 AM	Dry	---
Casing Pulled	8/11/2021	11:18 AM	Dry	Caved at 11.7 FT
Long-Term	---	---	---	---

DEPTH (FT)	STRATUM	LITHOLOGIC SYMBOL	GEOLOGIC DESCRIPTION OF SOIL AND ROCK STRATA	USCS	ELEVATION	SAMPLE NUMBER	SAMPLE TYPE	SAMPLING DATA	SPT VALUE	TESTS	REMARKS
0.0	F		2.5" Concrete, 6" aggregate, and 2" asphalt		407.0	P-1		36+50/3"	48		Augers scraping at 1.5 FT
2.3			Fine to coarse silty sand FILL, moist - black	SM	404.7	P-2		12+9+14+14	23		FILL
3.0	B		Fine sandy ELASTIC SILT, trace pyrrhotite and mica, moist - red, orange, and black		404.0	P-3		5+7+19	26		Relict structure at 3 FT
			do, with sand, orange, red, and black	MH		P-4		7+7+9	16	W=53.6%	RESIDUUM
						P-5		3+4+6	10	W=53.4%	
			do, orange, black, and red			P-6		5+8+10	18		
15.0			Boring Terminated at 15.0 FT								

Notes : 1. Boring elevations obtained from Sheet C-2 of the 3/5/2021 Concept Plan by WW Associates.
2. Boring backfilled upon completion.

Appendix B: Soil Laboratory Test Results

Summary of Soil Laboratory Tests		
Sample Location	B-1	B-3
Sample Type	JAR	JAR
Sample Depth (ft)	7.0-8.5	9.0-10.5
Stratum	B	B
Description, Symbol USCS	ELASTIC SILT with sand, MH	ELASTIC SILT, MH
Natural Water Content (%)	46.1	53.4
% Passing No. 4 Sieve	98.6	100
% Passing No. 40 Sieve	86.1	96.8
% Passing No. 200 Sieve	74.0	88.3
Liquid Limit	61	69
Plastic Limit	47	53
Plasticity Index	14	16

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May 11, 2022

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Report Addendum, Culpeper Station Railroad Pedestrian Bridge, 111 S. Commerce Street, Town of Culpeper, Virginia (Underhill Engineering Project No. 21069)

Dear Mr. White:

Underhill Engineering, LLC (Underhill) is pleased to present this Addendum to the September 27, 2021, Report to include updated foundation recommendations for support of the proposed building. Underhill's services for this project are provided in accordance with Underhill Engineering's proposal dated August 2, 2021, and accepted August 6, 2022.

Underhill's Geotechnical Report included foundation recommendations for support of the proposed bridge abutments and restroom building by shallow foundations following the complete removal of existing fill and replacement with new compacted structural fill.

Considering the additional data regarding the anticipated design grades as provided to Underhill by the design team, the brunt of Stratum F, as identified in the test borings, is expected to be removed during normal grading activities. Therefore, a helical pier foundation system for the bridge abutments is anticipated to be practical and competitive when compared to deep undercut and replacement schemes. The restroom building will still be supported by a shallow foundation as originally recommended in the September 27, 2021 report.

Helical Piers

Helical piers are recommended for support of the proposed bridge abutments. The recommended helical pier system for the project consists of the Hubbell Power Systems, Inc. (A.B. Chance) hot-dipped galvanized (ASTM A153 Class B-1) SS150 piers with Rock-IT Helical Lead Sections consisting of an 8/10/12 lead (denoting helix diameter sizes in inches, from bottom to top). Note that these piers are proposed as *Helical "Pull-down" piers*, where a grout column is constructed around the shaft of the standard helical pier foundation system.

The pull-down piers provide the integration of Portland cement-based grout to increase the section properties of the helical pier shaft. By combining the end-bearing on the helical plates (helices) and side friction (i.e., skin friction) along the rough surface of the cast grout column, the helical pier system provides a high capacity than what a standard un-grouted helical pier system would achieve.

The pull-down pier is formed when a spacer section following the helical pier lead, "pulls down" around the helical pier shaft forming a cavity around the shaft, which is then filled with the high strength grout. The resulting deep foundation system provides both a friction-bearing central shaft and end-bearing helical plates (i.e., helices) when installed to the competent bearing strata.

Considering the test boring data and the anticipated design grades, Underhill recommends helical pier lengths of 25 feet and 30 feet be considered for planning purposes for the west and east abutment, respectively. Piers should extend through the fill and into the underlying stiff residuum terminating at refusal on rock or when the installation torque is reached (i.e., 7,800 ft-lb installation torque). Note that refusal grades above a depth of 10 feet should be evaluated by the Engineer.

For pull-down piers installed as indicated above, ultimate capacities of 114 kips in compression and 110 kips in tension may be considered. These ultimate capacities provide allowable capacities of **57 kips in compression** and **46 kips in tension**, respectively, considering a factor of safety, **FS = 2.0**. A minimum of three SS150 piers are anticipated to be needed at each column location considering the anticipated column loads of 128 kips in compression and 58 kips in tension at the columns (i.e., resulting P3 pier caps) provided by the Client.

The group efficiency of the piers with respect to vertical compressive capacity should be equal to at least one, considering that a pier center-to-center spacing of at least three (maximum) helix diameters is maintained, provided that the minimum spacing is not less than 3 feet. Thus, the capacity of the group should be at least equal to the individual pier capacity multiplied by the number of piers in the group.

Settlements of foundations founded as described above are not expected to exceed ½ inch. Differential settlements between similarly loaded foundation elements are expected to be minimal. Differential settlement between helical pier support abutments and shallow foundation support abutments are anticipated to be about ½ inch.

Helical piers provide minimal resistance to lateral loading when installed vertically. Therefore, lateral resistance, where needed, should be obtained considering passive resistance of the side of pier cap and considering battered helical piers. The pull-down helical piers as recommended above should be battered to provide the supplemental lateral resistance as may be needed. Helical pull-down piers installed with a batter of 15 degrees from vertical provide an **allowable lateral resistance of 15 kips and 12 kips** for piers installed in compression and tension configurations, respectively, to the depths recommended herein.

Additional lateral resistance should be considered based the passive and frictional resistance of mat slabs where planned. Passive resistance may be evaluated based on the passive equivalent fluid unit weight for on-site soils and Compacted Structural Fill of **345 PCF**. The design should not consider passive resistance to act against the front face of the foundation above a depth of 2 ft. Sliding resistance may be considered based on an ultimate frictional resistance factor, f, between the concrete base and the soil of **f = 0.35**.

Concrete piers should be set at least 1.5 FT below grade. The foundation system consisting of the pier caps bearing on the helical piers extending to the proposed depths as indicated above will meet local frost depth criteria.

Underhill Engineering should observe the installation of the foundation system including documenting the helical pier locations, depths, and termination criteria.

Construction Considerations

Pier cap foundation concrete should be cast neat against the sides of the excavation; or if pier caps are formed, pier cap excavations should be backfilled with compacted on-site soils to the top of foundation grade to reduce the potential for water to collect beneath the footings. Regardless, foundation excavations should not be left open for an extended time. Similarly, ground surface grades around the building should be sloped away from the foundations to provide positive drainage and reduce the potential for water ponding next to the foundations.

An experienced contractor, authorized to do the specialized work by the manufacturer, should install the pull-down helical piers. Prior to beginning the work, the contractor should submit a written plan of the helical pier installation including type, depth, and location.

Equipment used to install helical piers should consist of rotary-type, torque motor with forward and reverse capabilities. The equipment should be capable of developing a minimum torque of at least 8,000 ft-lbs. The equipment should include a torque-monitoring device and the Contractor should monitor the torque throughout the helical per installation. The installation process can employ grout uncased or in combination with steel or PVC casing where caving soils are anticipated.

The Contractor should install the helical piers in a smooth, continuous manner using sufficient pressure to advance the pier at a rate of rotation of 5 to 20 revolutions per minute. If the helical pier encounters obstructions during installation, the Contractor should remove the obstruction or contact the Engineer regarding relocating the pier to avoid the obstruction.

The helical pier system does not require the removal of spoils from the site. After the lead section containing the helical plates (helices) penetrates the soil, a lead displacement plate and extension are placed onto the shaft. Torque is again applied on the assembly to advance the helical pier, as equipped, which pulls the displacement plate downward, forcing soil outward and creating a cylindrical void around the shaft.

From a reservoir at the surface, the contractor introduces a flowable grout to immediately fill the resulting void surrounding the shaft. Additional extensions and plates are added, and installed and grouted, until the pier reaches the specified tip grade criteria, so that a full length of shaft up from the lead section to the surface is fully encased in grout.

The remaining recommendations as provided in Underhill's report dated September 27, 2021, are unchanged.

The analyses and recommendations submitted in this report addendum are based on the information available at the time of analyses. This report addendum attempts to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during construction.

Underhill has prepared this report addendum to aid in the evaluation of the site and to assist in the design of the project. It is intended for use concerning this specific project. Underhill has based the

recommendations as presented herein on the information available for the site and the proposed construction, as referenced in this report addendum. Changes in loads, locations, or grades should be brought to Underhill's attention so that recommendations can be modified as needed.

Underhill has 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 addendum, or other instrument of service.

Thank you for the opportunity to provide our services. If you have any questions or require additional information, please do not hesitate to contact the undersigned.

Sincerely,

UNDERHILL ENGINEERING, LLC

O. Christopher Webster, PE, F ASCE
Principal