

DEPARTMENT OF VETERANS AFFAIRS

ALEXANDRIA NATIONAL CEMETERY
CITY OF ALEXANDRIA, VIRGINIA

ROAD, WALKWAY, DRAINAGE, AND ROSTRUM REPAIRS, "PACKAGE B"
NCA MASTER SPECIFICATIONS

PROJECT NUMBER 872-MM-03

FINAL CONSTRUCTION DOCUMENTS
SEPTEMBER 20, 2017

**DEPARTMENT OF VETERANS AFFAIRS
NCA MASTER SPECIFICATIONS**

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SECTION 00 01 15
LIST OF DRAWING SHEETS

The drawings listed below accompanying this specification form a part of
the contract.

<u>No.</u>	<u>DRAWING</u>	<u>DRAWING TITLE</u>
01	GI-001	Cover Sheet
02	GI-002	General Notes
03	GI-501	Site Details
04	GC-001	Erosion and Sediment Control Notes
05	GC-501	Erosion and Sediment Control Details
06	GC-101	Erosion and Sediment Control Plan
07	XP-101	Existing Conditions
08	CS-101	Site Plan
09	CS-102	Site Plan
10	CU-261	Storm Drain Profiles

SECTION 01 00 02
GENERAL REQUIREMENTS

1.1 STATEMENT OF BID ITEM(S)

- A. Contractor shall provide all labor, tools, materials, equipment, testing services, and supervision necessary to complete the work identified on the attached drawing sheets at the Alexandria National Cemetery. Work includes but may not be limited to:
1. Installation of new asphalt pavement section, concrete sidewalk, drainage improvements, hardscape improvements, wall and step improvements, storm drainage installation, curb and gutter and other site improvements as noted in the design documents.

1.2 DRAWINGS

- A. Drawings are included.

No.	DRAWING	DRAWING TITLE
01	GI-001	Cover Sheet
02	GI-002	General Notes
03	GI-501	Site Details
04	GC-001	Erosion and Sediment Control Notes
05	GC-501	Erosion and Sediment Control Details
06	GC-101	Erosion and Sediment Control Plan
07	XP-101	Existing Conditions
08	CS-101	Site Plan
09	CS-102	Site Plan
10	CU-261	Storm Drain Profiles

1.3 SITE VISIT

- A. Bidders may inspect the site, investigate by observation, and Request Information via (RFI) and responses through the Contracting Office to satisfy their understanding of the work to be done, all general, local and technical conditions that may affect the cost and the feasibility of their proposal. In no event shall failure to inspect the site constitute grounds for a claim after award. Visitors planning to conduct a site visit shall contact the Cemetery Director or Foreman to make arrangements:

Cemetery POC(s):

George Truslow, (703) 221-2183
Rico Silvetti, (215) 381-3787 ext. 4050

1.4 SAFETY REQUIREMENTS

- A. Contractor foreman shall be onsite during all work activities and shall have completed OSHA 30-hour training. Prior to commencing work, general contractor shall provide proof that an OSHA certified "competent person" (CP) (29 CFR 1926.20(b)(2)) will maintain a presence at the work site whenever the general or subcontractors are present.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations.
- C. Fire and safety rules shall be observed in performance of work:
Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.

1.5 PERFORMANCE DETAILS

- A. Contractor shall complete all work within 6 months (180 calendar days) after receipt of Notice to Proceed, subject to all terms, conditions, provisions and schedules of the contract. No cost time extension will be considered for cold weather delays as requested by the Contractor.
- B. Work Hours: Work may be performed between the normal hours of 8:00 a.m. and 4:30 p.m., Monday through Friday. At the Contractor's request; with prior coordination with the cemetery director and with the written permission of the COR; work will also be permitted to be scheduled for weekends and/or Holidays, only in the following situations: In emergency situations caused by the Contractor, or when severe adverse weather prohibits work during the week, the Contractor shall arrange to work on weekends and/or holidays in order to meet the contract performance period. The Government will not compensate the Contractor for any alternate work schedules needed to complete all contract work within the contract performance period. No work will be permitted during Memorial Day or Veteran's Day weekend activities or during any other Federal Holidays. No work will be performed at the immediate site of a scheduled interment or ceremony. Notwithstanding,

if any work under this contract is required outside of the VA's normal working hours (8:00 a.m. to 4:30 p.m. Monday through Friday excluding holidays), the Contractor shall coordinate with the cemetery director and COR and request a deviation in writing to the COR at least 72 hours in advance.

- C. When working on a Government site, the Contractor shall coordinate with the COR on a daily basis, before start of work, the daily work schedule to ensure that no work is being performed at the immediate site of a scheduled interment or ceremony. Burial activities at a National Cemetery shall take precedence over Contractor activities. Cemetery interment services cannot be disturbed. To cause the least possible interference with cemetery activities, the Contractor shall cease all work in areas where burials are taking place. Contractor equipment and personnel are prohibited from passing through the service area during this period.
- D. The Contractor shall execute daily work in such a manner as to interfere as little as possible with work being done by others. Keep roads clear of materials, debris, equipment and vehicles at all times. Materials and equipment shall not be stored in other than assigned areas. At the end of each day the Contractor shall maintain all Contractor and Government property impacted by the Contractor's performance of work in a high standard of quality and cleanliness required for a national shrine.
- E. Contractor personnel are subject to the cemetery rules of conduct. The Contractor is responsible for ensuring that no contract work causes any committal service, ceremony, procession or visitation to be delayed, altered, or otherwise impacted in such a way that the dignity, security, or safety of the event or visit is compromised.
- F Contractor shall remove and dispose all contract generated debris.
- G. Motor Vehicle Restrictions
 - 1. Contractor and employees shall coordinate parking and access with the COR.

1.6 OPERATIONS AND STORAGE AREAS

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by

the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance. Contractor shall coordinate all work and obtain and pay for any required permits necessary for completion of this project.

- B. The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.
- C. Construction Fence shall be required only when required as noted on construction drawings. Before construction operations begin, Contractor shall provide a chain link construction fence, seven feet minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 15 inches. Bottom of fences shall extend to one inch above grade. Remove the fence when directed by the COR.
- D. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of the COR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without a detailed work plan, and the Cemetery Director's prior knowledge and written approval.
- E. Contractor shall submit a request to interrupt any such services to COR, in writing, 7 days in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.

- F. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of Cemetery. Interruption time approved by Cemetery may not occur at other than Contractor's normal working hours.
- G. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the COR.
- H. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged at the main, branch or panel they originate from. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings, within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely behind the finished surfaces.
- I. Minimize interference of construction activities with flow of Cemetery traffic, comply with the following:
 - 1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles.
 - 2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be coordinated and approved by the COR.
- J. Coordination of Construction with Cemetery Director: The burial activities at a National Cemetery shall take precedence over construction activities. The Contractor shall cooperate and coordinate with the Cemetery Director, through the COR, in arranging construction schedule to cause the least possible interference with cemetery activities in actual burial areas. Construction noise during the interment services shall not disturb the service. Trucks and workmen shall not pass through the service area during this period:
 - 1. The Contractor is required to discontinue his work sufficiently in advance of Easter Sunday, Mother's Day, Father's Day, Memorial Day, Veteran's Day and/or Federal holidays, to permit him to clean up all

areas of operation adjacent to existing burial plots before these dates.

2. Cleaning up shall include the removal of all equipment, tools, materials and debris and leaving the areas in a clean, neat condition.

- K. The Contractor shall clean any Government property; including cemetery structures, headstones and monuments; that are soiled or stained because of Contractor's performance. The Contractor shall wash-down with water all soiled or stained structures, headstones and monuments at the end of each workday. Any such cleaning or washing shall be brought to the immediate attention of the COR prior to cleaning or washing. No hazardous chemicals shall be used at any time on Government property.
- L. At the end of each day, the Contractor shall remove all debris from the cemetery site resulting from the performance of the work. The Contractor shall ensure at all times that rubbish and trash generated by the Contractor is kept clear of vehicular and pedestrian traffic throughout the site. The Government will not provide receptacle(s) for disposal of debris related to this contract. The Contractor will be permitted to place trash receptacle dumpsters in the COR approved staging area.

1.7 CONTRACTOR PERSONNEL STANDARDS OF BEHAVIOR (WORK ON A GOVERNMENT INSTALLATION)

A. Dignity Clause:

1. Every action by contractor personnel at a national cemetery shall be performed with the special care, reverence, dignity, and respect that acknowledge the cemetery as the final resting place that commemorates the service and sacrifice that service members, Veterans and their families made for our Nation. Critically important is the awareness required of the Contractor employees of the remains buried in the grounds where the work is performed. The utmost care shall be given to these remains and the headstones and flat grave markers that mark those gravesites and memorialize the service of individuals.
2. Contractors shall not walk, stand, lean, sit or jump on headstones or markers. Nor shall they drive over them. Contractor personnel

should use tools approved by the Contracting Officer Representative (COR), such as shovels, pry bars or pinch bars to lift flat markers out of the ground; pick axes are not an acceptable tool.

B. Smoking is prohibited inside any buildings at the cemetery. Possession of weapons is prohibited from any cemetery buildings and grounds. Enclosed containers, including tool kits, shall be subject to search. Violations of VA regulations may result in citation answerable in the United States (Federal) District Court, not a local district, state, or municipal court

C. Contractor personnel are required to adhere to the following standards of dress, conduct, supervision and training while performing work on a Government Installation. Any violations shall be subject to immediate enforcement action by the Contracting Officer if these standards are not met. Contractor is responsible for training and safety precautions prescribed by OSHA regarding safety equipment and devices. Contractor personnel shall:

- (1) Be fully clothed at all times, to include upper garment to cover body from the waist to the neck and long pants or slacks. Garments, which have a message, slogan or printing of any kind other than the Contractor's business attire, are prohibited. Uniforms are acceptable.
- (2) Maintain a neat and professional appearance throughout its workforce, vehicles, equipment, and maintenance areas. Uniforms are acceptable. If uniforms are used, they must be in unison among all employees.
- (3) Not engage in loud or boisterous behavior, angry outbursts or use profane or abusive language at any time on Government premises. Playing radios and/or electronic games/devices shall only be done at lunchtime and in a designated break area. Due to the sensitive mission of the cemetery, Contractor employees shall come into daily contact with grieving individuals, therefore Contractor employees shall exercise and exhibit absolute decorum, courtesy, and respect while within the cemetery or at its perimeter or entrances. Inquiries from cemetery visitors shall be politely referred to

Government cemetery staff. Gratuities of any kind are strictly prohibited.

- (4) Consume food and beverage only within areas designated by the cemetery director (or his/her designated representative). Intoxication, and violence or criminal acts of any kind shall not be tolerated and is cause for immediate removal from a Government Installation. Use or sale of intoxicating beverages and/or drugs is strictly prohibited and use of tobacco products is only allowed in specific areas designated by the cemetery director (or his/her designated representative).
- (5) Only take breaks/rest periods, lunch breaks and bathrooms breaks in the Contractor Break Area, designated by the cemetery director (or his/her designated representative), not in the field. Misconduct shall form the basis for immediate contract enforcement action, to include immediate removal from the cemetery.
- (6) The Contractor shall ensure that his/her employees (including Contractor Consultants, Sub-Contractors, etc.) are aware of all the terms and conditions set forth in the contract regarding their performance and conduct.

1.8 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS

- A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.
- B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by

the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

1.9 RESTORATION

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the COR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COR before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
- B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.
- C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.10 LAYOUT OF WORK

- A. The Contractor shall lay out the work from Government established base lines and bench marks, indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any

1.11 TEMPORARY TOILETS

- A. When necessary, contractor shall provide temporary sanitary toilet accommodations. Coordinate location with Cemetery Director. Keep such places clean and free from flies. Failure to maintain satisfactory condition in toilets will deprive Contractor of the privilege to use such toilets.

1.12 AVAILABILITY AND USE OF UTILITY SERVICES

- A. 120 outlets may be available and shall be coordinated with the COR for use if necessary.
- B. Water for Construction: Furnish temporary water service.
1. Contractor may obtain water by connecting to the Cemetery water distribution system. Provide reduced pressure backflow preventer at each connection as per code. Water is available at no cost to the Contractor.
 2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation at COR's discretion of use of water from Cemetery's system.

1.13 PROJECT HEALTH AND SAFETY PLAN

A. Prior to commencing any construction, the Contractor shall submit a site specific Project Health and Safety Plan (PHSP). At a minimum, the PHSP shall cover the following topics:

1. Organizational structure (including Responsible Persons)
2. Site Characterization and Job Hazard Identification
3. Site Control and Security
4. Training
5. PPE
6. Heat Stress
7. Spill Containment
8. Decontamination
9. Emergency Response
10. Trench Safety

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SECTION 01 33 23
SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- 1.1 For the purposes of this contract, samples (including laboratory samples to be tested), test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.
- 1.2 Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:
 - A. Satisfactory written evidence is presented to, and approved by Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;
 - B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
 - C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- 1.3 Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals (including any laboratory samples to be tested) will not serve as a basis for extending contract time for completion.
- 1.4 Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by Resident Engineer on behalf of the Contracting Officer.
- 1.5 Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.
- 1.6 The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional

submittals beyond those required by the contract are furnished pursuant to request therefor by Contracting Officer, adjustment in contract price and time will be made in accordance with VA standards

- 1.7 Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and Architect- Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.
- 1.8. Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.
 - A. Submit samples required in single units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.
 - B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter shall be sent via first class mail and shall contain the list of items, name of Cemetery, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.
 1. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.
 2. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the Cemetery, name of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.

3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.
- C. In addition to complying with the applicable requirements specified in preceding Article 1.8, samples which are required to have Laboratory Tests (those preceded by symbol "LT" under the separate sections of the specification shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer.
1. Laboratory shall furnish Contracting Officer with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.
 2. Certificates shall also set forth a list of comparable projects upon which laboratory has performed similar functions during past five years.
 3. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory.
 4. Contractor shall send a copy of transmittal letter to both Resident Engineer and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
 5. Laboratory test reports shall be sent directly to Resident Engineer for appropriate action.
 6. Laboratory reports shall list contract specification test requirements and a comparative list of the laboratory test results. When tests show that the material meets specification requirements, the laboratory shall so certify on test report.
 7. Laboratory test reports shall also include a recommendation for approval or disapproval of tested item.
- D. If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples shall be marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.
- E. Approved samples will be kept on file by the Resident Engineer at the site until completion of contract, at which time such samples will be

delivered to Contractor as Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.

F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.

1. For each drawing required, submit one legible photographic paper or vellum reproducible.
 2. Reproducible shall be full size.
 3. Each drawing shall have marked thereon, proper descriptive title, including Cemetery location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
 4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
 5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
 6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
 7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.
- 1.9 Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

(Architect-Engineer)

_GORDON

_301 North Mildred Street, Suite 1, Charles Town, West Virginia 25414

- 1.10 At the time of transmittal to the Architect-Engineer, the Contractor shall also send a copy of the complete submittal directly to the Resident Engineer.

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**SECTION 01 42 19
REFERENCE STANDARDS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the availability and source of references and standards specified in the project manual under paragraphs APPLICABLE PUBLICATIONS and/or shown on the drawings.

1.2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS FPMR PART 101-29 (FAR 52.211-1) (AUG 1998)

- A. The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29 and copies of specifications, standards, and commercial item descriptions cited in the solicitation may be obtained for a fee by submitting a request to - GSA Federal Supply Service, Specifications Section, Suite 8100, 470 East L'Enfant Plaza, SW, Washington, DC 20407, Telephone (202) 619-8925, Facsimile (202) 619-8978.
- B. If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitation, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

1.3 AVAILABILITY FOR EXAMINATION OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-4) (JUN 1988)

- A. The specifications and standards cited in this solicitation can be examined at the following location:
- United States Department of Veteran Affairs
Technical Information Library
<http://www.cfm.va.gov/til/>

1.4 AVAILABILITY OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-3) (JUN 1988)

- A. The specifications cited in this solicitation may be obtained from the associations or organizations listed below.
- AA Aluminum Association, Inc.
<http://www.aluminum.org>
- AABC Associated Air Balance Council
<http://www.aabchq.com>

AADM	American Association of Automatic Door Manufacturers http://www.aaadm.com
AATC	American Association of Textile Chemists and Colorist http://www.aatcc.org
AAMA	American Architectural Manufacturer's Association http://www.aamanet.org
AAN	American Nursery and Landscape Association http://www.anla.org
AASHTO	American Association of State Highway and Transportation Officials http://www.transportation.org/Pages/default.aspx
ACGIH	American Conference of Governmental Industrial Hygienists http://www.acgi.org
ACI	American Concrete Institute http://www.aci-int.net
ACPA	American Concrete Pipe Association http://www.concrete-pipe.org
ACPPA	American Concrete Pressure Pipe Association http://www.acppa.org
ADA	American with Disabilities Act http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/background/adaag
ADC	Air Diffusion Council http://flexibleduct.org
AGA	American Gas Association http://www.aga.org
AGC	Associated General Contractors of America http://www.agc.org
AHA	American Hardboard Association http://www.domensino.com/AHA/
AIHA	American National Standards Institute/American Industrial Hygiene Association http://www.aiha.org/Pages/default.aspx
AISC	American Institute of Steel Construction http://www.aisc.org
AISI	American Iron and Steel Institute http://www.steel.org

AITC	American Institute of Timber Construction http://www.aitc-glulam.org
ALI	Automotive Lift Institute http://www.autolift.org/
AMCA	Air Movement and Control Association http://www.amca.org/
ANLA	American Nursery & Landscape Association http://www.anla.org
ANSI	American National Standards Institute, Inc. http://www.ansi.org
APA	Architectural Precast Association http://www.archprecast.org/
APA	The Engineered Wood Association http://www.apawood.org
ARI	Air-Conditioning and Refrigeration Institute http://www.lightindustries.com/ARI/
ARMA	Asphalt Roofing Manufacturers Association http://www.asphaltroofing.org/
ASAE	American Society of Agricultural Engineers http://www.asabe.org
ASCE	American Society of Civil Engineers http://www.asce.org
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers http://www.ashrae.org
ASME	American Society of Mechanical Engineers http://www.asme.org
ASSE	American Society of Sanitary Engineering http://www.asse-plumbing.org
ASTM	American Society for Testing and Materials http://www.astm.org
AWI	Architectural Woodwork Institute http://www.awinet.org
AWS	American Welding Society http://www.aws.org
AWPA	American Wood Protection Association http://www.awpa.com

AWWA	American Water Works Association http://www.awwa.org
BHMA	Builders Hardware Manufacturers Association http://www.buildershardware.com
BIA	The Brick Industry Association http://www.bia.org
CAGI	Compressed Air and Gas Institute http://www.cagi.org
CARB	California Environmental Protection Agency Air Resources Board http://arb.ca.gov/hompage.html/
CFR	Code of Federal Regulations http://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR
CGA	Compressed Gas Association, Inc. http://www.cganet.com
CID	Commercial Item Description http://www.gsa.gov/portal/content/100847
CISCA	Ceilings and Interior Systems Construction Association http://www.cisca.org
CISPI	Cast Iron Soil Pipe Institute http://www.cispi.org
CLFMI	Chain Link Fence Manufacturers Institute http://www.chainlinkinfo.org
CPA	Composite Panel Association http://www.compositepanel.org/
CRA	California Redwood Association http://www.calredwood.org
CRI	Carpet and Rug Institute http://www.carpet-rug.com
CRRC	Cool Roof Rating System http://coolroofs.org/
CRSI	Concrete Reinforcing Steel Institute http://www.crsi.org
CSI	Cast Stone Institute http://www.caststone.org
DASMA	Door and Access Systems Manufacturers Association http://www.dasma.com/

DHI	Door and Hardware Institute http://www.dhi.org
DOE	U.S. Department of Energy http://www.energy.gov/
EEI	Edison Electric Institute http://www.eei.org
EGSA	Electrical Generating Systems Association http://www.egsa.org
EIMA	Exterior Insulation Manufacturers Association http://www.eima.com/
EPA	Environmental Protection Agency http://www.epa.gov
ETL	ETL Testing Laboratories, Inc. http://www.envirotestinglabs.com/
FCC	Federal Communications Commission http://www.fcc.gov
FHA	Federal Highway Administration http://www.fhwa.dot.gov/
FM	FM Global http://www.fmglobal.com
FPS	The Forest Products Society http://www.forestprod.org
FSC	Forest Stewardship Council http://www.fscus.org
GA	Gypsum Association http://www.gypsum.org
GANA	Glass Association of North America http://www.glasswebsite.com
GBI	Green Building Initiative http://www.thegbi.org/
GS	Green Seal http://www.greenseal.org
GSA	General Services Administration http://www.gsa.gov
HI	Hydraulic Institute http://www.pumps.org
HPVA	Hardwood Plywood & Veneer Association http://www.hpva.org

ICC	The International Code Council http://www.iccsafe.org/Pages/default.aspx
ICEA	Insulated Cable Engineers Association Inc. http://www.icea.net
IEEE	Institute of Electrical and Electronics Engineers http://www.ieee.org/
IGMA	Insulating Glass Manufacturers Alliance http://www.igmaonline.org
ITS	Intertek Training Services http://www.intertek.com/
MBMA	Metal Buildings Manufacturers Association http://www.mbma.com
MHI	Material Handling Industry of America http://www.mhi.org/
MIA	Marble Institute of America http://www.marble-institute.com/
MIC	Masonry Industry Council
MPI	Master Painters Institute http://www.mpi.net/
MSJC	Masonry Standards Joint Committee http://www.masonrysociety.org/msjc/
NAAMM	National Association of Architectural Metal Manufacturers http://www.naamm.org
NAPHCC	Plumbing-Heating-Cooling Contractors Association http://www.phccweb.org/
NBS	National Bureau of Standards See - NIST
NEC	National Electric Code See - NFPA National Fire Protection Association
NEMA	National Electrical Manufacturers Association http://www.nema.org
NFPA	National Fire Protection Association http://www.nfpa.org
NFRC	National Fenestration Rating Council http://www.nfrc.org/
NHLA	National Hardwood Lumber Association http://www.natlhardwood.org

NIH National Institute of Health
<http://www.nih.gov>

NIOSH The National Institute for Occupational Safety and Health
<http://www.cdc.gov/niosh/>

NIST National Institute of Standards and Technology
<http://www.nist.gov>

NLMA Northeastern Lumber Manufacturers Association, Inc.
<http://www.nelma.org>

NPA National Particleboard Association
 18928 Premiere Court
 Gaithersburg, MD 20879
 (301) 670-0604

NPCA National Precast Concrete Association
<http://www.precast.org>

NRCA National Roofing Contractors Association
<http://www.nrca.net>

NSF National Sanitation Foundation
<http://www.nsf.org>

NSF NSF International
<http://www.nsf.org/>

NTMA National Terrazzo and Mosaic Association
<http://ntma.com/>

NWWDA Window and Door Manufacturers Association
<http://www.nwwda.org>

OSHA Occupational Safety and Health Administration
 Department of Labor
<http://www.osha.gov>

PCA Portland Cement Association
<http://www.cement.org/>

PCI Precast Prestressed Concrete Institute
<http://www.pci.org>

PPI The Plastic Pipe Institute
<http://www.plasticpipe.org>

PEI Porcelain Enamel Institute, Inc.
<http://www.porcelainenamel.com>

PTI Post-Tensioning Institute
<http://www.post-tensioning.org>

RCSC	Research Council of Structural Connections http://www.boltcouncil.org/
RFCI	The Resilient Floor Covering Institute http://www.rfci.com
RIS	Redwood Inspection Service See - CRA
RMA	Rubber Manufacturers Association, Inc. http://www.rma.org
SCAQMD	South Coast Air Quality Management District http://www.aqmd.gov
SCMA	Southern Cypress Manufacturers Association http://www.cypressinfo.org
SDI	Steel Deck Institute http://www.sdi.org
SDI	Steel Door Institute http://www.steeldoor.org
SEI	Structural Engineering Institute http://www.asce.org/SEI/
SJI	Steel Joist Institute http://www.steeljoist.org
SMACNA	Sheet Metal and Air-Conditioning Contractors National Association, Inc. http://www.smacna.org
SPRI	Single Ply Roofing Industry http://www.spri.org
SSPC	The Society for Protective Coatings http://www.sspc.org
STI	Steel Tank Institute http://www.steeltank.com
SWI	Steel Window Institute http://www.steelwindows.com
SWRI	Sealant Waterproofing and Restoration Institute http://www.swrionline.org/
TCNA	Tile Council of North America, Inc. http://www.tileusa.com
TPI	Truss Plate Institute, Inc. http://www.tpinst.org/

UL Underwriters' Laboratories Incorporated
<http://www.ul.com>

ULC Underwriters' Laboratories of Canada
<http://www.ulc.ca>

USDA U.S. Department of Agriculture
<http://www.usda.gov>

USGBC U.S. Green Building Council
<http://www.usgbc.org>

WCLIB West Coast Lumber Inspection Bureau
<http://www.wclib.org/>

WDMA Window and Door Manufacturers Association
<https://www.wdma.com/>

WH Warnock Hersey
<http://www.intertek.com/marks/wh/>

WRCLA Western Red Cedar Lumber Association
<http://www.wrcla.org/>

WWPA Western Wood Products Association
<http://www2.wwpa.org/>

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SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by Contractor. Refer to Section 01 00 02, GENERAL REQUIREMENTS MINOR, for additional information.

1.2 RELATED DOCUMENTS

- A. Section 01 00 02, GENERAL REQUIREMENTS MINOR.

1.3 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

- B. American Association of State Highway and Transportation Officials (AASHTO):

T27-11	Sieve Analysis of Fine and Coarse Aggregates
T96-02(R2006)	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
T99-10	The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
T104-99(R2007)	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
T180-10	Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
T191-02(R2006)	Density of Soil In-Place by the Sand-Cone Method

- C. American Society for Testing and Materials (ASTM):

A325-10	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
A370-12a	Definitions for Mechanical Testing of Steel Products

A490-12	Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
C31/C31M-12	Making and Curing Concrete Test Specimens in the Field
C33/C33M-13	Concrete Aggregates
C39/C39M-12	Compressive Strength of Cylindrical Concrete Specimens
C109/C109M-12	Compressive Strength of Hydraulic Cement Mortars
C138/C138M-12a	Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
C140-13	Sampling and Testing Concrete Masonry Units and Related Units
C143/C143M-12	Slump of Hydraulic Cement Concrete
C172/C172M-10	Sampling Freshly Mixed Concrete
C173/C173M-12	Air Content of freshly Mixed Concrete by the Volumetric Method
C330/C330M-09	Lightweight Aggregates for Structural Concrete
C567/C567M-11	Density Structural Lightweight Concrete
C780-12a	Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C1019-11	Sampling and Testing Grout
C1064/C1064M-12	Freshly Mixed Hydraulic Cement Concrete
C1077-13	Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
C1314-12	Compressive Strength of Masonry Prisms
C1364-10b	Architectural Cast Stone
D698-12	Laboratory Compaction Characteristics of Soil Using Standard Effort
D1143/D1143M-07	Deep Foundations Under Static Axial Compressive Load
D1188-07	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
D1556-07	Density and Unit Weight of Soil in Place by the Sand-Cone Method

D1557-12	Laboratory Compaction Characteristics of Soil Using Modified Effort
D2166-06	Unconfined Compressive Strength of Cohesive Soil
D2167-08	Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2216-10	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2974-07	Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
D3666-11	Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials
D3740-12a	Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock
E94-04(2010)	Radiographic Examination
E164-08	Contact Ultrasonic Testing of Weldments
E329-11c	Agencies Engaged in Construction Inspection, Testing, or Special Inspection
E543-13	Agencies Performing Nondestructive Testing
E709-08	Guide for Magnetic Particle Testing
E1155-96(2008)	Determining FF Floor Flatness and FL Floor Levelness Numbers

D. American Welding Society (AWS):

D1.1-07	Structural Welding Code-Steel
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1.4 REQUIREMENTS

- A. Accreditation Requirements: Testing Laboratory retained and paid for by Contractor must be accredited by one or more of the National Voluntary Laboratory Accreditation Program (NVLAP) programs acceptable in the geographic region for the project. Furnish to the RE/COR a copy of the Certificate of Accreditation and Scope of Accreditation. For testing laboratories that have not yet obtained accreditation by a NVLAP program, submit an acknowledgement letter from one of the laboratory accreditation authorities indicating that the application for accreditation has been received and the accreditation process has started, and submit to the RE/COR for approval, certified statements, signed by an official of the testing laboratory attesting that the proposed laboratory, meets or conforms to the ASTM standards listed below as appropriate to the testing field.

1. Laboratories engaged in testing of construction materials must meet the requirements of ASTM E329.
 2. Laboratories engaged in testing of concrete and concrete aggregates must meet the requirements of ASTM C1077.
 3. Laboratories engaged in testing of bituminous paving materials must meet the requirements of ASTM D3666.
 4. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, must meet the requirements of ASTM D3740.
 5. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A880.
 6. Laboratories engaged in non-destructive testing (NDT) must meet the requirements of ASTM E543.
 7. Laboratories engaged in Hazardous Materials Testing must meet the requirements of OSHA and EPA.
- B. Inspection and Testing: Testing laboratory to inspect materials and workmanship and perform tests described herein and additional tests requested by RE/COR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory must direct attention of RE/COR to such failure.
- C. Written Reports: Testing laboratory to submit test reports to RE/COR, Contractor, and Local Building Authority within 24 hours after each test is completed unless other arrangements are agreed to in writing by the RE/COR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to RE/COR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK

- A. General: The Testing Laboratory is to provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed is as identified herein including, but not be limited to, the following:
1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course.

- Provide recommendations to the RE/COR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to RE/COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
2. Provide full time observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
 3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.
- B. Testing Compaction:
1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with AASHTO T99/T180.
 2. Make field density tests in accordance with the primary testing method following ASTM D2922 wherever possible. Field density tests utilizing ASTM D1556, AASHTO T191, or ASTM D2167 to be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they must provide satisfactory explanation to the RE/COR before the tests are conducted.
 - a. Pavement Subgrade: One test for each 335 m² (400 square yards), but in no case fewer than two tests.
 - b. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
 - c. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.
- C. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.
- D. Testing Materials: Test suitability of on-site and off-site borrow as directed by RE/COR.

3.2 NOT USED

3.3 LANDSCAPING

- A. Test topsoil for organic materials, pH, phosphate, potash content, and gradation of particles.

1. Test for organic material by using ASTM D2974.
2. Determine percent of silt, sand, clay, and foreign materials such as rock, roots, and vegetation.

B. Submit laboratory test report of topsoil to RE/COR.

3.4 ASPHALT CONCRETE PAVING

A. Aggregate Base Course:

1. Determine maximum density and optimum moisture content for aggregate base material in accordance with AASHTO T180, Method D.
2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with AASHTO T191.
3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the applicable state highway standards and specifications.

B. Asphalt Concrete:

1. Aggregate: Sample and test aggregates in stock pile and hot-bins as necessary to insure compliance with specification requirements for gradation (AASHTO T27), wear (AASHTO T96), and soundness (AASHTO T104).
2. Temperature: Check temperature of each load of asphalt concrete at mixing plant and at site of paving operation.
3. Density: Make a minimum of two field density tests in accordance with ASTM D1188 of asphalt base and surface course for each day's paving operation.

3.5 SITE WORK CONCRETE

A. Test site work concrete including materials for concrete as required in Article CONCRETE of this section.

3.6 CONCRETE

A. Batch Plant Inspection and Materials Testing:

1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of RE/COR with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by RE/COR.
2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to RE/COR.
3. Sample and test mix ingredients as necessary to insure compliance with specifications.

4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.
5. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m³ (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. After good concrete quality control has been established and maintained as determined by RE/COR make three cylinders for each 80 m³ (100 cubic yards) or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. Label each cylinder with an identification number. RE/COR may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.

5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m³ (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m³ (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
9. Verify that specified mixing has been accomplished.
10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
 - a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
 - b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.

15. Observe preparations for placement of concrete:
 - a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
 - b. Inspect preparation of construction, expansion, and isolation joints.
 16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
 17. Observe concrete mixing:
 - a. Monitor and record amount of water added at project site.
 - b. Observe minimum and maximum mixing times.
 18. Measure concrete flatwork for levelness and flatness as follows:
 - a. Perform Floor Tolerance Measurements F_F and F_L in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
 - b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
 - c. Provide the Contractor and the RE/COR with the results of all profile tests, including a running tabulation of the overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.
 19. Other inspections:
 - a. Grouting under base plates.
 - b. Grouting anchor bolts and reinforcing steel in hardened concrete.
- C. Laboratory Tests of Field Samples:
1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by RE/COR. Compile laboratory test reports as follows: Compressive strength test to be the result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it must be discarded and strength of spare cylinder to be used.
 2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
 3. Furnish certified compression test reports (duplicate) to RE/COR. In test report, indicate the following information:
 - a. Cylinder identification number and date cast.
 - b. Specific location at which test samples were taken.

- c. Type of concrete, slump, and percent air.
- d. Compressive strength of concrete in MPa (psi).
- e. Weight of lightweight structural concrete in kg/m³ (pounds per cubic feet).
- f. Weather conditions during placing.
- g. Temperature of concrete in each test cylinder when test cylinder was molded.
- h. Maximum and minimum ambient temperature during placing.
- i. Ambient temperature when concrete sample in test cylinder was taken.
- j. Date delivered to laboratory and date tested.

3.7 NOT USED**3.8 NOT USED****3.9 NOT USED****3.10 MASONRY****A. Mortar Tests:**

- 1. Laboratory compressive strength test:
 - a. Comply with ASTM C780.
 - b. Obtain samples during or immediately after discharge from batch mixer.
 - c. Furnish molds with 50 mm (2 inch), 3 compartment gang cube.
 - d. Test one sample at 7 days and 2 samples at 28 days.
- 2. Two tests during first week of operation; one test per week after initial test until masonry completion.

B. Grout Tests:

- 1. Laboratory compressive strength test:
 - a. Comply with ASTM C1019.
 - b. Test one sample at 7 days and 2 samples at 28 days.
 - c. Perform test for each 230 m² (2500 square feet) of masonry.

C. Masonry Unit Tests:

- 1. Laboratory Compressive Strength Test:
 - a. Comply with ASTM C140.
 - b. Test 3 samples for each 460 m² (5000 square feet) of wall area.

D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 460 m² (5000 square feet) of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.

E. Field Inspection and Materials Testing:

1. Verify the following prior to grouting:
 - a. Grout space is clean.
 - b. Type, spacing, and placement of reinforcement, connectors, and anchors comply with the contract requirements.

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SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, and solid waste, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.
- B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
 - 1. Adversely affect human health or welfare.
 - 2. Unfavorably alter ecological balances of importance to human life.
 - 3. Affect other species of importance to humankind.
 - 4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.

1.2 DEFINITIONS OF POLLUTANTS

- A. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
- B. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
- C. Sediment: Soil and other debris that has been eroded and transported by runoff water.
- D. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from project construction activities.
- E. Surface Discharge: The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "waters of the United States" and require a permit to discharge water from the governing agency.
- F. Rubbish: Combustible and noncombustible wastes such as, but not limited to, paper, plastic, metal and plastic containers and cans, boxes, metal and lumber scrap.
- G. Sanitary Wastes: Domestic Sanitary Sewage.

1.3 QUALITY CONTROL

- A. Establish and maintain quality control for the environmental protection of all items set forth herein.
- B. Record on daily reports any problems in complying with laws, regulations, ordinances and note any corrective action taken.

1.4 REFERENCES

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. U.S. National Archives and Records Administration (NARA):
33 CFR 328 Definitions, Waters of the United States.
- C. Federal Environmental Regulatory Requirements: Comply with applicable regulations. The following is for Contractor's information only:
 - 1. Storm water permits; refer to The Office of Wastewater Management, NPDES Storm Water Program: <http://www.epa.gov/npdes/stormwater>
 - 2. Dredge and fill (Section 404) permits; refer to U.S. EPA Office of Wetlands, Oceans, and Watersheds (OWOW): <http://www.epa.gov/owow/>
 - 3. RCRA hazardous and non-hazardous solid waste requirements; refer to EPA's Office of Solid Waste and Emergency Response:
<http://www.epa.gov/epaoswer/osw/laws-reg.htm>
 - 4. Oil spill requirements for construction activities; refer to EPA Oil Program web site: <http://www.epa.gov/oilspill/>
 - 5. Hazardous substances (Superfund Liability) requirements for construction activities; refer to EPA's Superfund website:
<http://www.epa.gov/superfund/index.htm>
 - 6. Polychlorinated Biphenyl (PCB) waste requirements; refer to EPA's Polychlorinated Biphenyl (PCB) Homepage: <http://www.epa.gov/pcb/>
 - 7. Air quality requirements for construction activities; refer to EPA'S Air Program Mobile Sources Page:
<http://www.epa.gov/ebtpages/airmobilesources.html>
 - 8. Asbestos requirements for construction activities; refer to EPA's Asbestos Management and Regulatory Requirements Website:
<http://www.epa.gov/fedsite/cd/asbestos.html>
 - 9. National Environmental Policy Act (NEPA) requirements for construction activities
 - 10. Endangered Species Act; refer to The US Fish and Wildlife Service Endangered Species Program: <http://endangered.fws.gov/>

11.National Historic Preservation Act

D. State and Local Environmental Regulatory Requirements: Comply with applicable regulations. The following is for Contractor's information only:

1. State Office/Department of Environmental Quality.
2. Local Office/Department of Environmental Quality.
3. The Construction Industry Compliance Assistance Center:
<http://www.cicacenter.org/index.cfm>
4. The National Environmental Compliance Assistance Clearinghouse:
<http://cfpub.epa.gov/clearinghouse/>

1.5 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements.
- B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit <http://www.biopreferred.gov>.

1.6 SUBMITTALS

- A. In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the Contractor shall furnish the following:
 1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, meet with the Resident Engineer/Contracting Officer's Representative (RE/COR) to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, prepare and submit to the RE/COR for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
 - a. Name(s) and qualifications of person(s) within the Contractor's organization who is (are) responsible for:
 - 1) Ensuring adherence to the Environmental Protection Plan.
 - 2) Manifesting hazardous waste to be removed from the site.
 - 3) Training the Contractor's environmental protection personnel.
 - b. Description of the Contractor's environmental protection personnel training program.

- c. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.
 - d. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.
 - e. Procedures to provide environmental protection that complies with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.
 - f. Permits, licenses, and the location of the solid waste disposal area.
 - g. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by the District Office of the U.S. Soil Conservation Service and/or mandated state agency, and the Department of Veterans Affairs.
 - h. Environmental Monitoring Plans for the job site including land, water, air, and noise.
 - i. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of construction limits or protected areas. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.
- B. Within 20 days after the date of its submittal, the RE/COR shall approve the Contractor's Comprehensive Environmental Protection Plan, or respond with an explanation for its rejection and resubmittal.
- C. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

1.7 PROTECTION OF ENVIRONMENTAL RESOURCES

- A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract and after the project is complete, based upon leaving the site that has yet to mature of hydroseeding. Confine construction activities to areas defined by construction limits, the specifications and drawings.
- B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, land forms, wetlands or wetland buffers without prior approval from the RE/COR. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or dictated by special emergency use.
 - 1. Work Area Limits: Prior to any construction, mark/fence/protect the areas that require work to be performed under this contract. Prior to construction, mark/fence/protect monuments, works of art, and any other markers to remain. Convey to all personnel the purpose of marking and protecting all marked and protected objects.
 - 2. Protection of Specific Regulated Elements: Wetlands and wetland buffers and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved protective techniques.
 - a. Protect trees and shrubs to remain on site to protect from damage per contract details.
 - b. All damage to existing trees and shrubs shall be immediately repaired by trimming, cleaning, and painting with antiseptic tree paint.
 - c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
 - 3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas only as needed to use to work the area to be developed. Form earthwork to final grade as shown as quickly as possible to minimize potential erosion damage. Immediately protect side slopes and back slopes upon completion of

- rough grading or clearing with appropriate material as defined in the Sediment and Erosion Control Plan.
4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, check dams and berms to retard and divert runoff from the construction site to protected drainage areas as intended under paragraph 208 of the Clean Water Act.
 - a. Sediment Basins: Trap sediment from construction areas in temporary or permanent sediment basins that accommodate the runoff of a local 10 (design year) storm. After each storm, pump the basins dry and remove the accumulated sediment. Control overflow/drainage with paved weirs or by vertical overflow pipes, that drain from the surface of the basin.
 - b. Reuse or conserve the collected topsoil sediment as directed by the RE/COR. Topsoil use and requirements are specified in Section 31 20 11, EARTH MOVING short form.
 - c. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
 5. Erosion and Sedimentation Control Devices: Construct or install all temporary and permanent erosion and sedimentation control features shown. Maintain temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, straw waddles, fiber rolls, until permanent drainage and erosion control facilities are completed and operative.
 6. Manage and control borrow and spoil areas on Government property to minimize erosion and to prevent soil and/or sediment from entering nearby water courses or lakes.
 7. Protect adjacent areas from despoilment by temporary excavations and embankments.
 8. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.
 9. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.

10. Handle discarded materials other than those included in the solid waste category as directed by the RE/COR.

- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
 - 1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in sediment basins prior to entering retention/detention ponds, allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
 - 2. Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.
 - 3. Monitor water areas, wetlands and wetland buffers affected by construction.
- D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list protected species that require specific attention along with measures for their protection.
- E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of Virginia and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.
 - 1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials from asphaltic batch plants if onsite, or other onsite material processing operations at all times, including weekends, holidays, and hours when work is not in progress.
 - 2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the

- project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, or other methods are permitted to control particulates in the work area as approved in the Environmental Protection Plan.
3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
 4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.
- F. Noise Control: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the Resident Engineer/COR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.
1. Perform construction activities involving repetitive, high-level impact noise only between 6:00 a.m. and 6:00 p.m unless otherwise permitted by local ordinance or the RE/COR. Repetitive impact noise on the property shall not exceed the following Decibel A-scale (dBA) limitations:

Time Duration of Impact Noise	Sound Level in dBA
More than 12 minutes in any hour	70
Less than 30 seconds of any hour	85
Less than three minutes of any hour	80
Less than 12 minutes of any hour	75

2. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:
 - a. Maintain maximum permissible construction equipment noise levels as measured with an A-scale decibel measuring device at 15 m (50 feet) (dBA):

CATEGORY OF EQUIPMENT			
EARTHMOVING		MATERIALS HANDLING	
EQUIPMENT STYLE	SOUND LEVEL dBA	EQUIPMENT STYLE	SOUND LEVEL dBA
FRONT LOADERS	75	CONCRETE MIXERS	75
BACKHOES	75	CONCRETE PUMPS	75

DOZERS	75	CRANES	75
TRACTORS	75	DERRICKS IMPACT	75
SCAPERS	80	PILE DRIVERS	95
GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS, STATIONARY	80	PNEUMATIC TOOLS	80
GENERATORS	75	SAWS	75
COMPRESSORS	75	VIBRATORS	75

- b. Provide soundproof housings or enclosures for noise-producing machinery.
 - c. Use efficient silencers on equipment air intakes.
 - d. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
 - e. Line hoppers and storage bins with sound deadening material.
 - f. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.
3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 75 dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the A weighted sound level of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face. Submit the recorded information to the Resident Engineer/COR noting any problems and the alternatives for mitigating actions.
- G. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.
 - H. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition as approved by the RE/COR. The

site shall be left meeting the requirements of the local and state environmental requirements associated with the (SWPPP) Storm Water Pollution Protection Plan as submitted. Cleaning shall include off-cemetery disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations, clearing, logging and general construction in accordance with state and local regulations and the contract.

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SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.
- B. Waste disposal in landfills shall be minimized to the greatest extent possible. Of the inevitable waste that is generated, as much of the waste material as economically feasible shall be salvaged, recycled or reused.
- C. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators, and facilitate their salvage and recycle not limited to the following:
 - 1. Waste Management Plan development and implementation.
 - 2. Techniques to minimize waste generation.
 - 3. Sorting and separating of waste materials.
 - 4. Salvage of existing materials and items for reuse or resale.
 - 5. Recycling of materials that cannot be reused or sold.
- D. At a minimum the following waste categories shall be diverted from landfills:
 - 1. Soil.
 - 2. Inerts (eg, concrete, masonry and asphalt).
 - 3. Clean dimensional wood and palette wood.
 - 4. Green waste (biodegradable landscaping materials).
 - 5. Engineered wood products (plywood, particle board and I-joists, etc).
 - 6. Metal products (eg, steel, wire, beverage containers, etc).
 - 7. Cardboard, paper and packaging.
 - 8. Bitumen roofing materials.
 - 9. Plastics (eg, ABS, PVC).
 - 10. Carpet and/or pad.
 - 11. Gypsum board.
 - 12. Insulation.
 - 13. Paint.

1.3 QUALITY ASSURANCE

- A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed

to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:

1. Excess or unusable construction materials.
 2. Packaging used for construction products.
 3. Poor planning and/or layout.
 4. Construction error.
 5. Over ordering.
 6. Weather damage.
 7. Contamination.
 8. Mishandling.
 9. Breakage.
- B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.
- C. Contractor shall develop and implement procedures to reuse and recycle new materials to a minimum of 50 percent.
- D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.
- E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations. The Whole Building Design Guide website <http://www.wbdg.org/tools/cwm.php> provides a Construction Waste Management Database that contains information on companies that haul, collect, and process recyclable debris from construction projects.
- F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.
- G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.
- H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

1.4 TERMINOLOGY

- A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial and industrial waste resulting from construction, remodeling, repair and demolition operations.
- B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils, solvents, mastics and like products.
- C. Construction and Demolition Waste: Includes all non-hazardous resources resulting from construction, remodeling, alterations, repair and demolition operations.
- D. Dismantle: The process of parting out a building in such a way as to preserve the usefulness of its materials and components.
- E. Disposal: Acceptance of solid wastes at a legally operating facility for the purpose of land filling (includes Class III landfills and inert fills).
- F. Inert Backfill Site: A location, other than inert fill or other disposal facility, to which inert materials are taken for the purpose of filling an excavation, shoring or other soil engineering operation.
- G. Inert Fill: A facility that can legally accept inert waste, such as asphalt and concrete exclusively for the purpose of disposal.
- H. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or soluble pollutants at concentrations in excess of water-quality objectives established by a regional water board, and does not contain significant quantities of decomposable solid resources.
- I. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.
- J. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.
- K. Permitted Waste Hauler: A company that holds a valid permit to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal.
- L. Recycling: The process of sorting, cleansing, treating, and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.

1. On-site Recycling - Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.
 2. Off-site Recycling - Materials hauled to a location and used in an altered form in the manufacture of new products.
- M. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of new products. Depending on the types of materials accepted and operating procedures, a recycling facility may or may not be required to have a solid waste facilities permit or be regulated by the local enforcement agency.
- N. Reuse: Materials that are recovered for use in the same form, on-site or off-site.
- O. Return: To give back reusable items or unused products to vendors for credit.
- P. Salvage: To remove waste materials from the site for resale or re-use by a third party.
- Q. Source-Separated Materials: Materials that are sorted by type at the site for the purpose of reuse and recycling.
- R. Solid Waste: Materials that have been designated as non-recyclable and are discarded for the purposes of disposal.
- S. Transfer Station: A facility that can legally accept solid waste for the purpose of temporarily storing the materials for re-loading onto other trucks and transporting them to a landfill for disposal, or recovering some materials for re-use or recycling.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:
- B. Prepare and submit to the Resident Engineer a written demolition debris management plan. The plan shall include, but not be limited to, the following information:
1. Procedures to be used for debris management.
 2. Techniques to be used to minimize waste generation.
 3. Analysis of the estimated job site waste to be generated:
 - a. List of each material and quantity to be salvaged, reused, recycled.
 - b. List of each material and quantity proposed to be taken to a landfill.

4. Detailed description of the Means/Methods to be used for material handling.
 - a. On site: Material separation, storage, protection where applicable.
 - b. Off site: Transportation means and destination. Include list of materials.
 - 1) Description of materials to be site-separated and self-hauled to designated facilities.
 - 2) Description of mixed materials to be collected by designated waste haulers and removed from the site.
 - c. The names and locations of mixed debris reuse and recycling facilities or sites.
 - d. The names and locations of trash disposal landfill facilities or sites.
 - e. Documentation that the facilities or sites are approved to receive the materials.
- B. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.
- C. Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

1.6 APPLICABLE PUBLICATIONS

Publications listed below form a part of this specification to the extent referenced. Publications are referenced by the basic designation only. In the event that criteria requirements conflict, the most stringent requirements shall be met.

- A. U.S. Green Building Council (USGBC):
LEED Green Building Rating System for New Construction

1.7 RECORDS

Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Records shall be kept in accordance with the LEED Reference Guide and LEED Template.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. List of each material and quantity to be salvaged, recycled, reused.
- B. List of each material and quantity proposed to be taken to a landfill.

- C. Material tracking data: Receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices, net total costs or savings.

PART 3 - EXECUTION

3.1 COLLECTION

- A. Provide all necessary containers, bins and storage areas to facilitate effective waste management.
- B. Clearly identify containers, bins and storage areas so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.
- C. Hazardous wastes shall be separated, stored, disposed of according to local, state, federal regulations.

3.2 DISPOSAL

- A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.
- B. Construction or demolition materials with no practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

3.3 REPORT

- A. With each application for progress payment, submit a summary of construction and demolition debris diversion and disposal including beginning and ending dates of period covered.
- B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed, transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.
- C. Quantify all materials disposed of during the period with the receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices. Include the net total costs for each disposal.

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SECTION 01 81 13
SUSTAINABLE CONSTRUCTION REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section describes general requirements and procedures to comply with federal mandates and U.S. Department of Veterans Affairs (VA) policies for sustainable construction as summarized in the VA Sustainable Design Manual.
- B. The Design Professional has selected materials and utilized integrated design processes that achieve the Government's objectives. Contractor is responsible to maintain and support these objectives in developing means and methods for performing work and in proposing product substitutions or changes to specified processes. By submitting a change or substitution of materials or processes, contractor must demonstrate its diligence in performing the level of investigation and comparison required under federal mandates and VA policies.

1.2 RELATED WORK

- A. Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT.

1.3 DEFINITIONS

- A. Total Materials Cost: A tally of actual material cost from specification divisions 03 through 10, 31 (applicable to foundations) and 32 (applicable to paving, site improvements, and planting). Alternatively, 45 percent of total construction hard costs in those specification divisions.
- B. Recycled Content: Recycled content of materials is defined according to Federal Trade Commission Guides for the Use of Environmental Marketing Claims (16 CFR Part 260). Recycled content value of a material assembly is determined by weight. Recycled fraction of assembly is multiplied by cost of assembly to determine recycled content value.
 - 1. "Post-Consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.

2. "Pre-Consumer" material is defined as material diverted from waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.
- C. Biobased Products: Biobased products are derived from plants and other renewable agricultural, marine, and forestry materials and provide an alternative to conventional petroleum derived products. Biobased products include diverse categories such as lubricants, cleaning products, inks, fertilizers, and bioplastics.
- D. Low Pollutant-Emitting Materials: Materials and products which are minimally odorous, irritating, or harmful to comfort and well-being of installers and occupants.
- E. Volatile Organic Compounds (VOC): Chemicals that are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects.

1.4 REFERENCE STANDARDS

- A. Carpet and Rug Institute Green Label Plus program.
- B. U.S. Department of Agriculture BioPreferred program (USDA BioPreferred).
- C. U.S. Environmental Protection Agency Comprehensive Procurement Guidelines (CPG).
- D. U.S. Environmental Protection Agency WaterSense Program (WaterSense).
- E. U.S. Environmental Protection Agency ENERGY STAR Program (ENERGY STAR).
- F. U. S. Department of Energy Federal Energy Management Program (FEMP).
- G. Green Electronic Council EPEAT Program (EPEAT).

1.5 SUBMITTALS

- A. All submittals to be provided by contractor to COR/Resident Engineer and Architect.
- B. Sustainability Action Plan:
 1. Submit documentation as required by this section; provide additional copies of typical submittals required under technical sections when sustainable construction requires copies of record submittals.
 2. Within 30 days after Preconstruction Meeting provide a narrative plan for complying with requirements stipulated within this section.
 3. Sustainability Action Plan must:

- a. Make reference to sustainable construction submittals defined by this section.
 - b. Address all items listed under PERFORMANCE CRITERIA.
 - c. Indicate individual(s) responsible for implementing the plan.
- C. Project Materials Cost Data Spreadsheet: Within 30 days after the Preconstruction Meeting provide a preliminary Project Materials Cost Data Spreadsheet. The Project Materials Cost Data Spreadsheet must be an electronic file and indicate all materials in Divisions 3 through 10, 31, and 32 used for Project (excluding labor costs and excluding all mechanical, electrical, and plumbing system components), and be organized by specification section. The spreadsheet must include the following:
 - 1. Identify each reused or salvaged material, its cost, and its replacement value.
 - 2. Identify each recycled-content material, its post-consumer and pre-consumer recycled content as a percentage the product's weight, its cost, its combined recycled content value, defined as the sum of post-consumer recycled content value plus one-half of pre-consumer recycled content value, and total combined recycled content value for all materials as a percentage of total materials costs.
 - 3. Identify each biobased material, its source, its cost, and total value of biobased materials as a percentage of total materials costs.
 - 4. Total cost for Project and total cost of building materials used for Project.
- F. Product Submittals:
 - 1. Recycled Content: Submit product data from manufacturer indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content (excluding MEP systems equipment and components).
 - 2. Biobased Content: Submittals for products to be installed or used included on the USDA BioPreferred program's product category lists. Data to include biobased content and source of biobased material; indicating name of manufacturer, cost of each material.
- G. Sustainable Construction Progress Reports: Concurrent with each Application for Payment, submit a Sustainable Construction Progress Report to confirm adherence with Sustainability Action Plan.

1. Include narratives of revised strategies for bringing work progress into compliance with plan and product submittal data and calculations to demonstrate compliance with thresholds based on materials costs.
 2. Include updated and current Project Materials Cost Data Spreadsheet.
 3. Include updated and current Low Pollutant-Emitting Materials Tracking Spreadsheet.
 4. Include construction waste tracking, in tons or cubic yards, including waste description, whether diverted or landfilled, hauler, and percent diverted for comingled quantities; and excluding land-clearing debris and soil. Provide haul receipts and documentation of diverted percentages for comingled wastes.
- H. Closeout Submittals: Within 14 days after Substantial Completion provide the following:
1. Final version of Project Material Cost Data Spreadsheet.
 2. Minimum 18 construction photographs including six photographs taken on three different occasions during construction of ANSI/SMACNA 008-2008, Chapter 3 approaches employed, along with a brief description of each approach, documenting implementation of IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.

1.6 QUALITY ASSURANCE

- A. Preconstruction Meeting: After award of Contract and prior to commencement of Work, schedule and conduct meeting with COR/Resident Engineer and Architect to discuss the Project Sustainable Action Plan content as it applies to submittals, project delivery, required Construction Indoor Air Quality (IAQ) Management Plan, and other Sustainable Construction Requirements. The purpose of this meeting is to develop a mutual understanding of the Sustainable Construction Requirements and coordination of contractor's management of these requirements with the Contracting Officer and the Construction Quality Manager.
- B. Construction Job Conferences: Status of compliance with Sustainable Construction Requirements of these specifications will be an agenda item at regular job meetings conducted during the course of work at the site.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

- A. Construction waste diversion from landfill disposal must comprise at least 50 percent of total construction waste, excluding land clearing debris and soil. Alternative daily cover (ADC) does not qualify as material diverted from disposal.
- B. Low Pollutant-Emitting Materials:
 - 1. Adhesives, sealants and sealant primers applied on site within the weatherproofing membrane must comply with VOC limits of SCAQMD Rule
 - a. Non-Flooring Adhesives and Sealants:
 - 1) Multipurpose Construction Adhesives: 70 g/L.
 - 2) Structural Glazing Adhesives: 100 g/L.
 - 3) Metal-to-Metal Substrate Adhesives: 30 g/L.
 - 4) Plastic Foam Substrate Adhesive: 50 g/L.
 - 5) Porous Material (Except Wood) Substrate Adhesive: 50 g/L.
 - 6) Wood Substrate Adhesive: 30 g/L.
 - 7) Other Sealant Primer: 750 g/L.
 - 8) Other Sealants: 420 g/L.
- C. Recycled Content:
 - 1. Any product being installed or used that are listed on EPA Comprehensive Procurement Guidelines designated product list must meet or exceed the EPA's recycled content recommendations. The EPA Comprehensive Procurement Guidelines categories include:
 - a. Cement and concrete.
 - b. Nonpressure pipe.
 - c. Compost and fertilizer made from recovered organic materials.
 - d. Hydraulic mulch.
 - 2. Provide building materials with recycled content such that post-consumer recycled content value plus half the pre-consumer recycled content value constitutes a minimum of [10] [20] percent of cost of materials used for Project, exclusive of mechanical, electrical and plumbing components, specialty items such as elevators, and labor and delivery costs.
- D. Biobased Content:
 - 1. Materials and equipment being installed or used that are listed on the USDA BioPreferred program product category list must meet or exceed USDA's minimum biobased content threshold. Refer to individual specification sections for detailed requirements applicable to that section.

- a. USDA BioPreferred program categories include:
 - 1) Cleaners.
 - 2) Corrosion Preventatives.
 - 3) Erosion Control Materials.
 - 4) Dust Suppressants.
 - 5) Fertilizers.
 - 6) Mulch and Compost Materials.
 - 7) Wood and Concrete Sealers.
- E. Materials, products, and equipment being installed which fall into a category covered by the WaterSense program must be WaterSense-labeled or meet or exceed WaterSense program performance requirements, unless disallowed for infection control reasons.
- F. Materials, products, and equipment being installed which fall into a category covered by the Energy Star program must be Energy Star-labeled.

-----END-----

**SECTION 02 41 10
DEMOLITION AND SITE CLEARING**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies all site preparation work, demolition and removal of buildings, portions of buildings, utilities, other structures and debris from trash dumps shown.

1.2 RELATED WORK

- A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: EARTH MOVING (SHORT FORM).
- B. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- C. Disconnecting utility services prior to demolition: Section 01 00 02, GENERAL REQUIREMENTS.
- D. Reserved items that are to remain the property of the Government: Section 01 00 02, GENERAL REQUIREMENTS MINOR.
- E. Waste Management: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT

1.3 PROTECTION

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 02, GENERAL REQUIREMENTS MINOR, Article 1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.
- E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it

results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.

- F. Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Cemetery; any damaged items shall be repaired or replaced as approved by the Resident Engineer/Contracting Officer's Representative (RE/COR). Coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have RE/COR's approval.
- G. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.4 UTILITY SERVICES

- A. Demolish and remove outside utility service lines shown to be removed.
- B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SITE CLEARING

- A. General: Remove trees, shrubs, grass, and other vegetation, pavements, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.
 - 1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
- B. Erosion Control: Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways. Install silt fence

and inlet protection as shown and as per requirements of the SWPPP, prior to any soil disturbance activities. Provide temporary seeding as required by the SWPPP.

- C. Maintain site controls in accordance with Storm Water Pollution Prevention Plan and repair as directed by COTR to sustain compliance with SPDES permit. Maintain all records as required by the SWPPP. Perform inspections as required by the SWPPP.
- D. Topsoil - On-site: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 150 mm (6 inches). Satisfactory topsoil is reasonably free and/or screened of subsoil, clay lumps, stones, and other objects over 25 mm (1 inch) in diameter, and without weeds, roots, and other objectionable material.
 - 1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
 - a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
 - 2. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles to prevent wind erosion in accordance with the Storm Water Pollution Prevention Plan. Refer to Division 2 Section 32 90 00, "Planting" for soil amendments required prior to spreading topsoil.
 - a. Stockpile shall be contained with erosion and sediment controls (silt fence) and stabilized if undisturbed in accordance with the Storm Water Pollution Prevention Plan.
 - 3. Dispose of unsuitable or excess topsoil as specified for disposal of waste material only after approval of the Architect.
- E. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to be left standing.
 - 1. Completely remove stumps, roots, and other debris protruding through ground surface.
 - 2. Use only hand methods for grubbing inside drip line of trees indicated to remain.

3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - a. Place fill material in horizontal layers not exceeding 150 mm (6 inches) loose depth, and thoroughly compact each layer to a density equal to adjacent original ground.
- F. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.
- G. Removing abandoned underground piping or conduits interfering with construction is included under this Section, except as indicated to be abandoned in-place.
- H. Continue maintenance of erosion controls in compliance with the Storm Water Pollution Prevention Plan until the work is completed and the threat of erosion is gone by either around surface stabilizer or lawn "grow-in" is at 85% complete. Temporary erosion control devices shall not be removed until the area is certified as being stabilized by the Qualified Inspector.

3.2 DEMOLITION

- A. Completely demolish and remove buildings and structures, including all appurtenances related or connected thereto, as noted below:
 1. As required for installation of new utility service lines.
 2. To full depth within an area defined by hypothetical lines located 5 feet outside building lines of new structures.
- B. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Cemetery Property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the RE/COR. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 24 inches square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.
- C. In removing buildings and structures of more than two stories, demolish work story by story starting at highest level and progressing down to third floor level. Demolition of first and second stories may proceed simultaneously.

- D. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 5 feet below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 5 feet, or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications. Burning is not permitted on the property.
- E. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the RE/COR. When Utility lines are encountered that are not indicated on the drawings, the RE/COR shall be notified prior to further work in that area.

3.3 CLEAN-UP

- A. On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to RE/COR. Clean-up shall include off the Cemetery Property disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

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SECTION 03 30 53
(SHORT-FORM) CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies cast-in-place structural concrete and material and mixes for other concrete.

1.2 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete roads, walks, and similar exterior site work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

1.3 TOLERANCES

- A. ACI 117.
- B. Slab Finishes: ACI 117, F-number method in accordance with ASTM E1155.

1.4 REGULATORY REQUIREMENTS

- A. ACI SP-66 - ACI Detailing Manual.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.

1.5 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements.
- B. Blended Cement: It is the intent of this specification to reduce CO2 emissions and other environmentally detrimental effects resulting from the production of Portland cement by requiring that all concrete mixes, in aggregate, utilize blended cement mixes to displace Portland cement typically included in conventional construction. Provide the following submittals:
 - 1. Copies of concrete design mixes for all installed concrete.
 - 2. Copies of typical regional baseline concrete design mixes for all compressive strengths used on the Project.
 - 3. Quantities in cubic yards of each installed concrete mix.
- C. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit <http://www.biopreferred.gov>.

1.6 REGULATORY REQUIREMENTS FOR RECYCLED CONTENT

- A. Products and Materials with Post-Consumer Content and Recovered Materials Content:
 - 1. Contractor is obligated by contract to satisfy Federal mandates for procurement of products and materials meeting recommendations for post-consumer content and recovered materials content; the list of designated product categories with recommendations has been compiled by the EPA - refer to <http://www.epa.gov/wastes/conserve/tools/cpg/products/>.
 - 2. Materials or products specified by this section may be obligated to satisfy this Federal mandate and Comprehensive Procurement Guidelines program.
 - 3. The EPA website also provides tools such as a Product Supplier Directory search engine and product resource guides.
- B. Fulfillment of regulatory requirements does not relieve the Contractor of satisfying sustainability requirements stipulated by Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS, as it relates to recycled content; additional product and material selections with recycled content may be required, as determined by Contractor's Sustainability Action Plan.

1.7 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Concrete Mix Design.
- C. Shop Drawings:
 - 1. Submit Steel Reinforcement Shop Drawings and Product Data to include all information necessary for fabrication and placement of reinforcement.
 - 2. Indicate grades of reinforcing steel.
 - 3. Clearly indicate the splice length for every size and type of bar used.
 - 4. Indicate the type, size and location of all accessories required for the proper assembly, placement and support of the reinforcement.
 - 5. Provide layout drawings of all floor slabs and formed concrete indicating control and expansion joints.
- D. Manufacturer's Certificates: Air-entraining admixture, chemical admixtures, curing compounds.

1.8 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. American Concrete Institute (ACI):

117-10	Tolerances for Concrete Construction and Materials and Commentary
211.1-91(R2009)	Selecting Proportions for Normal, Heavyweight, and Mass Concrete
211.2-98(R2004)	Selecting Proportions for Structural Lightweight Concrete
301-10	Structural Concrete
305R-10	Guide to Hot Weather Concreting
306R-10	Guide to Cold Weather Concreting
SP-66-04	ACI Detailing Manual
318/318M-11	Building Code Requirements for Structural Concrete and Commentary
347R-04	Guide to Formwork for Concrete

C. American Society for Testing and Materials (ASTM):

A185/A185M-07	Steel Welded Wire Reinforcement, Plain, for Concrete
A615/A615M-12	Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
A996/A996M-09b	Rail Steel and Axle Steel Deformed Bars for Concrete Reinforcement
C31/C31M-12	Making and Curing Concrete Test Specimens in the Field
C33/C33M-13	Concrete Aggregates
C39/C39M-12a	Compressive Strength of Cylindrical Concrete Specimens
C94/C94M-13	Ready Mixed Concrete
C143/C143M-12	Slump of Hydraulic Cement Concrete
C150/C150M-12	Portland Cement
C171-07	Sheet Materials for Curing Concrete
C172/C172M-10	Sampling Freshly Mixed Concrete
C173/C173M-12	Air Content of Freshly Mixed Concrete by the Volumetric Method

C192/C192M-12a	Making and Curing Concrete Test Specimens in the Laboratory
C231/C231M-10	Air Content of Freshly Mixed Concrete by the Pressure Method
C260/C260M-10a	Air-Entraining Admixtures for Concrete
C330/C330M-09	Lightweight Aggregates for Structural Concrete
C494/C494M-13	Chemical Admixtures for Concrete
C618-12a	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
D1751-04(R2008)	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
E1155-96(2008)	Determining FF Floor Flatness and FL Floor Levelness Numbers

PART 2 - PRODUCTS

2.1 FORMS

- A. Wood, plywood, metal, or other materials, approved by RE/COR, of grade or type suitable to obtain type of finish specified.
- B. Form releasing agents to be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents must not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds. If special form liners are to be used, follow the recommendation of the form coating manufacturer. Submit manufacturer's recommendation on method and rate of application of form releasing agents.

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type I or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33, Size 67. Size 467 may be used for footings and walls over 300 mm (12 inches) thick. Provide Size 7 coarse aggregate for applied topping and metal pan stair fill.
- D. Fine Aggregate: ASTM C33.
- E. Lightweight Aggregate for Structural Concrete: ASTM C330, Table 1
- F. Mixing Water: Fresh, clean, and potable.
- G. Air-Entraining Admixture: ASTM C260.

- H. Chemical Admixtures: ASTM C494.
- I. Vapor Barrier: ASTM E1745, 0.38 mm (15 mil).
- J. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. See structural drawings for grade.
- K. Welded Wire Fabric: ASTM A185.
- L. Expansion Joint Filler: ASTM D1751.
- M. Sheet Materials for Curing Concrete: ASTM C171.
- N. Abrasive Aggregates: Aluminum oxide grains or emery grits.
- O. Liquid Hardener and Dustproofer: Fluosilicate solution or magnesium fluosilicate or zinc fluosilicate. Magnesium and zinc may be used separately or in combination as recommended by manufacturer.
- P. Liquid Densifier/Sealer: 100 percent active colorless aqueous silicate solution.
- Q. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout cannot show settlement or vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement. Grout must produce a compressive strength of minimum 18 MPa (2500 psi) at 3 days and minimum 35 MPa (5000 psi) at 28 days.

2.3 CONCRETE MIXES

- A. Design of concrete mixes using materials specified as set forth under Option C of ASTM C94.
- B. Compressive strength at 28 days: Minimum 4000 psi.
- C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.
- D. Maximum slump for vibrated concrete is 100 mm (4 inches) tested in accordance with ASTM C143.
- E. Cement and water factor (See Table I):

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete: Strength	Non-Air-Entrained		Air-Entrained	
Min. 28 Day Comp. Str. MPa (psi)	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio
35 (5000) ^{1,3}	375 (630)	0.45	385 (650)	0.40
30 (4000) ^{1,3}	325 (550)	0.55	340 (570)	0.50
25 (3000) ^{1,3}	280 (470)	0.65	290 (490)	0.55
25 (3000) ^{1,2}	300 (500)	*	310 (520)	*

(SHORT FORM) CAST-IN-PLACE CONCRETE

1. If trial mixes are used, the proposed mix design must achieve a compressive strength 8.3 MPa (1200 psi) in excess of $f'c$. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design must achieve a compressive strength 9.7 MPa (1400 psi) in excess of $f'c$.
2. Lightweight Structural Concrete. Pump mixes may require higher cement values.
3. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
- * Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

F. Air-entrainment is required for all exterior concrete and as required for Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS. Air content must conform with ACI 318 Table 4.4.1.

2.4 BATCHING AND MIXING

- A. Store, batch, and mix materials as specified in ASTM C94.
 1. Job-Mixed: Mix in a batch mixer in manner specified for stationary mixers in ASTM C94.
 2. Ready-Mixed: Comply with ASTM C94, except use of non-agitating equipment for transporting concrete to the site will not be permitted. With each load of concrete delivered to project, ready-mixed concrete producer must furnish, in duplicate, certification as required by ASTM C94.
 3. Mixing structural lightweight concrete: Charge mixer with 2/3 of total mixing water and all of the aggregate. Mix ingredients for not less than 30 seconds in a stationary mixer or not less than 10 revolutions at mixing speed in a truck mixer. Add remaining mixing water and other ingredients and continue mixing. Above procedure may be modified as recommended by aggregate producer.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Installation conforms to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection while remaining within allowable construction tolerances, all dead and live loads to which they may be subjected.
- B. Treating and Wetting: Treat or wet contact forms as follows:

1. Coat plywood and board forms with non-staining form sealer. In hot weather cool forms by wetting with cool water just before concrete is placed.
 2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather, cool metal forms by thoroughly wetting with water just before placing concrete.
 3. Use sealer on reused plywood forms as specified for new material.
- C. Inserts, sleeves, and similar items: Flashing reglets, masonry ties, anchors, inserts, wires, hangers, sleeves, boxes for floor hinges and other items specified as furnished under this and other sections of specifications are required to be in their final position at time concrete is placed - properly located, accurately positioned, built into construction, and maintained securely in place.
- D. Construction Tolerances:
1. Set and maintain concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials.
 2. Cast-in-place concrete installed as part of, or in the complexes surrounding, columbarian or memorial wall elements to have concrete (on or above finished grade) constructed to dimensions indicated on Drawings within 6 mm (1/4 inch) of location and elevation.
 3. Engage a professional surveyor to survey the form work for the exposed portions of the foundations for the columbarium or memorial walls, including wall segments, piers and/or columns, prior to concrete being poured. If the forms are not correct, they must be corrected and resurveyed. When correct, provide a written certification from the surveyor, to the RE/COR, that the forms are set according to the plans, within the allowable tolerances for elevation, location, orientation, and dimensions called for on the plans.
 4. Properly brace the forms so the set concrete is correct within the allowable construction tolerances when the forms are removed.
 5. Upon removal of the forms, the professional surveyor must survey the placed concrete and provide information to the RE/COR where the work is not in conformance with the design drawings, within the allowable construction tolerances. The work cannot progress until the exposed concrete for the foundations are brought into compliance.

6. Remedial work necessary for correcting installations that is in excess of allowable tolerances are the responsibility of the Contractor.
7. Erected work that exceeds specified tolerance limits must be remedied or removed and replaced, at no additional cost to the Government.
8. Any remediation work is subject to approval of the RE/COR in advance of the work.
9. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2 REINFORCEMENT

- A. Details of concrete reinforcement, unless otherwise shown, in accordance with ACI 318 and ACI SP-66. Support and securely tie reinforcing steel to prevent displacement during placing of concrete.

3.3 VAPOR BARRIER

- A. Except where membrane waterproofing is required, place interior concrete slabs on a continuous vapor barrier.
- B. Place 100 mm (4 inches) of fine granular fill over the vapor barrier to act as a blotter for concrete slab.
- C. Lap joints 150 mm (6 inches) and seal with a compatible pressure-sensitive tape.
- D. Patch punctures and tears.

3.4 PLACING CONCRETE

- A. Remove water from excavations before concrete is placed. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Obtain approval of RE/COR before placing concrete. Provide screeds at required elevations for concrete slabs.
- B. Roughen and clean set concrete free from laitance, foreign matter, and loose particles, before placing new concrete on or against concrete which has set.
- C. Convey concrete from mixer to final place of deposit by method which will prevent segregation or loss of ingredients. Do not deposit in work concrete that has attained its initial set or has contained its water or cement more than 1 1/2 hours. Do not allow concrete to drop freely

more than 1500 mm (5 feet) in unexposed work nor more than 900 mm (3 feet) in exposed work. Place and consolidate concrete in horizontal layers not exceeding 300 mm (12 inches) in thickness. Consolidate concrete by spading, rodding, and mechanical vibrator. Do not secure vibrator to forms or reinforcement. Provide vibration continuously with placing of concrete.

- D. Hot weather placing of concrete: Follow recommendations of ACI 305R to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.
- E. Cold weather placing of concrete: Follow recommendations of ACI 306R, to prevent freezing of thin sections less than 300 mm (12 inches) and to permit concrete to gain strength properly, except that use of calcium chloride cannot be used without written approval from RE/COR.

3.5 PROTECTION AND CURING

- A. Protect exposed surfaces of concrete from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature. Curing method is subject to approval by RE/COR.

3.6 FORM REMOVAL

- A. Forms remain in place until concrete has a sufficient strength to carry its own weight and loads supported. Removal of forms at any time is the Contractor's sole responsibility.

3.7 SURFACE PREPARATION

- A. Immediately remove loose materials, after forms have been removed and work has been examined and approved by RE/COR, and patch all stone pockets, surface honeycomb, or similar deficiencies with cement mortar made with 1 part portland cement and 2 to 3 parts sand.
- B. For exposed surfaces of concrete for the columbarium and memorial walls and walls in their complexes, follow the procedures identified in Paragraph FINISHES for Exterior Exposed Areas (finished).
- C. For columbarium and memorial walls and their complexes, immediately after forms are removed, take steps to prepare and smooth the exposed portions of the concrete. Remove the form marks, including joint marks, fins, burrs and similar projections to produce a smooth surface. Complete the surface finish to result in a uniform textured surface with homogeneous color, unless surface is to be otherwise treated. Work must be as approved during the review of the mock-up.

3.8 FINISHES

A. Vertical and Overhead Surface Finishes:

1. Unfinished Areas: Vertical and overhead concrete surfaces exposed in unfinished areas, above suspended ceilings in manholes, and other unfinished areas exposed or concealed will not require additional finishing.
2. Interior and Exterior Exposed Areas (to be painted): Fins, burrs and similar projections on surface must be knocked off flush by mechanical means approved by RE/COR and rubbed lightly with a fine abrasive stone or hone. Use an ample amount of water during rubbing without working up a lather of mortar or changing texture of concrete.
3. Interior and Exterior Exposed Areas (finished): Provide grout finish of uniform color and smooth finish treated as follows:
 - a. After concrete has hardened and laitance, fins and burrs have been removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone or stone.
 - b. Apply grout composed of 1 part Portland cement and 1 part clean, fine sand (smaller than 600 micro-m (No. 30) sieve). Work grout into surface of concrete with cork floats or fiber brushes until all pits and honeycomb are filled.
 - c. After grout has hardened, but still plastic, remove surplus grout with a sponge rubber float and by rubbing with clean burlap.
 - d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish for any area in same day. Confine limits of finished areas to natural breaks in wall surface. Do not leave grout on concrete surface overnight.

B. Slab Finishes:

1. Scratch Finish: Slab surfaces to receive a bonded applied cementitious application must be thoroughly raked or wire broomed after partial setting (within 2 hours after placing) to roughen surface and ensure a permanent bond between base slab and applied cementitious materials.
2. Floating: Allow water brought to surface by float used for rough finishing to evaporate before surface is again floated or troweled. Do not sprinkle dry cement on surface to absorb water.
3. Float Finish: Screen and float ramps, stair treads, and platforms, both interior and exterior, equipment pads, and slabs to receive

- non-cementitious materials, except as specified, to a smooth dense finish. Check for alignment using a straightedge or template after first floating and while surface is still soft. Correct high spots by cutting down with a trowel or similar tool and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections on floated finish by rubbing or dry grinding. Refloat the slab to a uniform sandy texture.
4. Steel Trowel Finish: Applied toppings, concrete surfaces to receive resilient floor covering or carpet, future floor roof and all monolithic concrete floor slabs exposed in finished work and for which no other finish is shown or specified must be steel troweled. Delay final steel troweling to secure a smooth, dense surface as long as possible, generally when the surface can no longer be dented with finger. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure on trowel to compact cement paste and form a dense, smooth surface. Finished surface must be free of trowel marks, uniform in texture and appearance.
 5. Broom Finish: Finish all exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after the surfaces have been floated.
 6. Finished slab flatness (FF) and levelness (FL) values must comply with the following minimum requirements:

Slab On Grade & Shored Suspended Slabs	Unshored Suspended Slabs
Specified overall value F_F 25/ F_L 20	Specified overall value F_F 25
Minimum local value F_F 17/ F_L 15	Minimum local value F_F 17

3.9 SURFACE TREATMENTS

- A. Mix and apply surface treatments in accordance with manufacturer's printed instructions.
- B. Non-Slip Finish: Except where safety nosing and tread coverings are shown, apply non-slip abrasive aggregate to treads and platforms of all concrete steps and stairs, and to surfaces of exterior concrete ramps and platforms. Broadcast aggregate uniformly over concrete surface. Trowel concrete surface to smooth dense finish. After curing, rub the treated surface with abrasive brick and water sufficiently to slightly expose abrasive aggregate.

3.10 APPLIED TOPPING

- A. Separate concrete topping with thickness and strength shown with only enough water to insure a stiff, workable, plastic mix.
- B. Continuously place applied topping until entire section is complete, struck off with straightedge, compact by rolling or tamping, float and steel trowel to a hard smooth finish.

3.11 RESURFACING FLOORS

- A. Remove existing flooring, in areas to receive resurfacing, to expose existing structural slab and to extend not less than 25 mm (1 inch) below new finished floor level. Prepare exposed structural slab surface by roughening, broom cleaning, wetting, and grouting. Apply topping as specified.

3.12 RETAINING WALLS

- A. Provide concrete for retaining walls as shown and air-entrained.
- B. Install and construct expansion and contraction joints, waterstops, weep holes, reinforcement and railing sleeves as shown.
- C. Finish exposed surfaces to match adjacent concrete surfaces, new or existing.
- D. Place porous backfill as shown.

3.13 PRECAST CONCRETE ITEMS

- A. Cast precast concrete items, not specified elsewhere, using 25 MPa (3000 psi) air-entrained concrete to shapes and dimensions shown. Finish surfaces to match corresponding adjacent concrete surfaces. Reinforce with steel as necessary for safe handling and erection.

- - - E N D - - -

**SECTION 04 05 13
MASONRY MORTARING**

PART 1 - GENERAL

1.1 DESCRIPTION:

Section specifies mortar materials and mixes.

1.2 RELATED WORK:

A. Mortar used in Section:

1. Section 04 05 16, MASONRY GROUTING.
2. Section 04 20 00, UNIT MASONRY.
3. Section 04 05 31, MASONRY TUCK POINTING.
4. Section 04 72 00, CAST STONE MASONRY.

1.3 TESTING LABORATORY-CONTRACTOR RETAINED

- A. Engage a commercial testing laboratory approved by Resident Engineer to perform tests specified below.
- B. Submit information regarding testing laboratory's facilities and qualifications of technical personnel to Resident Engineer.

1.4 TESTS

- A. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:
- B. Mortar:
 1. Test for compressive strength and water retention; ASTM C270.
 2. Mortar compressive strengths 28 days as follows:

Type M: Minimum 17230 kPa (2500 psi) at 28 days.

Type S: Minimum 12400 kPa (1800 psi) at 28 days.

Type N: Minimum 5170 kPa (750 psi) at 28 days.
- C. Cement:
 1. Test for water soluble alkali (nonstaining) when nonstaining cement is specified.
 2. Nonstaining cement shall contain not more than 0.03 percent water soluble alkali.
- D. Sand: Test for deleterious substances, organic impurities, soundness and grading.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Certificates:

1. Indicating that following items meet specifications:

- a. Portland cement.
- b. Masonry cement.
- c. Mortar cement.
- d. Hydrated lime.
- e. Fine aggregate (sand).
- f. Color admixture.

C. Laboratory Test Reports:

- 1. Mortar, each type.
- 2. Admixtures.

D. Manufacturer's Literature and Data:

- 1. Cement, each kind.
- 2. Hydrated lime.
- 3. Admixtures.
- 4. Liquid acrylic resin.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver masonry materials in original sealed containers marked with name of manufacturer and identification of contents.
- B. Store masonry materials under waterproof covers on planking clear of ground, and protect damage from handling, dirt, stain, water and wind.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C40-11.....Organic Impurities in Fine Aggregates for
Concrete
 - C91-12.....Masonry Cement
 - C109-11.....Compressive Strength of Hydraulic Cement
Mortars (Using 2-in. or 50-MM Cube Specimens)
 - C144-04.....Aggregate for Masonry Mortar
 - C150-12.....Portland Cement
 - C207-06(2011).....Hydrated Lime for Masonry Purposes
 - C270-12.....Mortar for Unit Masonry
 - C595-13.....Blended Hydraulic Cement
 - C780-10.....Preconstruction and Construction Evaluation of
Mortars for Plain and Reinforced Unit Masonry

C979-10.....Pigments for Integrally Colored Concrete

C1329-12.....Mortar Cement

PART 2 - PRODUCTS

2.1 HYDRATED LIME

- A. ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY MORTAR

- A. ASTM C144 and as follows:
 - 1. Light colored sand for mortar for laying face brick.
 - 2. White plastering sand meeting sieve analysis for mortar joints for pointing
- B. Test sand for color value in accordance with ASTM C40. Sand producing color darker than specified standard is unacceptable.

2.3 BLENDED HYDRAULIC CEMENT

- A. ASTM C595, Type IS, IP.

2.4 MASONRY CEMENT

- A. ASTM C91. Type N, S, or M.
- B. Use white masonry cement whenever white mortar is specified.

2.5 MORTAR CEMENT

- A. ASTM C1329, Type N, S or M.

2.6 PORTLAND CEMENT

- A. ASTM C150, Type I.
- B. Use white Portland cement wherever white mortar is specified.

2.7 LIQUID ACRYLIC RESIN

- A. A formulation of acrylic polymers and modifiers in liquid form designed for use as an additive for mortar to improve physical properties.

2.8 WATER

- A. Potable, free of substances that are detrimental to mortar, masonry, and metal.

2.9 POINTING MORTAR

- A. For Cast Stone or Precast Concrete: Proportion by volume; One part white Portland cement, two parts white sand, and 1/5 part hydrated lime.
- B. Pointing Mortar for Glazed Structural Facing Tile:
 - 1. Proportion by volume: One part white Portland cement, two parts of graded white sand passing Number 50 sieve, and 1/8 part hydrated lime.

2.10 MASONRY MORTAR

- A. Conform to ASTM C270.
- B. Admixtures:
 - 1. Do not use mortar admixtures, except color admixtures if approved by Resident Engineer.
 - 2. Submit laboratory test report showing effect of proposed admixture on strength, water retention, and water repellency of mortar.
 - 3. Do not use antifreeze compounds.
- C. Colored Mortar:
 - 1. Maintain uniform mortar color for exposed work throughout.
 - 2. Match mortar color in approved sample.
 - 3. Color of mortar for exposed work in alteration work to match color of existing mortar.
- D. Color Admixtures:
 - 1. Proportion as specified by manufacturer.

2.11 COLOR ADMIXTURE

- A. Pigments: ASTM C979.
- B. Use mineral pigments only. Organic pigments are not acceptable.
- C. Pigments inert, stable to atmospheric conditions, nonfading, alkali resistant and water insoluble.

PART 3 - EXECUTION**3.1 MIXING**

- A. Mix in a mechanically operated mortar mixer.
 - 1. Mix mortar for at least three minutes but not more than five minutes.
- B. Measure ingredients by volume. Measure by the use of a container of known capacity.
- C. Mix water with dry ingredients in sufficient amount to provide a workable mixture which will adhere to vertical surfaces of masonry units.
- D. Mortar that has stiffened because of loss of water through evaporations:
 - 1. Re-tempered by adding water to restore to proper consistency and workability.
 - 2. Discard mortar that has reached its initial set or has not been used within two hours.
- E. Pointing Mortar:

1. Mix dry ingredients with enough water to produce a damp mixture of workable consistency which will retain its shape when formed into a ball.
2. Allow mortar to stand in dampened condition for one to 1-1/2 hours.
3. Add water to bring mortar to a workable consistency prior to application.

3.2 MORTAR USE LOCATION

- A. Use Type M mortar for precast concrete panels and waterproof parging below grade.
- B. Use Type S mortar for masonry containing vertical reinforcing bars (non-engineered), masonry below grade, setting cast stone and engineered reinforced unit masonry work.
- C. For brick veneer over frame back up walls, use Type N portland cement-lime mortar or Type S masonry cement or mortar cement mortar.
- D. Use Type N mortar for other masonry work, except as otherwise specified.
- E. Use Type N mortar for tuck pointing work.
- F. Use pointing mortar for items specified.

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**SECTION 04 05 16
MASONRY GROUTING**

PART 1 - GENERAL

1.1 DESCRIPTION:

Section specifies grout materials and mixes.

1.2 RELATED WORK:

A. Grout used in Section:

1. Section 04 20 00, UNIT MASONRY.
2. Section 04 72 00, CAST STONE MASONRY.

1.3 TESTS:

- A. Certified test reports for grout and materials specified.
- B. Identify materials by type, brand name and manufacturer or by origin.
- C. After tests have been made and materials approved, do not change without additional test and approval of Resident Engineer.
- D. Testing:
 1. Grout:
 - a. Test for compressive strength; ASTM C1019.
 - b. Grout compressive strength of 13790 kPa (2000 psi) at 28 days.
 2. Cement:
 - a. Test for water soluble alkali (nonstaining) when nonstaining cement is specified.
 - b. Nonstaining cement shall contain not more than 0.03 percent water soluble alkali.
 3. Sand: Test for deleterious substances, organic impurities, soundness and grading.

1.4 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Certificates:
 1. Indicating that following items meet specifications:
 - a. Portland cement.
 - b. Masonry cement.
 - c. Grout.
 - d. Hydrated lime.
 - e. Fine aggregate (sand).
 - f. Coarse aggregate for grout.

- g. Color admixture.
- C. Laboratory Test Reports:
 - 1. Grout, each type.
 - 2. Admixtures.
- D. Manufacturer's Literature and Data:
 - 1. Cement, each kind.
 - 2. Hydrated lime.
 - 3. Admixtures.
 - 4. Liquid acrylic resin.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver masonry materials in original sealed containers marked with name of manufacturer and identification of contents.
- B. Store masonry materials under waterproof covers on planking clear of ground, and protect damage from handling, dirt, stain, water and wind.

1.6 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C40-11.....Organic Impurities in Fine Aggregates for
Concrete
 - C91-12.....Masonry Cement
 - C150-12.....Portland Cement
 - C207-06(2011).....Hydrated Lime for Masonry Purposes
 - C404-11.....Aggregate for Masonry Grout
 - C476-10.....Grout for Masonry
 - C595-13.....Blended Hydraulic Cement
 - C979-10.....Pigments for Integrally Colored Concrete
 - C1019-11.....Sampling and Testing Grout

PART 2 - PRODUCTS

2.1 HYDRATED LIME:

- A. ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY GROUT:

- A. ASTM C404, Size 8.

2.3 BLENDED HYDRAULIC CEMENT:

- A. ASTM C595, Type IS, IP.

2.4 MASONRY CEMENT:

- A. ASTM C91. Type N, S, or M.
- B. Use white masonry cement whenever white mortar is specified.

2.5 PORTLAND CEMENT:

- A. ASTM C150, Type I.
- B. Use white Portland cement wherever white mortar is specified.

2.6 LIQUID ACRYLIC RESIN:

- A. A formulation of acrylic polymers and modifiers in liquid form designed for use as an additive for mortar to improve physical properties.

2.7 WATER:

- A. Potable, free of substances that are detrimental to grout, masonry, and metal.

2.8 GROUT:

- A. Conform to ASTM C476 except as specified.
- B. Grout type proportioned by volume as follows:
 - 1. Fine Grout:
 - a. Portland cement or blended hydraulic cement: one part.
 - b. Hydrated lime: 0 to 1/10 part.
 - c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
 - 2. Coarse Grout:
 - a. Portland cement or blended hydraulic cement: one part.
 - b. Hydrated lime: 0 to 1/10 part.
 - c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
 - d. Coarse aggregate: one to two times sum of volumes of cement and lime used.
 - 3. Sum of volumes of fine and coarse aggregates: Do not exceed four times sum of volumes of cement and lime used.

2.9 COLOR ADMIXTURE:

- A. Pigments: ASTM C979.
- B. Use mineral pigments only. Organic pigments are not acceptable.
- C. Pigments inert, stable to atmospheric conditions, nonfading, alkali resistant and water insoluble.

PART 3 - EXECUTION**3.1 MIXING:**

- A. Mix in a mechanically operated grout mixer.
 - 1. Mix grout for at least five minutes.

- B. Measure ingredients by volume.
- C. Mix water with grout dry ingredients in sufficient amount to bring grout mixture to a pouring consistency.

3.2 GROUT USE LOCATIONS:

- A. Use fine grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is 50 mm (2 inches) or less.
- B. Use either fine grout or coarse grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is greater than 50 mm (2 inches).
- C. Do not use grout for filling bond beam or lintel units.

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**SECTION 04 05 31
MASONRY TUCK POINTING**

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies requirements for tuck pointing of existing masonry and stone work.

1.2 RELATED WORK

Mortars: Section 04 05 13, MASONRY MORTARING.

1.3 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C67-09.....Brick and Structural Clay Tile, Sampling and Testing
 - C216-12.....Facing Brick (Solid Masonry Units Made From Clay or Shale)
 - C270-10.....Mortar for Unit Masonry
- C. International Masonry Institute: Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

PART 2 - PRODUCTS

2.1 TUCK POINTING MORTAR

- A. As per appendix X3 of ASTM C270.

2.2 REPLACEMENT MASONRY UNITS

- A. Face Brick:
 - 1. ASTM C216, Grade SW, Type FBS. Brick shall be classified slightly efflorescent or better when tested in accordance with ASTM C67.
 - 2. Face brick shall match facing brick of the existing building(s) that is being tuck pointed.
- B. Other Units to match existing.

PART 3 - EXECUTION

3.1 CUT OUT OF EXISTING MORTAR JOINTS

- A. Cut out existing mortar joints (both bed and head joints) and remove by means of a toothing chisel or a special pointer's grinder, to a uniform depth of to 19 mm (3/4-inch), or until sound mortar is reached. Take care to not damage edges of existing masonry units to remain.

- B. Remove dust and debris from the joints by brushing, blowing with air or rinsing with water. Do not rinse when temperature is below freezing.

3.2 JOB CONDITIONS

- A. Protection: Protect newly pointed joints from rain, until pointed joints are sufficiently hard enough to prevent damage.
- B. Cold Weather Protection:
 - 1. Tuck pointing may be performed in freezing weather when methods of protection are utilized.
 - 2. Comply with applicable sections of "Recommended Practices for Cold Weather Construction" as published by International Masonry Industry All Weather Council.
 - 3. Existing surfaces at temperatures to prevent mortar from freezing or causing other damage to mortar.

3.3 INSTALLATION OF TUCK POINTING MORTAR

- A. Immediately prior to application of mortar, dampen joints to be tuck pointed. Prior to application of pointing mortar, allow masonry units to absorb surface water.
- B. Tightly pack mortar into joints in thin layers, approximately 6 mm (1/4-inch) thick maximum.
- C. Allow layer to become "thumbprint hard" before applying next layer.
- D. Pack final layer flush with surfaces of masonry units. When mortar becomes "thumbprint hard", tool joints.

3.4 TOOLING OF JOINTS

- A. Tool joints with a jointing tool to produce a smooth, compacted, concaved joint.
- B. Tool joints in patch work with a jointing tool to match the existing surrounding joints.

3.5 REPLACEMENT OF MASONRY UNITS

- A. Cut out mortar joints surrounding masonry units that are to be removed and replaced.
 - 1. Units removed may be broken and removed, providing surrounding units to remain are not damaged.
 - 2. Once the units are removed, carefully chisel out the old mortar and remove dust and debris.
 - 3. If units are located in exterior wythe of a cavity or veneer wall, exercise care to prevent debris falling into cavity.
- B. Dampen surfaces of the surrounding units before new units are placed.

1. Allow existing masonry to absorb surface moisture prior to starting installation of the new replacement units.
2. Butter contact surfaces of existing masonry and new replacement masonry units with mortar.
3. Center replacement masonry units in opening and press into position.
4. Remove excess mortar with a trowel.
5. Point around replacement masonry units to ensure full head and bed joints.
6. When mortar becomes "thumbprint hard", tool joints.

3.6 CLEANING

- A. Clean exposed masonry surfaces on completion.
- B. Remove mortar droppings and other foreign substances from wall surfaces.
- C. First wet surfaces with clean water, then wash down with a solution of soapless detergent specially prepared for cleaning brick.
- D. Brush with stiff fiber brushes while washing, and immediately thereafter hose down with clean water.
- E. Free clean surfaces from traces of detergent, foreign streaks or stains. Protect materials during cleaning operations including adjoining construction.
- F. Use of muratic acid for cleaning is prohibited.

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**SECTION 04 20 00
UNIT MASONRY**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies requirements for construction of masonry unit walls.

1.2 RELATED WORK

- A. Mortars and Grouts: Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING.
- B. Sealants and Sealant Installation: Section 07 92 00, JOINT SEALANTS.

1.3 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples:
1. Face brick, sample panel, 200 mm by 400 mm (8 inches by 16 inches,) showing full color range and texture of bricks, bond, and proposed mortar joints.
 2. Concrete masonry units, when exposed in finish work.
 3. Anchors, and ties, one each and joint reinforcing 305 mm (12 inches) long.
- C. Shop Drawings:
1. Indicate special masonry shapes.
 2. Indicate reinforcement, applicable dimensions and methods of hanging soffit or lintel masonry and reinforcing masonry for embedment of anchors for hung fixtures.
 3. Submit shop drawings for fabrication, bending, and placement of reinforcing bars prepared in accordance with ACI 315.
- D. Certificates:
1. Submit certificates signed by manufacturer, including name and address of contractor, project location, and the quantity, and date or dates of shipment or delivery to which certificate applies.
 2. Indicate that the following items meet specification requirements:
 - a. Face brick.
 - b. Solid and load-bearing concrete masonry units.

3. Identify testing laboratories facilities and qualifications of its principals and key personnel to perform tests specified.

E. Manufacturer's Literature and Data:

1. Anchors, ties, and reinforcement.
2. Shear keys.
3. Reinforcing bars.

1.6 WARRANTY

- A. Warranty exterior masonry walls against moisture leaks and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period to be five years.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. American Society for Testing and Materials (ASTM):

A615/A615M-12	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A675/A675M-03 (2009)	Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
A951/A951M-11	Steel Wire for Masonry Joint Reinforcement
C67-12	Sampling and Testing Brick and Structural Clay Tile
C90-12	Load bearing Concrete Masonry Units
C216-12a	Facing Brick (Solid Masonry Units Made From Clay or Shale)
C476-10	Grout for Masonry
C612-10	Mineral Fiber Block and Board Thermal Insulation
D1056-07	Flexible Cellular Materials - Sponge or Expanded Rubber

C. American Welding Society (AWS):

D1.4/D1.4M-11	Structural Welding Code - Reinforcing Steel
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D. Brick Industry Association - Technical Notes on Brick Construction (BIA):

11-2001	Brick Masonry, Part I
11A-1988	Brick Masonry, Part II
11B-1988	Brick Masonry, Part III Execution

- 11C-1998 for Brick Masonry Engineered Brick Masonry,
Part IV
- 11D-1988 Brick Masonry Engineered Brick Masonry, Part IV
continued
- 11E-1991 Brick Masonry, Part V

E. Masonry Industry Council:

Hot and Cold Weather Masonry Construction Manual, 1999

F. Masonry Standards Joint Committee; Specifications for Masonry
Structures (TMS 602-11/ACI 530.1-11/ASCE 6-11) (MSJC)

G. American Concrete Institute (ACI):

SP-66(2004) ACI Detailing Manual

1.8 PRE-INSTALLATION CONFERENCE

- A. Convene a meeting on site, after submittals are received and approved but before any work, to review drawings and specifications, submittals, schedule, manufacturer instructions, site logistics and pertinent matters of coordination, temporary protection, governing regulations, tests and inspections; participants to include RE/COR and all parties whose work is effected or related to the work of this section.

PART 2 - PRODUCTS

2.1 BRICK

A. Face Brick:

- 1. ASTM C216, Grade SW, Type FBS.
- 2. Brick when tested in accordance with ASTM C67: Classified slightly efflorescent or better.
- 3. Size:
 - a. Modular.

2.2 CONCRETE MASONRY UNITS

- A. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.
 - 1. Unit Weight: Normal weight.
 - 2. Sizes: Modular.

2.3 REINFORCEMENT

- A. Steel Reinforcing Bars: ASTM A615, deformed bars, 420 MPa (Grade 60) for bars No. 10 to No. 57 (No. 3 to No. 18), except as otherwise indicated.
- B. Where 6 mm diameter (No. 2) bars are shown, provide plain, round, carbon steel bars, ASTM A675, 550 MPa (Grade 80).
- C. Joint Reinforcement:

1. Form from wire complying with ASTM A951.
2. Galvanized after fabrication.
3. Width of joint reinforcement 40 mm (1 5/8-inches) less than nominal width of masonry wall or partition.
4. Cross wires welded to longitudinal wires.
5. Joint reinforcing at least 3000 mm (10 feet) in length.
6. Joint reinforcing in rolls is not acceptable.
7. Joint reinforcing that is crimped to form drip is not acceptable.
8. Maximum spacing of cross wires 400 mm (16 inches) to longitudinal wires.

2.4 ANCHORS, TIES, AND REINFORCEMENT

A. Adjustable Veneer Anchor for Frame Walls:

1. Two piece, adjustable anchor and tie.
2. Anchor and tie may be either type; use only one type throughout.
3. Loop Type:
 - a. Anchor: Screw-on galvanized steel anchor strap 2.75 mm (0.11 inch) by 19 mm (3/4 inch) wide by 225 mm (9 inches) long, with 9 mm (0.35 inch) offset and 100 mm (4 inch) adjustment. Provide 5 mm (0.20 inch) hole at each end for fasteners.
 - b. Ties: Triangular tie, fabricated of 5 mm (0.20 inch) diameter galvanized cold drawn steel wire. Ties long enough to engage the anchor and be embedded not less than 50 mm (2 inches) into the bed joint of the masonry veneer.
4. Angle Type:
 - a. Anchor: Minimum 2 mm (16 gage) thick galvanized steel angle shaped anchor strap. Provide hole in vertical leg for fastener. Provide hole near end of outstanding leg to suit upstanding portion of tie.

B. Rigid Anchors: Fabricate from steel bars bent to configuration indicated.

C. Corrugated Wall Tie:

1. Form from 1.5 mm (0.0598 inch) thick corrugated, galvanized steel 30 mm (1-1/4 inches) wide by lengths so as to extend at least 100 mm (4 inches) into joints of new masonry plus 38 mm (1-1/2 inch) turn-up.
2. Provide 5 mm (3/16 inch) hole in turn-up for fastener attachment.

2.5 PREFORMED COMPRESSIBLE JOINT FILLER

- A. Thickness and depth to fill the joint as specified.
- B. Closed Cell Neoprene: ASTM D1056, Type 2, Class A, Grade 1.

C. Non-Combustible Type: ASTM C612, Type V, 1800 degrees F.

2.6 ACCESSORIES

- A. Weeps: Glass fiber ropes, 10 mm (3/8 inch) minimum diameter, 300 mm (12 inches) long.
- B. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, of length required to extend from exterior face of stone to cavity behind, in color selected from manufacturer's standard.
- C. Cavity Drain Material: Recycled polyester/polyethylene mesh trapezoidal shaped to maintain cavity air flow and drainage while suspending mortar droppings at unequal heights.
- D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- E. Masonry Cleaner:
 - 1. Detergent type cleaner selected for each type of masonry used.
 - 2. Acid cleaners are not acceptable.
 - 3. Use soap-less type specially prepared for cleaning brick or concrete masonry as appropriate.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

- A. Protection:
 - 1. Cover tops of walls with non-staining waterproof covering, when work is not in progress; secure to prevent wind blow off.
 - 2. On new work protect base of wall from mud, dirt, mortar droppings, and other materials that will stain face, until final landscaping or other site work is completed.
- B. Cold Weather Protection:
 - 1. Masonry may be laid in freezing weather when methods of protection are utilized.
 - 2. Comply with MSJC and "Hot and Cold Weather Masonry Construction Manual".

3.2 CONSTRUCTION TOLERANCES

- A. Lay masonry units plumb, level and true to line within the tolerances as per MSJC requirements and as follows:
- B. Maximum variation from plumb:
 - 1. In 3,000 mm (10 feet) - 6 mm (1/4 inch).

2. In 6,000 mm (20 feet) - 10 mm (3/8 inch).
- C. Maximum variation from level:
 1. In any bay or up to 6,000 mm (20 feet) - 6 mm (1/4 inch).
 2. In 12,000 mm (40 feet) or more - 13 mm (1/2 inch).
- D. Maximum variation from linear building lines:
 1. In any bay or up to 6,000 mm (20 feet) - 13 mm (1/2 inch).
 2. In 12,000 mm (40 feet) or more - 19 mm (3/4 inch).
- E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown:
 1. Minus 6 mm (1/4 inch).
 2. Plus 13 mm (1/2 inch).
- F. Maximum variation in prepared opening dimensions:
 1. Accurate to minus 0 mm (0 inch).
 2. Plus 6 mm (1/4 inch).

3.3 INSTALLATION GENERAL

- A. Keep finish work free from mortar smears or spatters, and leave neat and clean.
- B. Anchor masonry as specified in Paragraph, ANCHORAGE.
- C. Wall Openings:
 1. Fill hollow metal frames built into masonry walls and partitions solid with mortar as laying of masonry progresses.
 2. If items are not available when walls are built, prepare openings for subsequent installation.
- D. Tooling Joints:
 1. Do not tool until mortar has stiffened enough to retain thumb print when thumb is pressed against mortar.
 2. Tool while mortar is soft enough to be compressed into joints and not raked out.
 3. Finish joints in exterior face masonry work with a jointing tool, and provide smooth, water-tight concave joint unless specified otherwise.
 4. Tool Exposed interior joints in finish work concave unless specified otherwise.
- E. Lintels:
 1. Lintels are not required for openings less than 1,000 mm (3 feet 4 inches) wide that have hollow metal frames.
 2. Openings 610 mm (2 feet 0 inches) wide to 1600 mm (5 feet 4 inches) wide with no structural steel lintel or frames, require a lintel

- formed of concrete masonry lintel or bond beam units filled with grout per ASTM C476 and reinforced with 1- #15m (1-#5) rod top and bottom for each 100 mm (4 inches) of nominal thickness unless shown otherwise.
3. Use steel lintels, for openings over 1600 mm (5 feet 4 inches) wide, and brick masonry unless shown otherwise.
 4. Provide length for minimum bearing of 100 mm (4 inches) at ends.
- F. Before connecting new masonry with previously laid, remove loosened masonry or mortar, and clean and wet work in place as specified under wetting.
- G. When new masonry partitions start on existing floors, machine cut existing floor finish material down to concrete surface.
- H. Wetting and Wetting Test:
1. Test and wet brick in accordance with BIA 11B.
 2. Do not wet concrete masonry units before laying.

3.4 ANCHORAGE

- A. Veneer to Frame or Masonry Walls:
1. Use adjustable veneer anchors.
 2. Fasten anchor to stud through sheathing with self-drilling and tapping screw, one at each end of loop type anchor. In masonry backup stagger ties in alternate courses.
 3. Space anchors not more than 400 mm (16 inches) on center vertically at each stud or 600 mm (24 inches) maximum horizontally.

3.5 REINFORCEMENT

- A. Joint Reinforcement:
1. Use as joint reinforcement in CMU wythe of combination brick and CMU, cavity walls, and single wythe concrete masonry unit walls or partitions.
 2. Reinforcing may be used instead of individual ties for anchoring brick facing to CMU backup in exterior masonry walls.
 3. Brick veneer over frame backing walls does not require joint reinforcement.
- B. Steel Reinforcing Bars:
1. Install in cells of hollow masonry units where required for vertical reinforcement and in bond beam units for lintels and bond beam horizontal reinforcement. Install in wall cavities of reinforced masonry walls where shown.

3.6 BRICK EXPANSION AND CMU CONTROL JOINTS

- A. Provide brick expansion (BEJ) and CMU control (CJ) joints where shown on drawings.
- B. Keep joint free of mortar and other debris.
- C. Where joints occur in masonry walls:
 - 1. Install preformed compressible joint filler in brick wythe.
 - 2. Install cross shaped shear keys in concrete masonry unit wythe with preformed compressible joint filler on each side of shear key unless otherwise specified.
 - 3. Install filler, backer rod, and sealant on exposed faces.
- D. Use standard notched concrete masonry units (sash blocks) made in full and half-length units where shear keys are used to create a continuous vertical joint.
- E. Interrupt steel joint reinforcement at expansion and control joints unless otherwise shown.
- F. Fill opening in exposed face of expansion and control joints with sealant as specified in Section 07 92 00, JOINT SEALANTS.

3.8 BRICKWORK

- A. Lay clay brick in accordance with BIA Technical Note 11 series.
- B. Laying:
 - 1. Lay brick in running bond with course of masonry bonded at corners unless shown otherwise. Match bond of existing building on alterations and additions.
 - 2. Maintain bond pattern throughout.
 - 3. Do not use brick smaller than half-brick at any angle, corner, break or jamb.
 - 4. Where length of cut brick is greater than one half but less than a whole brick, maintain the vertical joint location of such units.
 - 5. Lay exposed brickwork joints symmetrical about center lines of openings.
 - 6. Before starting work, lay facing brick on foundation wall and adjust bond to openings, angles, and corners.
 - 7. Lay brick for sills with wash and drip.
 - 8. Build solid brickwork as required for anchorage of items.
- C. Joints:
 - 1. Exterior and interior joint widths: Lay for three equal joints in 200 mm (eight inches) vertically, unless shown otherwise.

2. Rake joints for pointing with colored mortar when colored mortar is not full depth.

D. Weep Holes:

1. Install weep holes at 600 mm (24 inches) on center in bottom of vertical joints of exterior masonry veneer or cavity wall facing over foundations, bond beams, and other water stops in the wall.
2. Form weep holes using wicks made of mineral fiber insulation strips turned up 200 mm (8 inches) in cavity. Anchor top of strip to backup to securely hold in place.

3.9 CONCRETE MASONRY UNITS

A. Kind and Users:

1. Provide special concrete masonry shapes as required, including lintel and bond beam units, sash units, and corner units. Use solid concrete masonry units, where full units cannot be used, or where needed for anchorage of accessories.
2. Provide solid load-bearing concrete masonry units or grout the cell of hollow units at jambs of openings in walls, where structural members impose loads directly on concrete masonry, and where shown.

B. Laying:

1. Lay concrete masonry units with 10 mm (3/8 inch) joints, with a bond overlap of not less than 1/4 of the unit length.
2. Do not wet concrete masonry units before laying.
3. Bond external corners of partitions by overlapping alternate courses.
4. Lay first course in a full mortar bed.
5. Set anchorage items as work progress.
6. Where ends of anchors, bolts, and other embedded items, project into voids of units, completely fill such voids with mortar or grout.
7. Provide a 6 mm (1/4 inch) open joint for caulking between existing construction, exterior walls, concrete work, and abutting masonry partitions.
8. Lay concrete masonry units with full face shell mortar beds and fill head joint beds for depth equivalent to face shell thickness.
9. Lay concrete masonry units so that cores of units, that are to be filled with grout, are vertically continuous with joints of cross webs of such cores completely filled with mortar.
10. Do not wedge the masonry against the steel reinforcing. Minimum 13 mm (1/2 inch) clear distance between reinforcing and masonry units.

11. Hold vertical steel reinforcement in place by centering clips, caging devices, tie wire, or other approved methods, vertically at spacing noted.
12. Grout cells of concrete masonry units, containing the reinforcing bars, solid as specified under grouting.

3.10 GROUTING

A. Preparation:

1. Clean grout space of mortar droppings before placing grout.
2. Close cleanouts.

B. Placing:

1. Consolidate each lift of grout after free water has disappeared but before plasticity is lost.
2. Interruptions: When grouting must be stopped for more than an hour, top off grout 40 mm (1-1/2 inch) below top of last masonry course.

3.11 PLACING REINFORCEMENT

- A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on the Contract Drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.
- B. Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 25 mm (1 inch), whichever is greater.
- C. Splice reinforcement bars where shown; do not splice at other places unless accepted by the RE/COR. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.
- D. Provide not less than minimum lap as indicated on shop drawings, or if not indicated, as required by governing code.
- E. Embed metal ties in mortar joints as work progresses, with a minimum mortar cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations.
- F. Embed prefabricated horizontal joint reinforcement as the work progresses, with a minimum cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations. Lap joint reinforcement not less than 150 mm (6 inches) at ends. Use

prefabricated "L" and "T" sections to provide continuity at corners and intersections. Cut and bend joint reinforcement as recommended by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

- G. Anchoring: Anchor reinforced masonry work to supporting structure as indicated.

3.12 CLEANING AND REPAIR

A. General:

1. Clean exposed masonry surfaces on completion.
2. Protect adjoining construction materials and landscaping during cleaning operations.
3. Cut out defective exposed new joints to depth of approximately 19 mm (3/4 inch) and repoint.
4. Remove mortar droppings and other foreign substances from wall surfaces.

B. Brickwork:

1. First wet surfaces with clean water; then wash down with a solution of soap-less detergent. Do not use muriatic acid.
2. Brush with stiff fiber brushes while washing, and immediately thereafter hose down with clean water.
3. Free clean surfaces of traces of detergent, foreign streaks, or stains of any nature.

C. Concrete Masonry Units:

1. Immediately following setting, brush exposed surfaces free of mortar or other foreign matter.
2. Allow mud to dry before brushing.

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**SECTION 04 43 00
NATURAL STONE VENEER**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies requirements for construction of natural stone veneer.

1.2 RELATED WORK

- B. Mortars and grouts: Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING.
- C. Sealants and sealant installation: Section 07 92 00, JOINT SEALANTS.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples:
1. Stone Veneer, sample, 200 mm by 400 mm (8 inches by 16 inches,) showing full color range and texture of stone, bond, and proposed mortar joints.
 2. Anchors, and ties, one each and joint reinforcing 1200 mm (48 inches) long.
- C. Certificates signed by stone source, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies; indicate that the stone veneer meets specification requirements.
- D. Manufacturer's Literature and Data:
1. Anchors, ties, and reinforcement.
 2. Reinforcing bars.

1.4 SAMPLE PANEL

- A. Before starting masonry, lay up a sample panel as specified:
1. Use stone units from random pallets of units delivered on site.
 2. Include reinforcing, ties, and anchors.
 3. Provide a 1.2m x 1.8m (4 feet x 5 feet) panel.
- B. Use sample panels approved by RE/COR for standard of workmanship of new masonry work.
- C. Use sample panel to test cleaning methods.

1.5 WARRANTY

- A. Warrant exterior masonry walls against moisture leaks and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period to be five years.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. American Society for Testing and Materials (ASTM):

A82/A82M-07	Steel Wire, Plain, for Concrete Reinforcement
A153/A153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A951/A951M-11	Steel Wire for Masonry Joint Reinforcement
C97/C97M-09	Absorption and Bulk Gravity of Dimension Stone
C99/C99M-09	Modulus of Rupture of Dimension Stone
C119-11	Standard Terminology Relating to Dimension Stone
C170/C170M-09	Compressive Strength of Dimension Stone
C568/C568M-10	Limestone Dimension Stone
C615/C615M-11	Granite Dimension Stone
C616/C616M-10	Quartz-Based Dimension Stone
C880/C880M-09	Flexural Strength of Dimension Stone
C1242-12a ¹	Selection, Design, and Installation of Dimension Stone Attachment Systems
C1353-09	Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform, Double-Head Abraser
C1515-11	Cleaning of Exterior Dimension Stone, Vertical and Horizontal Surfaces, New or Existing
C1528-12b	Selection of Dimension Stone
D1056-07	Flexible Cellular Materials - Sponge Expanded Rubber
D7089-06	Determination of the Effectiveness of Anti-Graffiti Coating for Use on Concrete, Masonry, and Natural Stone Surfaces by Pressure Washing

C. Masonry Industry Council:

All Weather Masonry Construction Manual, 2000

D. International Masonry Industry All Weather Council (IMIAC):

Recommended Practices and Guide Specification for Cold Weather Masonry Construction

1.7 PRE-INSTALLATION CONFERENCE

- A. Convene a meeting on site, after submittals are received and approved but before any work, to review drawings and specifications, submittals, schedule, manufacturer instructions, site logistics and pertinent matters of coordination, temporary protection, governing regulations, tests and inspections; participants to include RE/COR and all parties whose work is effected or related to the work of this section.

PART 2 - PRODUCTS**2.1 ACCEPTABLE STONE PRODUCTS**

- A. Limestone Veneer: Meet ASTM C568, Classification: II Medium-Density.
 - 1. Face Size: As indicated.
 - 2. Color Range, finish, producer.
- B. Granite Veneer: Meet ASTM C615.
 - 1. Face Size: As indicated.
 - 2. Color Range, finish, producer.

2.2 REINFORCEMENT AND ANCHORAGES

- A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply paragraphs below, unless otherwise indicated.
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82; with ASTM A153/153M, Class B-2 coating.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but at least 16mm (5/8 inch) cover on outside face. Outer ends of wires are bent 90 degrees and extend 50 mm (2 inches) parallel to face of veneer.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 100 mm (4 inches).
 - 1. Where withes do not align or are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 32 mm (1-1/4 inches).
 - 2. Wire: Fabricate from 4.8 mm (3/16 inch) diameter, hot-dip galvanized steel wire. Mill-galvanized wire ties may be used in interior walls, unless otherwise indicated.
 - 3. Basis of Design for Acceptable Product: Heckman Building Products, Inc.; No. 262.
- D. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a 445 N (100 lbf) load in both tension and compression without deforming or developing play in excess of 1.3 mm (0.05 inch).
2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
 - a. Anchor Section: Zinc-alloy barrel section with flanged head with eye and corrosion-resistant, self-drilling screw. Eye designed to receive wire tie and to serve as head for drilling fastener into framing. Barrel length to suit sheathing thickness, allowing screw to seat directly against framing with flanged head covering hole in sheathing.
 - b. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 4.8 mm (0.188 inch) diameter, hot-dip galvanized steel wire.
 - c. Acceptable Product: Heckmann Building Products, Inc.; No. 75 Pos-I-Tie.

2.3 ACCESSORIES

- A. Joint Sealant: Refer to Section 07 92 00.
- B. Nailing Strips: Western softwood, preservative treated, sized to masonry joints.
- C. Weep Holes: Leave-out of full head mortar joints.
- D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 1. Strips, full-depth of cavity and 250 mm (10 inches) wide, with dovetail shaped notches 175 mm (7 inches) deep that prevent mesh from being clogged with mortar droppings.
- E. Mortar: Refer to Section 04 05 13.
- F. Expansion Joint Fillers: ASTM D1056 Class RE-11.
- G. Cementitious Dampproofing: Cementitious formulation nonstaining to stone; compatible with joint sealants and noncorrosive to anchors and attachments.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

- B. Verify items provided by other Sections of work are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.
- D. Beginning of installation means installer accepts existing conditions.

3.2 PREPARATION

- A. Verify items provided by other Sections of work are properly sized and located.
- B. Establish lines, levels, and coursing; protect from disturbance.
- C. Provide temporary bracing during erection of masonry work. Maintain in place until building structure provides permanent bracing.
- D. Scaffolding: Provide, erect, maintain, move, and finally remove scaffolding and staging required for masonry installation. Construct and maintain scaffolding in compliance with applicable ordinances, laws, rules and regulations. Scaffolding must be sufficiently substantial to support workmen, and necessary materials and equipment. Provide adequate guard rails for protection of property, workmen, and passerby.
- E. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
- F. Coat stone with dampproofing to extent indicated below:
 - 1. Stone at Grade: Beds, joints, and back surfaces to at least 12 inches above finish-grade elevations.
 - 2. Stone Extending Below Grade: Beds, joints, back surfaces, and face surfaces below grade.
 - 3. Allow dampproofing to cure before setting dampproofed stone. Do not damage or remove dampproofing while handling and setting stone.

3.3 COURSING

- A. Place masonry to lines and level indicated.
- B. Arrange and trim stones for adequate fit in a range ashlar Pattern with course heights as indicated, random lengths, uniform joint widths with offset between vertical joints as indicated.

3.4 PLACING AND BONDING

- A. Lay masonry in full bed of mortar (horizontal, vertical, and collar joints), properly jointed with other work. Buttering corners of joints and deep or excessive furrowing of mortar joints is not permitted.
- B. Fully bond intersections, and external and internal corners.
- C. Do not shift, or tap masonry units after mortar has taken initial set. Where adjustment must be made, remove mortar and replace.
- D. Remove excess mortar on surface and in cavities.
- E. Perform job site saw cutting with proper tools to provide straight unchipped edges. Take care to prevent breaking masonry unit corners or edges.

3.5 TOLERANCES

- A. Alignment of Columns: Maximum of 6 mm (1/4 inch) from true line.
- B. Variation from Unit to Adjacent Unit: 0.8 mm (1/32 inch) maximum.
- C. Variation from Plane of Wall: 6 mm (1/4 inch) in 3 m (10 feet) and 12 mm (1/2 inch) in 6 m (20 feet) or more.
- D. Variation from Plumb: 6 mm (1/4 inch) per story non-cumulative, 12 mm (1/2 inch) in two stories or more.
- E. Variation from Level Coursing: 3 mm (1/8 inch) in 1 m (3 feet); 6 mm (1/4 inch) in 3 m (10 feet); 6 mm (1/4 inch) maximum.
- F. Variation of Joint Thickness: 3 mm (1/8 inch) in 1 m (3 feet).
- G. Maximum variation from Cross Sectional Thickness of Walls: Plus or minus 6 mm (1/4 inch).

3.6 REINFORCEMENT AND ANCHORAGES

- A. Attach wall ties to wall studs (or other solid and secure framing members) for veneer construction at maximum 400 mm (16 inches) oc vertically and 400 mm (16 inches) oc horizontally. Place at maximum 200 mm (8 inches) oc (or every third course) each way around perimeter of openings, within 300 mm (12 inches) of openings.
- B. Anchor stone veneer to unit masonry with metal veneer anchors as follows:
 - 1. Secure wire anchors by inserting pintles into eyes of masonry wall reinforcement projecting from horizontal mortar joints.
 - 2. Embed anchors in veneer mortar joints to within 25 mm (1 inch) of face.

3.7 MASONRY FLASHINGS

- A. Extend flashings to exterior face of veneer, turn up a minimum of 200 mm (8 inches) and seal onto face of sheathing over stud framed back-up.

- B. Lap end joints minimum 150 mm (6 inches) and seal watertight per manufacturer's recommendation.
- C. Use flashing manufacturer's recommended adhesive and termination sealant.
- D. Create end dams at end of window heads, and other vertical elements to channel water to nearest weep hole away from windows and other items which might allow water to travel vertically.

3.8 LINTELS

- A. Install loose steel lintels as scheduled or shown. Leave space at end of lintels to expand.

3.9 WEEPS AND VENTS

- A. Install weep holes in veneer at 600 mm (24 inches) on center horizontally above through-wall flashing, above shelf angles, and at bottom of walls.

3.10 CONTROL/EXPANSION JOINTS

- A. Size control joints in accordance with Section 07 92 00 for sealant performance, but in no case larger than adjacent mortar joints.
- B. Provide expansion joints as indicated.

3.11 BUILT-IN WORK

- A. As work progresses, build-in metal door frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates, and other items to be built in the work supplied by other Sections.
- B. Build-in items plumb and level.
- C. Bed anchors of metal door and glazed frames in mortar joints. Fill frame voids solid with mortar.
- D. Do not build-in organic materials subject to deterioration.

3.12 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Cooperate with other Sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting any area not indicated or where appearance or strength of masonry work may be impaired.

3.13 CLEANING

- A. Remove excess mortar and smears.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with non-acidic solution which will not harm masonry or adjacent materials. Consult masonry manufacturer for

acceptable cleaners. Leave surfaces thoroughly clean and free of all mortar and other soiling.

D. Use non-metallic tools in cleaning operations.

E. Comply with ASTM C1515 and D7089.

3.14 PROTECTION

A. Maintain protective boards at exposed external corners which may be damaged by construction activities.

B. Provide protection without damaging completed work.

C. Keep expansion joint voids clear of mortar.

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**SECTION 04 72 00
CAST STONE MASONRY**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies concrete building units manufactured and installed to simulate natural cut stone. Cast Stone is made from fine and coarse aggregates, Portland cement, mineral oxide color pigments, chemical admixtures and water to simulate a natural stone.
- B. Unless specifically indicated otherwise, cast stone provided for this project is to be wet-cast type.

1.2 RELATED WORK

- A. Setting and Pointing Mortar: Section 04 05 13, MASONRY MORTARING / Section 04 05 16, MASONRY GROUTING.
- B. Joint Sealant and Application: Section 07 92 00, JOINT SEALANTS.

1.3 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
 - 1. Provide cast stone sample panel, minimum size 100 by 300 by 300 mm (4 by 12 by 12 inches), for each color and each finish.
 - 2. Show finish on two 100 mm (4 inch) edges and 300 by 300 mm (12 by 12 inch) surface.
 - 3. For caps, samples must demonstrate the color and finish for all exposed surfaces; include samples of edges and drip slots.
- C. Shop Drawings:
 - 1. Cast stone showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing and sizes.
 - 2. For any caps, the approved shop drawings must indicate which surfaces will be exposed in the final installation.
 - 3. For caps, all exposed surfaces to be identified and manufactured as finished surfaces, including the overhang and the drip slots where caps overhang the precast concrete niche units or other elements.
 - 4. Setting drawings with setting mark.
 - 5. Lifting Devices:

- a. Submit design details for lifting devices (not straps or slings) that will support the pieces at vertical lifting points using protective pads of materials that won't damage the stone.
- b. Lifting devices are required for all cap stones.
- c. Design lifting devices that function to safely lift cap stones by contacting the stones on the bottom finished edges, where the drip slots are located, so the units can be set into position without causing any marking or damage to the stones.
- D. Certificates: Test results indicating that the cast stone meets specification requirements and proof of plant certification; certification documents must be current within one year of preconstruction meeting.
- E. Submit manufacturers test results of cast stone previously made by manufacturer, indicating compliance with ASTM C1364.
- F. Laboratory Qualifications: Description of testing laboratories facilities and qualifications of its principals and key personnel.
- G. List of jobs furnished by the manufacturer, which were similar in scope and at least three (3) years of age.
- H. Installer Qualifications: Provide documentation of requirements specified herein.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Store cast stone under waterproof covers on planking clear of ground.
- B. Protect from handling, dirt, stain, and water damage.
- C. Mark production units with the identification marks as shown on the shop drawings.
- D. Package units and protect them from staining or damage during shipping and storage.
- E. Provide packaging and lifting devices from the manufacturer that are designed to permit the installer easy removal for inspection, or to handle the cast stone for installation without causing damage to the units.
- F. Provide an itemized list of product to support the bill of lading.

1.6 WARRANTY

- A. Warranty exterior masonry walls against moisture leaks, any defects and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period to be two years.

1.7 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. American Concrete Institute (ACI):

318/318M-11	Building Code Requirements for Structural Concrete and Commentary
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C. Architectural Precast Association; certification program.

D. American Society for Testing and Materials (ASTM):

A167-99(2009)	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
A185/A185M-07	Steel, Welded Wire Reinforcement, Plain, for Concrete
A240/A240M-13a	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
A276-13	Stainless Steel Bars and Shapes
A615/A615M-12	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A666	Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
C33/C33M-13	Concrete Aggregates
C150/C150M-12	Portland Cement
C260/C260M-10a	Air-Entraining Admixtures for Concrete
C426-10	Linear Drying Shrinkage of Concrete Masonry Units
C494/C494M-13	Chemical Admixtures for Concrete
C503/C503M-10	Marble Dimension Stone
C568/C568M-10	Limestone Dimension Stone
C615/C615M-11	Granite Dimension Stone
C616/C616M-10	Quartz-Based Dimension Stone
C618-12a	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
C979/C979M-10	Pigments for Integrally Colored Concrete
C989/C989M-13	Slag Cement for Use in Concrete and Mortars
C1194-03(2011)	Compressive Strength of Architectural Cast Stone

C1195-03(2011)	Absorption of Architectural Cast Stone
C1364-10b	Architectural Cast Stone
D2244-11	Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

E. Cast Stone Institute Technical Manual and Cast Stone Institute standard specifications.

1.8 QUALITY ASSURANCE

A. Manufacturer:

1. Must have five years minimum continuous operating experience, and have facilities for producing cast stone of the shapes, quantities and size required for this project.
2. Must be a producer certified by the Cast Stone Institute or the Architectural Precast Association.
3. Producer assumes responsibility for engineering units to comply with performance requirements and use indicated, including a comprehensive engineering analysis by a qualified professional engineer who is licensed in their place of practice and who is experienced in providing engineering services of the kind indicated.
4. Shop drawings to bear seal and signature of professional engineer responsible for the design and preparation.

B. Installer:

1. Must provide documentation demonstrating that they have a minimum of five years' experience setting cast or natural building stone.
2. Provide written handling and installation procedures that will be followed for the installation of the work for cast stones lifted, moved, adjusted in any way, other than by hand. Describe procedure starting at the inspection of the products once delivered to the site, and continue through the final setting of the cast stone units with them being secured into place in the work. Include procedures with description of the equipment that will be used, as well as all protection procedures to be followed, to ensure that no exposed surfaces or edges of the cast stone are damaged during handling or installation.
3. Provide written procedures for removal and replacement of cast stone units that have been damaged on any edges or faces that will be visible in the final installation, including drip slots.

4. Provide procedures for inspection and identification of any exposed damage, with procedures for immediate marking of the units to be removed and replaced prior to grouting or sealing of joints.

C. Testing:

1. Follow the procedures in ASTM C1364.
2. One (1) sample from production units may be selected at random from the field for each 14 m³ (500 cubic feet) delivered to the job:
 - a. Three (3) field cut cube specimens from each of these sample to have an average minimum compressive strength of not less than 85 percent with no single specimen testing less than 75 percent of design strength as specified.
 - b. Three (3) field cut cube specimens from each of these samples to have an average maximum cold-water absorption of 6 percent.
 - c. Test field specimens in accordance with ASTM C1194 and C1195.
 - d. Manufacturer to submit a written list of projects similar and at least three (3) years of age, along with owner, architect and contractor references.

- D. Pre-Installation Conference: Convene a meeting on site, after submittals are received and approved but before any work, to review drawings and specifications, submittals, schedule, manufacturer instructions, site logistics and pertinent matters of coordination, temporary protection, governing regulations, tests and inspections; participants to include RE/COR and all parties whose work is effected or related to the work of this section.

1.9 MANUFACTURING TOLERANCES

- A. Cross section dimensions must not deviate by more than + 3 mm (1/8 in.) from approved dimension.
- B. Length of units must not deviate by more than length 3 mm (/360 or + 1/8 in.), whichever is greater, not to exceed 6 mm (+ 1/4 in.) Maximum length of any unit must not exceed 15 times the average thickness of such unit unless otherwise agreed by the manufacturer.
- C. Warp bow or twist of units must not exceed length 3 mm (/360 or + 1/8 in.), whichever is greater.
- D. Location of dowel holes, anchor slots, flashing grooves, false joints and similar features - On formed sides of unit, 3 mm (1/8 in.), on unformed sides of unit, 9 mm (3/8 in.) maximum deviation.

1.11 PROJECT CONDITIONS

- A. Field Measurements: Verify actual conditions to receive cast stone components by field measurements before production.
- B. Dimensions on shop drawings to be based upon field measurements.

PART 2 - PRODUCTS**2.1 ARCHITECTURAL CAST STONE**

- A. Comply with ASTM C1364.
- B. Physical Properties: Provide the following:
 - 1. Compressive Strength - ASTM C1194: 45 Mpa (6,500 psi) minimum for products at 28 days.
 - 2. Absorption - ASTM C1195: 6 percent maximum by the cold water method, or 10 percent maximum by the boiling method for products as 28 days.
 - 3. Air Content for Wet Cast Product - ASTM C173 or C231: 4-8 percent for units exposed to freeze-thaw environments.
 - 4. Freeze Thaw - ASTM C1364: The cumulative percent weight loss (CPWL) less than 5 percent after 300 cycles of freezing and thawing.
 - 5. Linear Shrinkage - ASTM C426: Maximum 0.065 percent.
- C. Job Site Testing - One (1) sample from production units may be selected at random from the field for each 14m³ (500 cubic feet) delivered to the job site:
 - 1. Three (3) field cut cube specimens from each of these samples must have an average minimum compressive strength of not less than 85 percent with no single specimen testing less than 75 percent of design strength as allowed by ACI 318.
 - 2. Three (3) field cut cube specimens from each of these samples must have an average maximum cold-water absorption of 6 percent.
 - 3. Test field specimens in accordance with ASTM C1194 and C1195.

2.2 RAW MATERIALS

- A. Portland Cement: Type I or Type III, white and/or grey, ASTM C150.
- B. Coarse Aggregates: Granite, quartz or limestone, ASTM C33, except for gradation, and are optional for the vibrant dry tamp (VDT) casting method.
- C. Fine Aggregates: Manufactured or natural sands, ASTM C33, except for gradation.
- D. Colors: Inorganic iron oxide pigments, ASTM C979 except that carbon black pigments cannot be used.
- E. Admixtures: Comply with the following:
 - 1. ASTM C260 for air-entraining admixtures.

2. ASTM C494/C495M Types A-G for water reducing, retarding, accelerating and high range admixtures.
3. Other Admixtures: Integral water repellents and other chemicals, for which no ASTM Standard exists, must be previously established as suitable for use in concrete by proven field performance or through laboratory testing.
 - a. Produce units with water repellent accepted by fabricator within mix design; product for mix design and setting mortar to be from same source.
4. ASTM C618; do not use mineral admixtures of dark and variable colors in surfaces intended to be exposed to view.
5. ASTM C989; granulated blast furnace slag may be used to improve physical properties, as verified by testing documentation.

F. Water: Potable.

G. Reinforcing Bars:

1. ASTM A615/A615M, Grade 40 or 60 steel galvanized or epoxy coated when cover is less than 37 mm (1.5 in.).
2. Welded Wire Fabric: ASTM A185 where applicable for wet cast units.

H. Provide anchors, dowels and other anchoring devices and shims that are standard building stone anchors commercially available in a non-corrosive material such as zinc plated, galvanized steel, brass, or stainless steel Type 302 or 304.

2.3 COLOR AND FINISH

- A. Provide fine-grained texture similar to natural stone, for surfaces intended to be exposed to view. Air voids are not permitted in excess of 0.8 mm (1/32 in.), and the density of such voids must be less than 3 occurrences per any 25 mm² (1 in²). Air voids are not permitted when obvious under direct daylight illumination at a 1.5 m (5 ft.) distance.
- B. Units must exhibit a texture of no less quality than the approved sample when viewed under direct daylight illumination at a 3 m (10 ft.) distance.
- C. Units to comply with ASTM D2244 permissible variation in color between units of comparable age subjected to similar weathering exposure.
 1. Total color difference - not greater than 6 units.
 2. Total hue difference-not greater than 2 units.
- D. Chipping on edges or surfaces of caps, where they will be visible in the final installation, whether resulting from shipment, delivery or other factors or causes is not acceptable, and the units must be

removed and replaced with new units. For units, other than caps, minor chips may be allowed if they are not obvious under direct daylight illumination from a 1 m (3 ft.) distance as determined by the RE/COR.//

- F. The occurrence of crazing or efflorescence may constitute a cause for rejection, at the sole discretion of the RE/COR.
- G. Remove cement film, if required, from exposed surface prior to packaging for shipment.

2.4 REINFORCING

- A. Reinforce the units as required by the shop drawings, and prepared under direction of professional engineer, for safe handling and structural stress. For wall caps, include adequate reinforcing to prevent the caps from breaking when supported by shims at the ends of the units, and having workers on top of the units.
 - 1. Reinforcing to be minimum 0.25 percent of the cross section area.
- B. Provide non-corrosive reinforcement where faces exposed to weather are covered with less than 38 mm (1.5 in.) of concrete material. Provide reinforcement with minimum concrete coverage of twice the diameter of the bars.

2.5 EMBEDDED ANCHORS AND OTHER INSERTS

- A. Fabricate from stainless steel complying with ASTM A240/A240M, ASTM A276, or ASTM A666, Type 304.

2.6 CURING

- A. Cure units in a warm curing chamber 537.8 C (1000 F) at 95 percent relative humidity for approximately 12 hours, or cure in a 95 percent moist environment at a minimum 371.1 C (700 F) for 16 hours after casting. Provide additional yard curing at 95 percent relative humidity and 350-degree-days (i.e. 7 days at 260.0 C (500 F) or 5 days at 371.1 C (700 F) prior to shipping. Protect form-cured units from moisture evaporation with curing blankets or curing compounds after casting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Check cast stone materials for damage, coloration, finish, crazing, efflorescence, fit and finish prior to installation. Do not set unacceptable units.

3.2 SETTING TOLERANCES

- A. Comply with the more stringent tolerances of the Cast Stone InstituteSM Technical Manual or this section.
- B. Set stones 3 mm (1/8 in.) or less, within the plane of adjacent units.

C. Joints, plus - 1.5 mm (1/6 in.), minus - 3 mm (1/8 in.).

3.3 JOINTING

A. Joint Size:

1. At stone/brick joints 9.5 mm (3/8 in.).
2. At stone/stone joints in vertical position 6 mm (1/4 in.).
3. Stone/stone joint exposed on top 9.5 mm (3/8 in.).

B. Joint Materials:

1. Mortar, Type N, ASTM C270.
2. Use a full bed of mortar at all bed joints.
3. Flush vertical joints full with mortar.
4. Leave all joints with exposed tops or under relieving angles open for sealant.
5. Leave head joints in coping and projecting components open for sealant.

C. Location of Joints:

1. As shown on shop drawings.
2. At control and expansion joints unless otherwise shown.

3.4 SETTING

A. Mortar Bed Setting:

1. Drench units with clean water prior to setting.
2. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.
3. Set units in full bed of mortar containing water repellant, unless otherwise detailed.
4. Rake mortar joints 18 mm (3/4 in.) for pointing.
5. Remove excess mortar from unit faces immediately after setting.
6. Tuck point unit joints to a slight concave profile.

B. Shim Setting:

1. Set each piece on shims as indicated, minimum of two for each piece and four for each cap piece.
2. Set shims where located on the shop drawings.
 - a. Caps on Precast Niche Units:
 - 1) Place shims directly above the vertical webs below, where the web is not abutting an open ended unit.
 - 2) Install shims one full web back from any open ended joint in the precast niche units (approximately 12 inches back from the open ended joint).

- b. Install shims on cast-in-place concrete or filled CMU as indicated on the shop drawings.
- 3. Furnish and install cap supporting non-shrink grout as part of the shim type of cap installation, with the supporting non-shrink grout being installed as indicated on the shop drawings, only at locations that are directly over vertical webs below.

3.5 JOINT PROTECTION

- A. Comply with requirements of Section 07 92 00, JOINT SEALANTS.
- B. Prime ends of units, insert properly sized backing rod at the correct depth and install required sealant.

3.6 REPAIR AND CLEANING

- A. Repair chips with touchup materials furnished by manufacturer.
- B. Saturate units to be cleaned prior to applying an approved masonry cleaner.
- C. Consult with manufacturer for appropriate cleaners.

3.7 INSPECTION AND ACCEPTANCE

- A. Inspect finished installation according to Bulletin #36 published by the Cast Stone Institute except distance for measuring acceptability to be reduced to 1 m (3 ft.).

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**SECTION 07 92 00
JOINT SEALANTS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section covers all sealant and caulking materials and their application, wherever required for complete installation of building materials or systems.

1.2 RELATED WORK

1.3 QUALITY CONTROL

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.
1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
 3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.
 4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
 5. Determine sealants will not stain joint substrates according to ASTM C1248.
- D. Meet VOC requirements of pertinent CARB and/or SCAQMD Rule for sealants VOC (4 percent by weight VOC or less in less than 16 ounce package or less than 250 g/L in larger package). All non-porous sealant primers must be below 250g/L and primers for porous substrates less than 775 g/L.

1.4 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements.
- B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit <http://www.biopreferred.gov>.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's installation instructions for each product used.
- C. Cured samples of exposed sealants for each color where required to match adjacent material.
- D. Manufacturer's Literature and Data:
 - 1. Caulking compound.
 - 2. Primers.
 - 3. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

1.6 PRE-INSTALLATION CONFERENCE

- A. Convene a meeting on site, after submittals are received and approved but before any work, to review drawings and specifications, submittals, schedule, manufacturer instructions, site logistics and pertinent matters of coordination, temporary protection, governing regulations, tests and inspections; participants to include RE/COR and all parties whose work is effected or related to the work of this section.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not proceed with installation of joint sealants under following conditions:
 - a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 °C (40 °F).
 - b. When joint substrates are wet.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 DELIVERY, HANDLING, AND STORAGE

- A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.
- B. Carefully handle and store to prevent inclusion of foreign materials.
- C. Do not subject to sustained temperatures less than 5° C (40° F) or exceeding 32° C (90° F).

1.9 DEFINITIONS

- A. Definitions of terms in accordance with ASTM C717 and as specified.
- B. Back-up Rod: A type of sealant backing.
- C. Bond Breakers: A type of sealant backing.
- D. Filler: A sealant backing used behind a back-up rod.

1.10 WARRANTY

- A. Warranty exterior sealing against leaks, adhesion, and cohesive failure, and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period to be extended to five (5) years.
- B. General Warranty: Special warranty specified in this Article will not deprive Government of other rights Government may have under other provisions of Contract Documents and are in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

1.11 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Society for Testing and Materials (ASTM):

C612-10	Mineral Fiber Block and Board Thermal Insulation
C717-12b	Standard Terminology of Building Seals and Sealants
C734-06(2012)	Low Temperature Flexibility of Latex Sealants after Artificial Weathering
C834-10	Latex Sealants

C919-12	Use of Sealants in Acoustical Applications
C920-11	Elastomeric Joint Sealants
C1021-08	Laboratories Engaged in Testing of Building Sealants
C1193-13	Use of Joint Sealants
C1248-08(2012)	Staining of Porous Substrate by Joint Sealants
C1330-02(2013)	Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants
D217-10	Cone Penetration of Lubricating Grease
D1056-07	Flexible Cellular Materials—Sponge or Expanded Rubber
E84-12c	Surface Burning Characteristics of Building Materials

C. California Air Resources Board (CARB)

D. South Coast Air Quality Management District (SCAQMD)

E. Sealant, Waterproofing and Restoration Institute (SWRI):
The Professionals' Guide

PART 2 - PRODUCTS

2.1 SEALANTS

A. S-1:

1. ASTM C920, polyurethane.
2. Type M.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 20-40.

B. S-2:

1. ASTM C920, polyurethane.
2. Type M.
3. Class 25.
4. Grade P.
5. Shore A hardness of 25-40.

C. S-3:

1. ASTM C920, polyurethane.
2. Type S.
3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-25.
6. Minimum elongation of 700 percent.

D. S-4:

1. ASTM C920 polyurethane.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-40.

E. S-5:

1. ASTM C920, polyurethane.
2. Type S.
3. Class 25.
4. Grade P.
5. Shore hardness of 15-45.

F. S-6:

1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class: Joint movement range of plus 100 percent to minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-20.

G. S-7:

1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Structural glazing application.

H. S-8:

1. ASTM C920, silicone, acetoxycure.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Structural glazing application.

I. S-9:

1. ASTM C920 silicone.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.

6. Non-yellowing, mildew resistant.

J. S-10:

1. ASTM C920, coal tar extended fuel resistance polyurethane.
2. Type M/S.
3. Class 25.
4. Grade P/NS.
5. Shore A hardness of 15-20.

K. S-11:

1. ASTM C920 polyurethane.
2. Type M/S.
3. Class 25.
4. Grade P/NS.
5. Shore A hardness of 35 to 50.

L. S-12:

1. ASTM C920, polyurethane.
2. Type M/S.
3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade P/NS.
5. Shore A hardness of 25 to 50.

2.2 CAULKING COMPOUND

- A. C-1: ASTM C834, acrylic latex.
- B. C-2: Polymer-based acoustical sealant conforming to ASTM C919 must have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84. Acoustical sealant must have a consistency of 250 to 310 when tested in accordance with ASTM D217, and must remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C734, and must be non-staining.

2.3 COLOR

- A. Match color of mortar joints at exposed masonry.
- B. Match color of adjacent concrete at unpainted concrete.
- C. Provide light gray or aluminum, unless specified otherwise, for other locations.
- D. Provide light gray or white caulking, unless specified otherwise.

2.4 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

- B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32° C (minus 26° F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 FILLER

- A. Mineral fiber board: ASTM C612, Type IVA.
- B. Thickness same as joint width.
- C. Depth to fill void completely behind back-up rod.

2.6 PRIMER

- A. As recommended by manufacturer of caulking or sealant material.
- B. Stain free type.

2.7 CLEANERS-NON POUROUS SURFACES

- A. Chemical cleaners acceptable to manufacturer of sealants and sealant backing material, free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.
- B. Coordinate for repair and resolution of unsound substrate materials.
- C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

3.2 PREPARATIONS

- A. Prepare joints in accordance with manufacturer's instructions and as specified only when installers are ready to initiate sealant

application as soon as practicable after preparation and before subsequent surface deterioration.

- B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
 - 1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
 - 2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- C. Do not cut or damage joint edges.
- D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.
 - 1. Apply primer prior to installation of back-up rod or bond breaker tape.
 - 2. Use brush or other approved means that will reach all parts of joints.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

3.3 BACKING INSTALLATION

- A. Install back-up material, to form joints enclosed on three sides as required for specified depth of sealant.
- B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.
- C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.
- D. Install back-up rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.
- E. Where space for back-up rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

3.4 SEALANT DEPTHS AND GEOMETRY

- A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.
- B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

3.5 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written installation instructions for products and applications indicated.
- B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.
- C. Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.
 - 1. Apply a 6 mm (1/4 inch) minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
 - 2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
 - 3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.

4. Openings: Apply a 6 mm (1/4 inch) bead of sealant around all cut-outs to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

3.6 CLEANING

- A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by the caulking or sealant manufacturer.
- B. After filling and finishing joints, remove masking tape.
- C. Leave adjacent surfaces in a clean and unstained condition.

3.7 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.8 LOCATIONS

- A. Exterior Building Joints, Horizontal and Vertical:
 1. Metal to Metal: Type S-6, S-7.
 2. Metal to Masonry or Stone: Type S-1.
 3. Masonry to Masonry or Stone: Type S-1.
 4. Stone to Stone: Type S-1.
 5. Cast Stone to Cast Stone: Type S-1.
 6. Threshold Setting Bed: Type S-1, S-3, S-4.
 7. Masonry Expansion and Control Joints: Type S-6.
 8. Wood to Masonry: Type S-1.
- B. Metal Reglets and Flashings:
 1. Flashings to Wall: Type S-6.
 2. Metal to Metal: Type S-6.
- C. Sanitary Joints:
 1. Walls to Plumbing Fixtures: Type S-9.
 2. Counter Tops to Walls: Type S-9.
 3. Pipe Penetrations: Type S-9.
- D. Horizontal Traffic Joints:

1. Concrete Paving, Unit Pavers: Type S-11 or S-12.

E. Interior Caulking:

1. Typical Narrow Joint 6 mm, (1/4 inch) or less at Walls and Adjacent Components: Types C-1, C-2 and C-3.
2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Types C-1, C-2 and C-3.
3. Joints at Masonry Walls and Columns, Piers, Concrete Walls or Exterior Walls: Types C-1, C-2 and C-3.
4. Exposed Isolation Joints at Top of Full Height Walls: Types C-1, C-2 and C-3.
5. Exposed Acoustical Joint at Sound Rated Partitions: Type C-2.
6. Concealed Acoustic Sealant Type: S-4, C-1, C-2 and C-3.

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**SECTION 09 91 00
PAINTING**

PART 1-GENERAL

1.1 DESCRIPTION

- A. Section specifies field painting.
- B. Section specifies prime coats which may be applied in shop under other sections.
- C. Painting includes shellacs, stains, varnishes, and coatings specified.

1.2 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements.
- B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit <http://www.biopreferred.gov>.

1.3 REGULATORY REQUIREMENTS FOR RECYCLED CONTENT

- A. Products and Materials with Post-Consumer Content and Recovered Materials Content:
 - 1. Contractor is obligated by contract to satisfy Federal mandates for procurement of products and materials meeting recommendations for post-consumer content and recovered materials content; the list of designated product categories with recommendations has been compiled by the EPA - refer to <http://www.epa.gov/wastes/conservation/tools/cpg/products/>.
 - 2. Materials or products specified by this section may be obligated to satisfy this Federal mandate and Comprehensive Procurement Guidelines program.
 - 3. The EPA website also provides tools such as a Product Supplier Directory search engine and product resource guides.
- B. Fulfillment of regulatory requirements does not relieve the Contractor of satisfying sustainability requirements stipulated by Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS, as it relates to recycled content; additional product and material selections with recycled content may be required, as determined by Contractor's Sustainability Action Plan.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Before work is started, or sample panels are prepared, submit manufacturer's literature, the current Master Painters Institute (MPI) "Approved Product List" indicating brand label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.
- C. Samples:
 - 1. After painters' materials have been approved and before work is started submit samples showing each type of finish and color specified.
 - 2. Samples to show color: Composition board, 150 by 150 (6 inch by 6 inch).
 - 3. Panel to show transparent finishes: Wood of same species and grain pattern as wood approved for use, 100 by 250 by 3 mm (4 inch by 10 inch face by 1/4 inch) thick minimum, and where both flat and edge grain will be exposed, 250 mm (10 inches) long by sufficient size, 50 by 50 mm (2 by 2 inch) minimum or actual wood member to show complete finish.
- D. Manufacturers' Certificates indicating compliance with specified requirements:
 - 1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.
 - 2. High temperature aluminum paint.
 - 3. Epoxy coating.
 - 4. Intumescent clear coating or fire retardant paint.
 - 5. Plastic floor coating.

1.5 DELIVERY AND STORAGE

- A. Deliver materials to site in manufacturer's sealed container marked to show following:

1. Name of manufacturer.
 2. Product type.
 3. Batch number.
 4. Instructions for use.
 5. Safety precautions.
- B. In addition to manufacturer's label, provide a label legibly printed as following:
1. Federal Specification Number, where applicable, and name of material.
 2. Surface upon which material is to be applied.
 3. If paint or other coating, state coat types; prime, body or finish.
- C. Maintain space for storage, and handling of painting materials and equipment in a neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.
- D. Store materials at site at least 24 hours before using, at a temperature between 18 and 30 degrees C (65 and 85 degrees F).

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. American Conference of Governmental Industrial Hygienists (ACGIH):
- | | |
|---------------------|---|
| ACGIH TLV-BKLT-2009 | Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs) |
| ACGIH TLV-DOC-2009 | Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition) |
- C. Master Painters Institute (MPI):
- | | |
|-----------|--|
| No. 4-13 | Interior/ Exterior Latex Block Filler |
| No. 5-13 | Exterior Alkyd Wood Primer |
| No. 7-13 | Exterior Oil Wood Primer |
| No. 8-13 | Exterior Alkyd, Flat MPI Gloss Level 1 (EO) |
| No. 9-13 | Exterior Alkyd Enamel MPI Gloss Level 6 (EO) |
| No. 10-13 | Exterior Latex, Flat (AE) |
| No. 11-13 | Exterior Latex, Semi-Gloss (AE) |
| No. 31-13 | Polyurethane, Moisture Cured, Clear Gloss (PV) |
| No. 36-13 | Knot Sealer |
| No. 43-13 | Interior Satin Latex, MPI Gloss Level 4 |

No. 44-13	Interior Low Sheen Latex, MPI Gloss Level 2
No. 45-13	Interior Primer Sealer
No. 46-13	Interior Enamel Undercoat
No. 47-13	Interior Alkyd, Semi-Gloss, MPI Gloss Level 5 (AK)
No. 48-13	Interior Alkyd, Gloss, MPI Gloss Level 6 (AK)
No. 50-13	Interior Latex Primer Sealer
No. 51-13	Interior Alkyd, Eggshell, MPI Gloss Level 3
No. 52-13	Interior Latex, MPI Gloss Level 3 (LE)
No. 53-13	Interior Latex, Flat, MPI Gloss Level 1 (LE)
No. 54-13	Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)
No. 60-13	Interior/Exterior Latex Porch & Floor Paint, Low Gloss
No. 68-13	Interior/ Exterior Latex Porch & Floor Paint, Gloss
No. 71-13	Polyurethane, Moisture Cured, Clear, Flat (PV)
No. 90-13	Interior Wood Stain, Semi-Transparent (WS)
No. 94-13	Exterior Alkyd, Semi-Gloss (EO)
No. 95-13	Fast Drying Metal Primer
No. 114-13	Interior Latex, Gloss (LE) and (LG)
No. 119-13	Exterior Latex, High Gloss (acrylic) (AE)
No. 134-13	Primer, Galvanized, Water Based
No. 138-13	Interior High Performance Latex, MPI Gloss Level 2 (LF)
No. 139-13	Interior High Performance Latex, MPI Gloss Level 3 (LL)
No. 140-13	Interior High Performance Latex, MPI Gloss Level 4
No. 141-13	Interior High Performance Latex (SG) MPI Gloss Level 5
D. Steel Structures Painting Council (SSPC):	
SSPC SP 1-04	Solvent Cleaning
SSPC SP 2-04	Hand Tool Cleaning
SSPC SP 3-04	Power Tool Cleaning

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Wood Sealer: Thinned with thinner recommended by manufacturer at rate of about one part of thinner to four parts of varnish.
- B. Plastic Tape:
 - 1. Pigmented vinyl plastic film in color.
 - 2. Pressure sensitive adhesive back.
 - 3. Widths as shown.
- C. Interior/Exterior Latex Block Filler: MPI 4.
- D. Exterior Alkyd Wood Primer: MPI 5.
- E. Exterior Oil Wood Primer: MPI 7.
- F. Exterior Alkyd, Flat (EO): MPI 8.
- G. Exterior Alkyd Enamel (EO): MPI 9.
- H. Exterior Latex, Flat (AE): MPI 10.
- I. Exterior Latex, Semi-Gloss (AE): MPI 11.
- J. Polyurethane, Clear Gloss: MPI 31.
- K. Knot Sealer: MPI 36.
- L. Interior Satin Latex: MPI 43.
- M. Interior Low Sheen Latex: MPI 44.
- N. Interior Primer Sealer: MPI 45.
- O. Interior Enamel Undercoat: MPI 46.
- P. Interior Alkyd, Semi-Gloss (AK): MPI 47.
- Q. Interior Latex Primer Sealer: MPI 50.
- R. Interior Alkyd, Eggshell: MPI 51
- S. Interior Latex, MPI Gloss Level 3 (LE): MPI 52.
- T. Interior Latex, Flat, MPI Gloss Level 1 (LE): MPI 53.
- U. Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE): MPI 54.
- V. Interior/ Exterior Latex Porch & Floor Paint, Low Gloss: MPI 60.
- W. Interior/ Exterior Latex Porch & Floor Paint, gloss: MPI 68.
- X. Polyurethane, Moisture Cured, Clear, Flat (PV): MPI 71.
- Y. Interior Wood Stain, Semi-Transparent (WS): MPI 90.
- Z. Exterior Alkyd, Semi-Gloss (EO): MPI 94.
- AA. Fast Drying Metal Primer: MPI 95.
- BB. Interior latex, Gloss (LE) and (LG): MPI 114.
- CC. Exterior Latex, High Gloss (acrylic) (AE): MPI 119.
- DD. Waterborne Galvanized Primer: MPI 134.
- EE. Interior High Performance Latex, MPI Gloss Level 2(LF): MPI 138.
- FF. Interior High Performance Latex, MPI Gloss Level 3 (LL): MPI 139.

GG. Interior High Performance Latex, MPI Gloss Level 4: MPI 140.

HH. Interior High Performance Latex (SG), MPI Gloss Level 5: MPI 141.

2.2 PAINT PROPERTIES

- A. Use ready-mixed (including colors), except two component epoxies, polyurethanes, polyesters, paints having metallic powders packaged separately and paints requiring specified additives.
- B. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.

2.3 REGULATORY REQUIREMENTS

- A. Paint materials must conform to the restrictions of the local Environmental and Toxic Control jurisdiction or the requirements of this section, whichever is most stringent.
 - 1. Lead-Based Paint:
 - a. Lead based paint is not permitted to be used.
 - 2. Asbestos: Materials must not contain asbestos.
 - 3. Chromate, Cadmium, Mercury, and Silica: Materials must not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
 - 4. Human Carcinogens: Materials must not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
 - 5. Use high performance acrylic paints in place of alkyd paints, where possible.
 - 6. VOC content for solvent-based paints must not exceed specified performance requirement; aromatic hydro carbons contained in solvent-based paints must not exceed one percent by weight.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

- A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.
 - 1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
 - 2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each day's work.
- B. Atmospheric and Surface Conditions:

1. Do not apply coating when air or substrate conditions are:
 - a. Less than 3 degrees C (5 degrees F) above dew point.
 - b. Below 10 degrees C (50 degrees F) or over 35 degrees C (95 degrees F), unless specifically pre-approved by the Contracting Officer and the product manufacturer.
2. Do not exceed application conditions recommended by the manufacturer.
3. Maintain interior temperatures until paint dries hard.
4. Do no exterior painting when it is windy and dusty.
5. Do not paint in direct sunlight or on surfaces that the sun will soon warm.
6. Apply only on clean, dry and frost free surfaces except as follows:
 - a. Apply water thinned acrylic and cementitious paints to damp (not wet) surfaces where allowed by manufacturer's printed instructions.
 - b. Dampened with a fine mist of water on hot dry days concrete and masonry surfaces to which water thinned acrylic and cementitious paints are applied to prevent excessive suction and to cool surface.
7. Varnishing:
 - a. Apply in clean areas and in still air.
 - b. Before varnishing vacuum and dust area.
 - c. Immediately before varnishing wipe down surfaces with a tack rag.

3.2 SURFACE PREPARATION

- A. Method of surface preparation is optional, provided results of finish painting produce solid even color and texture specified with no overlays.
- B. General:
 1. Remove prefabricated items not to be painted such as lighting fixtures, escutcheon plates, hardware, trim, and similar items for reinstallation after paint is dried.
 2. Remove items for reinstallation and complete painting of such items and adjacent areas when item or adjacent surface is not accessible or finish is different.
 3. See other sections of specifications for specified surface conditions and prime coat.
 4. Clean surfaces for painting with materials and methods compatible with substrate and specified finish. Remove any residue remaining

from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry.

C. Ferrous Metals:

1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter in accordance with SSPC-SP 1 (Solvent Cleaning).
2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 (Hand Tool Cleaning) and SSPC-SP 3 (Power Tool Cleaning). Exception: where high temperature aluminum paint is used, prepare surface in accordance with paint manufacturer's instructions.
3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors and similar items specified to have semi-gloss or gloss finish with TT-F-322D (Filler, Two-Component Type, For Dents, Small Holes and Blow-Holes). Finish flush with adjacent surfaces.
 - a. This includes flat head countersunk screws used for permanent anchors.
 - b. Do not fill screws of item intended for removal such as glazing beads.
4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.

D. Zinc-Coated (Galvanized) Metal, Aluminum, Copper and Copper Alloys
Surfaces Specified Painted:

1. Clean surfaces to remove grease, oil and other deterrents to paint adhesion in accordance with SSPC-SP 1 (Solvent Cleaning).
2. Spot coat abraded and damaged areas of zinc-coating which expose base metal on hot-dip zinc-coated items with Organic Zinc Rich Coating. Prime or spot prime with MPI 134 (Waterborne Galvanized Primer) depending on finish coat compatibility.

E. Masonry, Concrete, Cement Board, Cement Plaster and Stucco:

1. Clean and remove dust, dirt, oil, grease efflorescence, form release agents, laitance, and other deterrents to paint adhesion.

2. Use emulsion type cleaning agents to remove oil, grease, paint and similar products. Use of solvents, acid, or steam is not permitted.
3. Remove loose mortar in masonry work.
4. Replace mortar and fill open joints, holes, cracks and depressions with new mortar. Do not fill weep holes. Finish to match adjacent surfaces.
5. Neutralize Concrete floors to be painted by washing with a solution of 1.4 Kg (3 pounds) of zinc sulfate crystals to 3.8 L (1 gallon) of water, allow to dry three days and brush thoroughly free of crystals.
6. Repair broken and spalled concrete edges with concrete patching compound to match adjacent surfaces as specified in CONCRETE Sections. Remove projections to level of adjacent surface by grinding or similar methods.

F. Gypsum Plaster and Gypsum Board:

1. Remove efflorescence, loose and chalking plaster or finishing materials.
2. Remove dust, dirt, and other deterrents to paint adhesion.
3. Fill holes, cracks, and other depressions with CID-A-A-1272A [Plaster, Gypsum (Spackling Compound) finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over 25 mm (1-inch) in diameter as specified in Section for plaster or gypsum board.

3.3 PAINT PREPARATION

- A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.
- B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.
- C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.
- D. Mix two component and two part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.
- E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.4 APPLICATION

- A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.
- B. Unless otherwise specified, apply paint in three coats; prime, body, and finish. When two coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.
- C. Apply each coat evenly and cover substrate completely.
- D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by RE/COR.
- E. Finish surfaces to show solid even color, free from runs, lumps, brush marks, laps, holidays, or other defects.
- F. Apply by brush, roller or spray, except as otherwise specified.
- G. Do not spray paint in existing occupied spaces unless approved by RE/COR, except in spaces sealed from existing occupied spaces.
 - 1. Apply painting materials specifically required by manufacturer to be applied by spraying.
 - 2. In areas, where paint is applied by spray, mask or enclose with polyethylene, or similar air tight material with edges and seams continuously sealed including items specified in WORK NOT PAINTED, motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.
- H. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

3.5 PRIME PAINTING

- A. After surface preparation, prime surfaces before application of body and finish coats, except as otherwise specified.
- B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.
- C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel. Apply an additional prime coat.
- D. Prime rebates for stop and face glazing of wood, and for face glazing of steel.
- E. Metals:

1. Steel and Iron: MPI 95 (Fast Drying Metal Primer).
 2. Zinc-coated Steel and Iron: MPI 134 (Waterborne Galvanized Primer).
 3. Machinery Not Factory Finished: MPI 9 (Exterior Alkyd Enamel (EO)).
- F. Concrete Masonry Units except glazed or integrally colored and decorative units:
1. MPI 4 (Block Filler) on interior surfaces.
- G. Cement Plaster or stucco // Concrete Masonry, Brick Masonry:
1. MPI 53 (Interior Latex, Flat, MPI Gloss Level 1 LE))except use two coats where substrate has aged less than six months.

3.6 EXTERIOR FINISHES

- A. Apply following finish coats where specified.
- B. Steel and Ferrous Metal,:
 1. Two coats of MPI 9 (Exterior Alkyd Enamel (EO)) or MPI 94 (Exterior Alkyd, Semi-Gloss (EO)) on exposed surfaces, except on surfaces over 94 degrees C (200 degrees F).
- C. Machinery without factory finish except for primer: One coat MPI 8 (Exterior Alkyd, Flat (EO))

3.7 REFINISHING EXISTING PAINTED SURFACES

- A. Clean, patch and repair existing surfaces as specified under surface preparation.
- B. Remove and reinstall items as specified under surface preparation.
- C. Remove existing finishes or apply separation coats to prevent non-compatible coatings from having contact.
- D. Patched or Replaced Areas in Surfaces and Components: Apply spot prime and body coats as specified for new work to repaired areas or replaced components.
- E. Except where scheduled for complete painting apply finish coat over plane surface to nearest break in plane, such as corner, reveal, or frame.
- F. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.
- G. Coat knots and pitch streaks showing through old finish with Knot Sealer before refinishing.
- H. Sand or dull glossy surfaces prior to painting.
- I. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in finished work.

3.8 PAINT COLOR

- A. Color and gloss of finish coats shall match existing

B. Coat Colors:

1. Color of priming coat: Lighter than body coat.
2. Color of body coat: Lighter than finish coat.
3. Color prime and body coats to not show through the finish coat and to mask surface imperfections or contrasts.

C. Painting, Caulking, Closures, and Fillers Adjacent to Casework:

1. Paint to match color of casework where casework has a paint finish.
2. Paint to match color of wall where casework is stainless steel, plastic laminate, or varnished wood.

3.9 PROTECTION CLEAN UP, AND TOUCH-UP

- A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.
- B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.
- C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

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APPENDIX

Coordinate the following abbreviations used in Section 09 91 00,
PAINTING. Use the same abbreviation and terms consistently.

Paint or coating	Abbreviation
Acrylic Emulsion	AE (MPI 10 - flat/MPI 11 - semigloss/MPI 119 - gloss)
Alkyd Gloss Enamel	G (MPI 48)
Alkyd Semigloss Enamel	SG (MPI 47)
Aluminum Paint	AP)
Cementitious Paint	CEP (TT-P-1411)
Exterior Latex	EL?? (MPI 10 / 11 / 119)
Exterior Oil	EO (MPI 9 - gloss/MPI 8 - flat/MPI 94 - semigloss)
Fire Retardant Paint	FR
Fire Retardant Coating (Clear)	FC (intumescent type)
Heat Resistant Paint	HR
Latex Emulsion	LE (MPI 53, flat/MPI 52, eggshell/MPI 54, semigloss/MPI 114, gloss Level 6
Latex Flat	LF (MPI 138)
Latex Gloss	LG (MPI 114)
Latex Semigloss	SG (MPI 141)
Latex Low Luster	LL (MPI 139)
Plastic Floor Coating	PL
Polyurethane Varnish	PV
Rubber Paint	RF (CID-A-A-3120 - Paint for Swimming Pools (RF))
Water Paint, Cement	WPC (CID-A-A-1555 - Water Paint, Powder).
Wood Stain	WS

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SECTION 26 05 11
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section applies to all sections of Division 26.
- B. Contractor shall provide electrical equipment, materials, related components and accessories in accordance with the specifications and drawings.
- C. Electrical service entrance equipment (arrangements for temporary and permanent connections to the power company's system) shall conform to the power company's requirements. Coordinate fuses, circuit breakers and relays with the power company's system, and obtain power company approval for sizes and settings of these devices.
- D. Conductor shall be copper. Conductor ampacities are based on copper conductors, with the conduit and raceways properly sized. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

- A. Reference to the International Building Code (IBC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes are minimum required standards.
- B. Drawings and specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.3 TEST STANDARDS

- A. All materials and equipment shall be listed, labeled or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc., standards where test standards have been established. Equipment and materials which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a NRTL. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, or NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.
- B. Definitions:

1. Listed: Material and/or equipment included in a list published by an organization that:
 - a. Is acceptable to the Authority Having Jurisdiction (AHJ) and concerned with evaluation of products or services.
 - b. Is published by a nationally recognized laboratory which makes periodic inspection of production of such equipment.
 - c. States that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.
2. Labeled: Material and/or equipment is labeled when:
 - a. It embodies a valid label, symbol, or other identifying mark of a nationally recognized testing laboratory such as Underwriters Laboratories, Inc.
 - b. The laboratory makes periodic inspections of the production of such equipment.
 - c. The labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.
3. Certified: Material and/or equipment is certified when:
 - a. It has been tested and validated by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. It is periodically inspected by a NRTL.
 - c. It bears a label, tag, or other record of certification.
4. Nationally Recognized Testing Laboratory (NRTL): laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.
5. Provide: The term "provide" denotes "furnish, install and connect".

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturer's Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- B. Product Qualification:
 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
 2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

SPEC WRITER NOTES: In the following paragraph use 4 hours for metropolitan areas and 8 hours for rural areas.

- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within // four // eight // hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATION

- A. Applicable publications listed in all sections of Division 26 are the latest issues, unless otherwise noted.
- B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.6 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available. Materials and equipment furnished shall be new, and shall have superior quality and freshness.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
1. Components of an assembled unit need not be products of the same manufacturer.
 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 3. Components shall be compatible with each other and with the total assembly for the intended service.
 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Tests are specified, Factory Tests shall be performed in the factory by the equipment manufacturer, and witnessed by the contractor. In addition, the following requirements shall be complied with:

1. The Government shall have the option of witnessing factory tests. The Contractor shall notify the Government, through the Resident Engineer/COR, a minimum of thirty (30) days prior to the manufacturer's performing of the factory tests.
2. When factory tests are successful, contractor shall furnish four (4) copies of the equipment manufacturer's certified test reports to the Resident Engineer/COR fourteen (14) days prior to shipment of the equipment, and not more than ninety (90) days after completion of the factory tests.
3. When factory tests are not successful, factory tests shall be repeated in the factory by the equipment manufacturer, and witnessed by the Contractor. The Contractor shall be liable for all additional expenses for the Government to witness factory re-testing.

1.7 VARIATIONS FROM CONTRACT REQUIREMENTS

- A. Where the Government or the contractor requests variations from the contract requirements, contractor shall provide additional equipment, materials, related components and accessories to satisfy these variations. If Contractor requests variations from the contract requirements, contractor shall be liable for all additional costs and expenses.

1.8 EQUIPMENT AND MATERIALS PROTECTION

- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
 1. During installation, equipment and materials such as enclosures, switchboards, panelboards, conductors, luminaires etc. shall be protected against entry of foreign matter. Equipment and materials shall be vacuum cleaned both inside and outside before testing and operating and repainting if required.
 2. Damaged equipment shall be, as determined by the Resident Engineer/COR, replaced or repaired.
 3. Painted surfaces shall be protected with removable factory installed heavy kraft paper, sheet vinyl or equal.
 4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

- A. All electrical work must comply with the requirements of latest publications of the NFPA 70 (NEC), NFPA 70B, NFPA 70E, NFPA 110, OSHA

Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K in addition to other references required by contract.

- B. Job site safety and worker safety is the responsibility of the Contractor.
- C. Electrical work shall be accomplished with all affected circuits and equipment de-energized. Only non-invasive and non-destructive electrical testings may be performed under energized electrical work. In such case, Contractor shall submit request, and obtain authorization for such work from the Resident Engineer/COR.
- D. For work on existing electrical system, arrange, prioritize and perform work to assure no or minimal interference with normal functioning of the facility. Refer to Article OPERATIONS AND STORAGE AREAS under Sections 01 00 01 (Major NCA Projects) or 01 00 02 (Minor NCA Projects), GENERAL REQUIREMENTS.
- E. New work shall be installed and connected to existing work neatly and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions. Refer to Article RESTORATION under Section 01 00 02 (Minor NCA Projects), GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interferences.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on drawings.
- B. Working spaces shall not be less than specified in the NEC.
- C. Readily Accessible Equipment:
 - 1. Installed equipment shall be readily accessible. When the Government determines that the contractor has installed equipment not readily accessible, contractor shall remove and re-install the equipment as directed by the Government.

1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear, control devices and other significant equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure

nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions.

- C. Install adhesive arc flash warning labels on all equipment as required by the latest NFPA 70E.

1.12 SUBMITTALS

- A. Submit six copies to Resident Engineer/COR in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. The Government prohibits delivery, storage or installation of equipment or material which has not been approved through the submittal process.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SPECIFICATION SECTION _____".
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.
- E. The submittals shall include the following:
 - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
 - 2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 - 3. Parts list which shall include those replacement parts and part numbers recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- F. Maintenance and Operation Manuals:

1. Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
 2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
 3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
 4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation and maintenance instructions.
 - e. Safety precautions.
 - f. Diagrams and illustrations.
 - g. Testing methods.
 - h. Performance data.
 - i. Lubrication schedule including type, grade, temperature range, and frequency.
 - j. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
 - k. List qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
- G. Approvals will be based on complete submission of manuals together with shop drawings.

1.13 SINGULAR NUMBER

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.14 WARRANTY

- A. Workmanship, labor, equipment, materials, related components and accessories shall be free from defects and shall remain so for a period of one year from the date of project acceptance by the Government

1.15 TRAINING

- A. Training shall be provided to designated Government personnel for particular equipment or system as required in each associated specification section.
- B. Contractor shall furnish the services of factory certified and experienced instructors to provide full instruction in the adjustment, operation, and maintenance of the specified equipment and system. Instruction shall also include safety requirements.
- C. Contractor shall develop a training schedule, and submit training schedule to Resident Engineer/COR for review and approval at least thirty (30) days prior to the scheduled training.

- - - E N D - - -

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below. Low-voltage electrical power conductors and cables are also referred to as cable(s), conductor(s), wire, or wiring in this section.

1.2 RELATED WORK

- A. Section 31 20 11, EARTH MOVING (Short Form): Excavation and backfill for cables that are installed in conduit.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that apply to more than one section of Division 26.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings: Manufacturer's Literature and Data - Showing each cable type and rating.
 - 2. Certificates: Two weeks prior to final inspection, deliver to the Resident Engineer/COR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):
 - D2301-10.....Standard Specification for Vinyl Chloride
Plastic Pressure Sensitive Electrical
Insulating Tape
- C. National Electrical Manufacturers Association (NEMA):

WC 70-09.....Power Cable Rated 2000 Volts or less for the
Distribution of Electrical Energy

D. National Fire Protection Association (NFPA):

70-14.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-14.....Thermoset-Insulated Wires and Cables

83-14.....Thermoplastic-Insulated Wires and Cables

467-13.....Safety Electrical Grounding and Bonding
Equipment

486A-486B-13.....Safty Wire Connectors

486C-13.....Safety Splicing Wire Connectors

486D-15.....Safety Sealed Wire Connector Systems

486E-15.....Safety Equipment Wiring Terminals for Use with
Aluminum and/or Copper Conductors

493-07.....Safety Thermoplastic-Insulated Underground
Feeder and Branch Circuit Cable

514B-12.....Fittings for Cable and Conduit

1479-15.....Safety Fire Tests of Through-Penetration Fire
Stops

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Conductors and cables shall be in accordance with NEMA, UL, as
specified herein, and as shown on the drawings.

B. Single Conductor and Cable:

1. Shall be copper.
2. Shall be stranded for sizes No. 8 AWG and larger, solid for sizes
No. 10 AWG and smaller.
3. Shall be minimum size No. 12 AWG, except where smaller sizes are
specified herein or as shown on the drawings.

C. Insulation:

1. THHN-THWN.
2. Direct burial: UF or USE.

D. Color Code:

1. Secondary service, feeder and branch circuit conductors shall be color coded as follows:

208/120 volt	Phase	480/277 volt
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

- a. The lighting circuit "switch legs" and 3-way switch "traveling wires" shall have color coding unique and distinct (i.e. pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Field coordinate for a final color coding with the Resident Engineer/COR.
2. Use solid color compound or solid color coating for No. 12 AWG and No. 10 AWG branch circuit conductors and neutral sizes.
3. Phase conductors No. 8 AWG and larger shall be color-coded using one of the following methods:
 - a. Solid color compound or solid color coating.
 - b. Stripes, bands, or hash marks of color specified above.
 - c. Color as specified using 19 mm (3/4 inch) wide tape. Apply tape in half overlapping turns for a minimum of 75 mm (3 inches) for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.

2.2 SPLICES

- A. Splices shall be in accordance with NEC and UL.
- B. Above Ground Splices for No. 10 AWG and Smaller:
 1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped conductors.

3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.
- D. Above Ground Splices for 250 kcmil and Larger:
1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.
- E. Underground Splices for No. 10 AWG and Smaller:
1. Solderless, screw-on, reusable pressure cable type, with integral insulation. Listed for wet locations, and approved for copper and aluminum conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped conductors.
 3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- F. Underground Splices for No. 8 AWG and Larger:
1. Mechanical type, of high conductivity and corrosion-resistant material. Listed for wet locations, and approved for copper and aluminum conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.

- G. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

2.3 CONTROL WIRING

- A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.4 WIRE LUBRICATING COMPOUND

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

2.5 CONNECTORS AND TERMINATIONS

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be //zinc-plated//cadmium-plated// steel.

2.6 FIREPROOFING TAPE

- A. Fireproofing tape shall be flexible, non-corrosive, self-extinguishing, arcproof, and fireproof intumescent elastomer. Securing tape shall be glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (0.75 inch) wide.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in accordance with the NEC, as specified, and as shown on the drawings.
- B. Install all wiring in raceway systems.
- C. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.
- D. Wires of different systems (i.e. 120V, 277V) shall not be installed in the same conduit or junction box system.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.

- F. In panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
- G. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.
- H. Conductor and Wire Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 - 2. Use ropes made of nonmetallic material for pulling feeders.
 - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the COR/Resident Engineer.
 - 4. Pull in multiple conductors and wires that share the same conduit, simultaneously.
- I. No more than (3) single-phase branch circuits shall be installed in any one conduit.
- J. Conductors and wires shall be derated in accordance with NEC Article 310. Neutral wires, under conditions defined by the NEC, shall be considered current-carrying conductors.

3.2 SPLICE INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices.

3.3 CONTROL AND SIGNAL WIRING INSTALLATION

- A. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.

- D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- E. System voltages shall be 120 Volts or lower where shown on the drawings or as required by the NEC.

3.4 CONTROL AND SIGNAL SYSTEM IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.5 FEEDER IDENTIFICATION

- A. In each interior pullbox and junction box, install metal tags on each circuit cables and wires to clearly designate their circuit identification and voltage.
- B. In each manhole and handhole, provide tags of the embossed brass type, showing the cable type and voltage rating. Attach the tags to the cables with slip-free plastic cable lacing units.

3.6 DIRECT BURIAL CABLE INSTALLATION

- A. Tops of the cables:
 - 1. Below the finished grade: Minimum 600 mm (24 inches) unless greater depth is shown.
 - 2. Below road and other pavement surfaces: In conduit as specified, minimum 750 mm (30 inches) unless greater depth is shown.
 - 3. Do not install direct burial cables under railroad tracks.
- B. Under road and paved surfaces: Install cables in concrete encased galvanized steel rigid conduits. Size as shown on plans, but not less than 50 mm (2 inches) trade size with bushings at each end of each conduit run. Provide size/quantity of conduits required to accommodate cables plus one spare, unless more spares are indicated on drawings.
- C. Work with extreme care near existing ducts, conduits, cables and other utilities to prevent any damage.
- D. Cut the trenches neatly and uniformly:
 - 1. Excavating and backfilling is specified in Section 31 20 00, EARTH MOVING.
 - 2. Place a 75 mm (3 inches) layer of sand in the trenches before installing the cables.

3. Place a 75 mm (3 inches) layer of sand over the installed cables.
 4. Install continuous horizontal, 25 mm by 200 mm (1 inch by 8 inches) preservative impregnated wood planking 75 mm (3 inches) above the cables before backfilling.
- E. Provide horizontal slack in the cables for contraction during cold weather.
 - F. Install the cables in continuous lengths. Splices within cable runs will not be accepted.
 - G. Connections and terminations shall be submersible type designed for the cables being installed.
 - H. Warning tape shall be continuously placed 300 mm (12 inches) above the buried cables.

3.7 EXISTING CONDUCTORS AND WIRES

- A. Unless specifically indicated on the plans, existing wiring shall not be re-used for new installation.

3.8 ACCEPTANCE CHECKS AND TESTS

- A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.
- B. Tests shall be performed by megger and conductors shall test free from short-circuits and grounds.
- C. Test conductor phase-to-phase and phase-to-ground.
- D. Perform phase rotation test on all three-phase circuits. For renovation project, phase rotation shall be consistent between existing and new installations.
- E. The Contractor shall furnish the instruments, materials, and labor for these tests.

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of grounding and bonding system to form a complete electrical grounding system.
- B. "Grounding electrode system" refers to all electrodes required by NEC, including made, supplementary, lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this specification.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:
Low-voltage conductors.

1.3 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - b. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
 - 2. Test Reports: Two weeks prior to the final inspection, submit four copies of the ground resistance test reports to the Resident Engineer/COR.
 - 3. Certification: Prior to final inspection, submit to the Resident Engineer/COR four copies of the certification that the grounding equipment has been properly installed in accordance with the drawings and specifications

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - B1-13.....Specification for Hard-Drawn Copper Wire
 - B8-11.....Specification for Concentric-Lay-Stranded
Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 81-12.....IEEE Guide for Measuring Earth Resistivity,
Ground Impedance, and Earth Surface Potentials
of a Ground System
- D. National Fire Protection Association (NFPA):
 - 70-17.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
 - 44-14Safety Thermoset-Insulated Wires and Cables
 - 83-14Safety Thermoplastic-Insulated Wires and Cables
 - 467-13Safety Grounding and Bonding Equipment
 - 486A-486B-13Safety Wire Connectors and Soldering Lugs for
Use with Copper Conductors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.
- C. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.

2.2 GROUND RODS

- A. Provide ground rod(s) made of Steel or copper clad steel, 19 mm (3/4 inch) diameter by 3 M (10 feet) long.
- B. Quantity of rods shall be as shown on the drawings.

2.3 CONCRETE ENCASED ELECTRODE

- A. Concrete encased electrode shall be No. 4 AWG bare copper wire.
Location is as shown on the drawings.

2.4 GROUND CONNECTIONS

- A. Below Grade: Exothermic-welded type connectors.
- B. Above Grade:
 - 1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
 - 2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
 - 3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-plated or copper alloy fasteners.

2.5 EQUIPMENT RACK AND CABINET GROUND BARS

- A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x ¾ inch).

2.6 GROUND TERMINAL BLOCKS

- A. At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.7 GROUNDING BUS BAR

- A. Pre-drilled rectangular copper bar with stand-off insulators, minimum 6.3 mm (0.25 inch) thick x 100 mm (4 inches) high in cross-section, length as shown on the drawings, with hole size, quantity, and spacing per detail shown on the drawings. Provide insulators and mounting brackets.

PART 3 - EXECUTION**3.1 GENERAL**

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
- B. System Grounding:
 - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
 - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes,

cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

- A. Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.3 SECONDARY EQUIPMENT AND CIRCUITS

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Steel, and Supplemental Electrode(s):
 - 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.
 - 2. Provide a supplemental ground electrode and bond to the grounding electrode system.
- C. Service Disconnect (Separate Individual Enclosure): Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.
- D. Switchboards:
 - 1. Connect the various feeder equipment grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
 - 2. For service entrance equipment, connect the grounding electrode conductor to the ground bus.
 - 3. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and grounding conductor to the equipment ground bus.
- E. Conduit Systems:
 - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - 2. All conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.

3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
- F. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, power and lighting branch circuits.
- G. Boxes, Cabinets, Enclosures, and Panelboards:
 1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes.
 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
 3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
- H. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.
- I. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

3.4 CORROSION INHIBITORS

- A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.5 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.
- B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

3.11 ACCEPTANCE CHECKS AND TESTS

- A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility

company ground system, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.

- B. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
- C. Below-grade connections shall be visually inspected by the Resident Engineer/COR prior to backfilling. The Contractor shall notify the Resident Engineer/COR twenty four (24) hours before the connections are ready for inspection.

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SECTION 26 05 41
UNDERGROUND ELECTRICAL CONSTRUCTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation and connection of handholes and ducts to form a complete underground raceway system.
- B. "Duct" and "conduit", and "rigid metal conduit" and "rigid steel conduit" are used interchangeably in this specification and have the same meaning.

1.2 RELATED WORK

- A. Section 07 92 00, JOINT SEALANTS: Sealing of conduit penetrations.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that apply to more than one section of Division 26.
- C. Section 31 20 11, EARTH MOVING (Short Form): Trenching, backfill and compaction.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - b. Include handholes, duct materials, and hardware. Proposed deviations from details on the drawings shall be clearly marked on the submittals.
 - c. If necessary to locate ducts or handholes at locations other than shown on the drawings, show the proposed locations accurately on scaled site drawings, and submit four copies to the Resident Engineer/COR for approval prior to construction.
 - 2. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer/COR:
 - a. Certification that the materials are in accordance with the drawings and specifications.
 - b. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Concrete Institute (ACI):
- 318-14.....Building Code Requirements for Structural
Concrete & Commentary
- SP 66-04.....ACI Detailing Manual
- C. American National Standards Institute (ANSI):
- 77-13.....Underground Enclosure Integrity
- D. American Society for Testing and Materials (ASTM):
- C478/C478M-15.....Standard Specification for Precast Reinforced
Concrete Manhole Sections
- C858-10.....Underground Precast Concrete Utility Structures
- C990/C990M-09.....Joints for Concrete Pipe, Manholes and Precast
Box Sections Using Preformed Flexible Joint
Sealants.
- E. National Electrical Manufacturers Association (NEMA):
- TC 2-13.....Electrical Polyvinyl Chloride (PVC) Conduit
- TC 3-13.....Polyvinyl Chloride (PVC) Fittings for Use With
Rigid PVC Conduit And Tubing
- TC 6 & 8-13.....Polyvinyl Chloride (PVC) Plastic Utilities Duct
For Underground Installations
- TC 9-04.....Fittings For Polyvinyl Chloride (PVC) Plastic
Utilities Duct For Underground Installation
- F. National Fire Protection Association (NFPA):
- 70-14.....National Electrical Code (NEC)
- 70E-15.....National Electrical Safety Code
- G. Underwriters Laboratories, Inc. (UL):
- 6-07.....Electrical Rigid Metal Conduit-Steel
- 467-13.....Grounding and Bonding Equipment
- 651-11.....Schedule 40, 80, Type EB and A Rigid PVC
Conduit and Fittings
- 651A-11.....Schedule 40 and 80 High Density Polyethylene
(HDPE) Conduit

PART 2 - PRODUCTS

2.1 GROUNDING

- A. Ground Rods and Ground Wire: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

2.2 WARNING TAPE

- A. 4-mil polyethylene 75 mm (3 inches) wide, detectable tape, red with black letters, imprinted with "CAUTION - BURIED ELECTRIC CABLE BELOW" or similar.

2.3 PULL ROPE FOR SPARE DUCTS

- A. Plastic with 890 N (200 lb) minimum tensile strength.

PART 3 - EXECUTION

3.1 TRENCHING

- A. Refer to Section 31 20 11 EARTH MOVING (Short Form) for trenching backfilling, and compaction.
- B. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
- C. Cut the trenches neatly and uniformly.
- D. Individual conduits to be installed under existing paved areas and roads that cannot be disturbed shall be jacked into place using rigid metal conduit, or bored using plastic utilities duct or PVC conduit, as approved by the Resident Engineer/COR.

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SECTION 26 56 00
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of exterior luminaires, poles and supports. The terms "lighting fixtures", "fixtures" and "luminaires" are used interchangeably.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that apply to more than one section of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground handholes and conduits.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
1. Shop Drawings:
 - a. Sufficient information, clearly presented, shall be included for each type of luminaire shown on the LIGHTING FIXTURE SCHEDULE..
 - b. Include electrical ratings, dimensions, mounting, material and construction details, wiring schematic and connection diagrams, installation details, energy efficiency data, photometric data, complete lamp data, and complete ballast or LED driver data, and complete pole data.
 2. Manuals: Two weeks prior to final inspection, submit four copies of operating and maintenance manuals to the Resident Engineer/COR. Include technical data sheets, wiring and connection diagrams, and information for ordering replacement parts.
 3. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer/COR:

- a. Certification that the materials are in accordance with the drawings and specifications.
- b. Certification, by the Contractor, that the complete installation has been properly installed and tested.
- 1.5 APPLICABLE PUBLICATIONS**
- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
- LRFDLTS-15.....Structural Supports for Highway Signs,
Luminaries and Traffic Signals
- C. American Concrete Institute (ACI):
- 318-14Building Code Requirements for Structural
Concrete
- D. American National Standards Institute (ANSI):
- AA ANSI H35.1-13Alloy and Temper Designation Systems for
Aluminum
- E. American Society for Testing and Materials (ASTM):
- A123/A123M-15Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
- A153/A153M-16.....Zinc Coating (Hot-Dip) on Iron and Steel
Hardware - AASHTO No.: M232
- B108/108M-15Aluminum-Alloy Permanent Mold Castings
- C1089-13.....Spun Cast Prestressed Concrete Poles
- F. Institute of Electrical and Electronics Engineers (IEEE)
- C57.12-10.....General Requirements For Liquid-Immersed
Distribution, Power, and Regulating
Transformers
- G. Illuminating Engineering Society of North America (IESNA)
- IES LIGHTING HDBK-11....Lighting Handbook
- LM-79-08.....Electrical and Photometric Measurements of
Solid-State Lighting Products
- LM-80-15.....Measuring Luminous Flux and Color Maintenance
of LED Packages, Arrays and Modules
- RP-8-14.....Roadway Lighting

H. National Electrical Manufacturers Association (NEMA):

- C78.41-06.....Electric Lamps - Guidelines for Low-Pressure Sodium Lamps
- C78.42-09Electric Lamps - Guidelines for High-Pressure Sodium Lamps
- C78.43-13Electric Lamps - Single-Ended Metal-Halide Lamps
- C78.1381-98.....(R 1997) Electric Lamps - 70-Watt M85 Metal-Halide Lamps
- C82.4-02Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
- C136.3-14Roadway and Area Lighting Equipment - Luminaire Attachments
- C136.17-05/R10Roadway and Area Lighting Equipment - Enclosed Side-Mounted Luminaires for Horizontal-Burning High-Intensity-Discharge Lamps - Mechanical Interchangeability of Refractors
- ICS 2-00/08Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts
- ICS 6-93/R11Industrial Control and Systems Enclosures

I. National Fire Protection Association (NFPA):

- 70-14National Electrical Code (NEC)

J. Underwriters Laboratories, Inc. (UL):

- 496-08Edison-Base Lamp holders
- 773-95.....Plug-in, Locking Type Photo controls, for Use with Area Lighting
- 773A-16Non-industrial Photoelectric Switches for Lighting Control
- 1029-94.....High-Intensity-Discharge Lamp Ballasts
- 1598-08Luminaires
- 8750-15Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store poles on ground. Store the poles so they are at least 305 mm (one foot) above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

PART 2 - PRODUCTS**2.1 GENERAL**

- A. Materials and equipment shall be in accordance with ANSI, NFPA, NEMA, UL, and as shown on the drawings and specified.

2.2 LUMINAIRES

- A. Luminaires shall comply with NEMA, NFPA, and UL. Luminaires shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast/LED driver heat and safe cleaning and relamping.
- B. LED luminaires shall be provided as a complete unit with housing, LED module, and LED driver.
- C. Illumination distribution patterns, BUG ratings and cutoff types as defined by the IESNA shall be as shown on the drawings.
- D. Incorporate ballasts in the luminaire housing except where otherwise shown on the drawings.
- E. Lenses shall be frame-mounted heat-resistant, borosilicate glass, prismatic refractors. Attach the frame to the luminaire housing by hinges or chain. Use heat and aging resistant resilient gaskets to seal and cushion lenses and refractors in luminary doors.
- F. Lamp sockets for high intensity discharge (H.I.D) fixture shall have locking type porcelain enclosures in conformance to the applicable requirements of ANSI C81.61 and UL 496.
- G. Pre-wire internal components to terminal strips at the factory.
- H. Bracket mounted luminaries shall have leveling provisions and clamp type adjustable slip-fitters with locking screws.
- I. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.
- J. Provide manufacturers' standard finish, as scheduled on the drawings. Where indicated on the drawings, match finish process and color of pole or support materials.
- K. Luminaires shall carry factory labels, showing complete, specific lamp and ballast/LED driver information.

2.3 LAMPS

- A. Install the proper lamps in every luminaire installed as shown on the drawings.
- B. Lamps to be general-service, outdoor lighting types.
- C. Mercury vapor lamps shall not be used.

- D. Metal-Halide Lamps: NEMA C78.43 or NEMA C78.1381. Lamps shall be pulse start or ceramic type with wattage and correlated color temperature as shown on the LIGHTING FIXTURE SCHEDULE.
- E. LED source shall meet the following requirements:
 - 1. Shall be certified, listed and warranted by the manufacturer for operating temperature rating between -40 degrees C (-40 degrees F) and 50 degrees C (122 degrees F).
 - 2. Correlated Color Temperature (CCT): as indicated on the LIGHTING FIXTURE SCHEDULE.
 - 3. Color Rendering Index (CRI): ≥ 70 .

2.4 LED DRIVERS

- A. LED drivers shall meet the following requirements:
 - 1. Drivers shall have a minimum efficiency of 85%.
 - 2. Starting Temperature: -40 degrees C (-40 degrees F).
 - 3. Input Voltage: 120 to 480 ($\pm 10\%$) volt.
 - 4. Power Supplies: Class I or II output.
 - 5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μ s, 10kA/8 x 20 μ s) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ANSI C62.41.2 CORR 1, Scenario 1 Location Category C.
 - 6. Power Factor (PF): ≥ 0.90 .
 - 7. Total Harmonic Distortion (THD): $\leq 20\%$.
 - 8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
 - 9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

2.5 LIGHTING CONTACTORS

- A. NEMA ICS 2, electrically or mechanically held contactors. Rate contactors as indicated. Provide in NEMA 4 enclosure conforming to NEMA ICS 6. Contactors shall have silver alloy double-break contacts and coil clearing contacts for mechanically held contactor and shall require no arcing contacts. Provide contactors with hand-off-automatic or on-off selector switch.

2.6 CONTROLS

- A. Each Lighting System:
 - 1. Shall be controlled by the following method:
 - a. A photocell to act as the pilot device. The photocell shall be the type which fails safe to the closed position meeting UL 773 or 773A.

2. Mount and connect photocells per manufacturer's recommendations.
3. Photocells shall have the following features:
 - a. Quick-response, cadmium-sulfide type.
 - b. A 15 to 30 second, built-in time delay to prevent response to momentary lightning flashes, car headlights or cloud movements.
 - c. Energizes the system when the north sky light decreases to approximately 1.5 foot candles, and maintains the system energized until the north sky light increases to approximately 3 to 5 foot candles.

2.7 EXISTING LIGHTING SYSTEMS

- A. For modifications or additions to existing lighting systems, the new components shall be compatible with the existing systems.
- B. New poles and luminaries shall have approximately the same configurations and dimensions as the existing poles and luminaries except where otherwise shown on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.
- B. Photocell Switch Aiming: Aim switch according to manufacturer's recommendations.

3.2 GROUNDING

- A. Ground noncurrent-carrying parts of equipment including metal poles, luminaries, mounting arms, brackets, and metallic enclosures as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Where copper grounding a conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable and listed for this purpose.

3.3 ACCEPTANCE CHECKS AND TESTS

- A. Verify operation after installing luminaires and energizing circuits.

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**SECTION 31 20 11
EARTH MOVING (SHORT FORM)**

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the requirements for furnishing all equipment, materials, labor and techniques for earthwork including excavation, fill, backfill and site restoration utilizing fertilizer, seed and/or sod.

1.2 DEFINITIONS

A. Unsuitable Materials:

1. Fills: Topsoil, frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 3 inches; organic materials, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable.
2. Existing Subgrade (except footings): Same materials as above paragraph, that are not capable of direct support of slabs, pavement, and similar items, with the possible exception of improvement by compaction, proof rolling, or similar methods of improvement.
3. Existing Subgrade (footings only): Same as Paragraph 1, but no fill or backfill. If materials differ from reference borings and design requirements, excavate to acceptable strata subject to Resident Engineer's approval.

B. Earthwork: Earthwork operations required within the new construction area. It also includes earthwork required for auxiliary structures and buildings and sewer and other trench work throughout the job site.

C. Degree of Compaction: Degree of compaction is expressed as a percentage of maximum density obtained by the test procedure presented in AASHTO T99 Method A or ASTM D698 Method A.

D. The term fill means fill or backfill as appropriate.

1.3 CLASSIFICATION OF EXCAVATION

A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on the surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.

B. Rock Excavation:

1. Solid ledge rock (igneous, metamorphic, and sedimentary rock).

2. Bedded or conglomerate deposits so cemented as to present characteristics of solid rock which cannot be excavated without blasting; or the use of a modern power excavator (shovel, backhoe, or similar power excavators) of no less than 1 cubic yard capacity, properly used, having adequate power and in good running condition.
3. Boulders or other detached stones each having a volume of 1/2 cubic yard or more.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Rock Excavation Report:
 1. Certification of rock quantities excavated.
 2. Excavation method.
 3. Labor.
 4. Equipment.
 5. Land Surveyor's or Civil Engineer's name and official registration stamp.
 6. Plot plan showing elevations.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Nursery and Landscape Association (ANLA):

2004.....American Standard for Nursery Stock
- C. American Association of State Highway and Transportation Officials (AASHTO):

T99-01 (R2004).....Moisture-Density Relations of Soils Using a 5.5 lb Rammer and a 12 inch Drop

T180-01 (2004).....Moisture-Density Relations of Soils Using a 10 lb Rammer and a 18 inch Drop
- D. American Society for Testing and Materials (ASTM):

D698-07.....Laboratory Compaction Characteristics of Soil Using Standard Effort

D1557-07.....Laboratory Compaction Characteristics of Soil Using Modified Effort
- E. Standard Specifications of Virginia State Department of Transportation, latest revision.

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Fills: Materials approved from on site and off site sources having a minimum dry density of 110 pcf, a maximum Plasticity Index of 6, and a maximum Liquid Limit of 30.
- B. Granular Fill:
 - 1. Under concrete slab, crushed stone or gravel graded from 1 inch to No. 4.
 - 2. Bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 1/2 inch to No. 4.
- C. Fertilizer: (5-10-5) delivered to site in unopened containers that clearly display the manufacturer's label, indicating the analysis of the contents.
- D. Seed: Grass mixture comparable to existing turf delivered to site in unopened containers that clearly display the manufacturer's label, indicating the analysis of the contents.
- E. Sod: Comparable species with existing turf. Use State Certified or State Approved sod when available. Deliver sod to site immediately after cutting and in a moist condition. Thickness of cut must be 3/4 inch to 1 1/4 inches excluding top growth. There shall be no broken pads and torn or uneven ends.

PART 3 - EXECUTION**3.1 SITE PREPARATION**

- A. Clearing: Clearing within the limits of earthwork operations as described or designated by the Resident Engineer. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash and any other obstructions. Remove materials from the Cemetery Property.
- B. Grubbing: Remove stumps and roots 3 inches and larger diameter. Undisturbed sound stumps, roots up to 3 inches diameter, and nonperishable solid objects which will be a minimum of 3 feet below subgrade or finished embankment may be left. Cemetery Projects: do not leave material within the burial profile up to 8 feet below finished grade.
- C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from the areas within 15 feet of new construction and 7'-6" of utility lines if such removal is approved in advance by the Resident

Engineer. Remove materials from the Cemetery Property. Trees and shrubs, shown to be transplanted, shall be dug with a ball of earth and burlapped in accordance with the latest issue of the, "American Standard for Nursery Stock", of the American Association of Nurserymen, Inc. Transplant trees and shrubs to a permanent or temporary position within two hours after digging. Maintain trees and shrubs held in temporary locations by watering as necessary and feeding semi-annually with liquid fertilizer with a minimum analysis of 5 percent nitrogen, 10 percent phosphorus and 5 percent potash. Maintain plants moved to permanent positions as specified for plants in temporary locations until the conclusion of the contract. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in the construction area. Repair immediately damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including the roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Building materials shall not be stored closer to trees and shrubs, that are to remain, than the farthest extension of their limbs.

- D. Stripping Topsoil: Unless otherwise indicated on the drawings, the limits of earthwork operations shall extend anywhere the existing grade is filled or cut or where construction operations have compacted or otherwise disturbed the existing grade or turf. Strip topsoil as defined herein, or as indicated in the geotechnical report, from within the limits of earthwork operations as specified above unless specifically indicated or specified elsewhere in the specifications or shown on the drawings. Topsoil shall be fertile, friable, natural topsoil of loamy character and characteristic of the locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by the Resident Engineer. Eliminate foreign material, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials, larger than 1/2 cubic foot in volume, from soil as it is stockpiled. Retain topsoil on the station. Remove foreign materials larger than 2 inches in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work, shall not, under any circumstances, be carried out when the soil is wet so that the tilth of the soil will be destroyed.

1. Cemetery Projects: Recommend that the top soil be tested for chemicals, pesticides and fertilizers if topsoil is to be removed from lands formerly utilized as farmland, to verify suitability for

use as topsoil in the cemetery where new lawn areas are to be established.

- E. Retaining wall installation shall be in accordance with the plans and the manufacturers specifications.
- F. All Earthwork shall be in accordance with the Geotechnical Report prepared by Triad.
- G. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION

- A. Shoring, Sheet piling and Bracing: Shore, brace, or slope to its angle of repose banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities, in compliance with OSHA requirements.
 - 1. Extend shoring and bracing to the bottom of the excavation. Shore excavations that are carried below the elevations of adjacent existing foundations.
- B. Excavation Drainage: Operate pumping equipment and/or provide other materials, means and equipment as required, to keep excavations free of water and subgrades dry, firm, and undisturbed until approval of permanent work has been received from Resident Engineer. Approval by the Resident Engineer is also required before placement of the permanent work on all subgrades. When subgrade for foundations has been disturbed by water, remove the disturbed material to firm undisturbed material after the water is brought under control. Replace disturbed subgrade in trenches by mechanically tamped sand or gravel. When removed disturbed material is located where it is not possible to install and properly compact disturbed subgrade material with mechanically compacted sand or gravel, the Resident Engineer should be contacted to consider the use of flowable fill.
- C. Blasting: Blasting shall be permitted only when authorized by the Resident Engineer. Blasting shall be done with explosives of such quantity and power, and fired in such sequence and locations as to not injure personnel, damage or crack rock against which concrete is to be placed, damage property, or damage existing work or other portions of new work. The Contractor shall be responsible for damage caused by blasting operations.
- D. Building Earthwork:
 - 1. Excavation shall be accomplished as required by drawings and specifications.
 - 2. Excavate foundation excavations to solid undisturbed subgrade.
 - 3. Remove loose or soft material to solid bottom.

4. Fill excess cut under footings or foundations with 3000 psi concrete, poured separately from the footings.
5. Do not tamp earth for backfilling in footing bottoms, except as specified.

D. Trench Earthwork:

1. Utility trenches (except sanitary and storm sewer):
 - a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
 - b. Grade bottom of trenches with bell-holes, scooped-out to provide a uniform bearing.
 - c. Support piping on undisturbed earth unless a mechanical support is shown.
 - d. The length of open trench in advance of pipe laying shall not be greater than is authorized by the Resident Engineer.
2. Sanitary and storm sewer trenches:
 - a. Trench width below a point 6 inches above top of the pipe shall be 24 inches for up to and including 12 inches diameter and four-thirds diameter of pipe plus 8 inches for pipe larger than 12 inches. Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.
 - b. The bottom quadrant of the pipe shall be bedded on undisturbed soil or granular fill.
 - 1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 12 inches above top of pipe shall be clean earth placed and tamped by hand.
 - 2) Granular Fill: Depth of fill shall be a minimum of 3 inches plus one-sixth of pipe diameter below the pipe of 12 inches above top of pipe. Place and tamp fill material by hand.
 - c. Place and compact as specified the remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.
 - d. Use granular fill for bedding where rock or rocky materials are excavated.

- E. Site Earthwork: Excavation shall be accomplished as required by drawings and specifications. Remove subgrade materials, that are determined by the Resident Engineer as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the Contractor shall obtain samples of the material, under the direction of the Resident Engineer, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. When unsuitable material is

encountered and removed, the contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL REQUIREMENTS as applicable. Adjustments to be based on meters (yardage) in cut section only.

F. Finished elevation of subgrade shall be as follows:

1. Pavement Areas - bottom of the pavement or base course as applicable.
2. Planting and Lawn Areas - 4 inches below the finished grade, unless otherwise specified or indicated on the drawings.

3.3 FILLING AND BACKFILLING

- A. General: Do not fill or backfill until all debris, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from the excavation. Proof-roll exposed subgrades with a fully loaded dump truck. Use excavated materials or borrow for fill and backfill, as applicable. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, and pipes coming in contact with backfill have been installed, and inspected and approved by Resident Engineer.
- B. Proof-rolling Existing Subgrade: Proof-roll with a fully loaded dump truck. Make a minimum of one pass in each direction. Remove unstable uncompactable material and replace with granular fill material completed to mix requirements specified.
- C. Placing: Place material in horizontal layers not exceeding 8 inches in loose depth and then compacted. Do not place material on surfaces that are muddy, frozen, or contain frost.
- D. Compaction: Use approved equipment (hand or mechanical) well suited to the type of material being compacted. Do not operate mechanized vibratory compaction equipment within 10 feet of new or existing building walls without the prior approval of the Resident Engineer. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Compact each layer to not less than 95 percent of the maximum density determined in accordance with the following test method AASHTO T99 Method A or ASTM D698 Method A.

3.4 GRADING

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points

where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.

- B. Cut rough or sloping rock to level beds for foundations. In unfinished areas fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside the building away from the building walls for a minimum distance of 6 feet.
- D. The finished grade shall be 6 inches below bottom line of windows or other building wall openings unless greater depth is shown.
- E. Place crushed stone or gravel fill under concrete slabs on grade tamped and leveled. The thickness of the fill shall be 6 inches, unless otherwise indicated.
- F. Finish subgrade in a condition acceptable to the Resident Engineer immediately in advance of the paving operations. Maintain finished subgrade in a smooth and compacted condition until the succeeding operation has been accomplished. Scarify, compact, and grade the subgrade prior to further construction when approved compacted subgrade is disturbed by contractor's subsequent operations or adverse weather.
- G. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 0.25 inches of indicated grades.

3.5 LAWN AREAS

- A. General: Harrow and till to a depth of 4 inches, new or existing lawn areas to remain, which are disturbed during construction. Establish existing or design grades by dragging or similar operations. Do not carry out lawn areas earthwork out when the soil is wet so that the tilth of the soil will be destroyed. Plant bed must be approved by Resident Engineer before seeding or sodding operation begins.
- B. Finished Grading: Begin finish grading after rough grading has had sufficient time for settlement. Scarify subgrade surface in lawn areas to a depth of 4 inches. Apply topsoil so that after normal compaction, dragging and raking operations (to bring surface to indicated finish grades) there will be a minimum of 4 inches of topsoil over all lawn areas; make smooth, even surface and true grades, which will not allow water to stand at any point. Shape top and bottom of banks to form reverse curves in section; make junctions with undisturbed areas to conform to existing topography. Solid lines within grading limits indicate finished contours. Existing contours, indicated by broken lines are believed approximately correct but are not guaranteed.
- C. Fertilizing: Incorporate fertilizer into the soil to a depth of 4 inches at a rate of 25 pounds per 1000 square feet.

- D. Seeding: Seed at a rate of 4 pounds per 1000 square feet and accomplished only during periods when uniform distribution may be assured. Lightly rake seed into bed immediately after seeding. Roll seeded area immediately with a roller not to exceed 150 pounds per foot of roller width.
- E. Sodding: Topsoil shall be firmed by rolling and during periods of high temperature the topsoil shall be watered lightly immediately prior to laying sod. Sod strips shall be tightly butted at the ends and staggered in a running bond fashion. Placement on slopes shall be from the bottom to top of slope with sod strips running across slope. Secure sodded slopes by pegging or other approved methods. Roll sodded area with a roller not to exceed 150 pounds per foot of the roller width to improve contact of sod with the soil.
- F. Watering: The Resident Engineer is responsible for having adequate water available at the site. As sodding is completed in any one section, the entire sodded area shall be thoroughly irrigated by the contractor, to a sufficient depth, that the underside of the new sod pad and soil, immediately below sod, is thoroughly wet. Resident Engineer will be responsible for sod after installation and acceptance.

3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Cemetery property.
- B. Place excess excavated materials suitable for fill and/or backfill on site where directed.
- C. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- D. Segregate all excavated contaminated soil designated by the Resident Engineer from all other excavated soils, and stockpile on site on two 0.15 mm (6 mil) polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State and Local requirements.

3.7 CLEAN-UP

- A. Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove debris, rubbish, and excess material from the Cemetery Property.

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SECTION 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Subbase for concrete pavements.
2. Curbs, gutters, and combination curbs and gutters.
3. Pedestrian Pavement: Walks, grade slabs, wheelchair curb ramps, steps, patios.
4. Equipment Pads

1.2 RELATED REQUIREMENTS

- A. Field Testing: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation and Subbase Compaction: Section 31 20 11, EARTH MOVING.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 1. M147-65-UL-04 - Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
 2. M233-86 - Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
- C. American Concrete Institute (ACI):
 1. 305R-10 - Guide to Hot Weather Concreting.
 2. 306R-10 - Guide to Cold Weather Concreting.
- D. American National Standards Institute (ANSI):
 1. B101.3 - Wet DOCF of Common Hard Surface Floor Materials (Including Action and Limit Thresholds for the Suitable Assessment of the Measured Values).
- E. ASTM International (ASTM):
 1. A615/A615M-16 - Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
 2. A996/A996M-15 - Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
 3. A1064/A1064M-16 - Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 4. C33/C33M-16 - Concrete Aggregates.

5. C94/C94M-16 - Ready Mixed Concrete.
6. C143/C143M-15a - Slump of Hydraulic Cement Concrete.
7. C150/C150M-16 - Portland Cement.
8. C171-16 - Sheet Materials for Curing Concrete.
9. C260/C260M-10a - Air Entraining Admixtures for Concrete.
10. C309-11 - Liquid Membrane Forming Compounds for Curing Concrete.
11. C494/C494M-15a - Chemical Admixtures for Concrete.
12. C618-15 - Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
13. C979/C979M-16 - Pigments for Integrally Colored Concrete.
14. C989/C989M-14 - Slag Cement for Use in Concrete and Mortars.
15. C1240-15 - Silica Fume Used in Cementitious Mixtures.
16. D1751-04(2013)e1 - Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
17. D5893/D5893M-10 - Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
18. D6690-15 - Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

1.4 PREINSTALLATION MEETINGS

- A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.
 1. Required Participants:
 - a. Contracting Officer's Representative.
 - b. Inspection and Testing Agency.
 - c. Contractor.
 - d. Installer.
 - e. Other installers responsible for adjacent and intersecting work, including excavation, plantings, traffic markings.
 2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
 - a. Installation schedule.
 - b. Installation sequence.
 - c. Preparatory work.
 - d. Protection before, during, and after installation.
 - e. Installation.
 - f. Terminations.
 - g. Transitions and connections to other work.

- h. Inspecting and testing.
- i. Other items affecting successful completion.
- 3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.5 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
 - 1. Show size, configuration, and fabrication and installation details.
 - 2. Show reinforcing.
 - 3. Include jointing plan for concrete pavements, curbs and gutters.
- C. Manufacturer's Literature and Data:
 - 1. Description of each product.
 - 2. Installation instructions.
- D. Samples:
 - 1. Exposed Aggregate Concrete Panel: 0.4 sq. m by 50 mm (4 sq. ft. by 2 inches) thick, 2 required, each color and finish.
- E. Test reports: Certify products comply with specifications.
 - 1. Concrete materials.
 - 2. Select subbase materials.
 - 3. Field test reports.
- F. Certificates: Certify products comply with specifications.
 - 1. Expansion joint filler.
 - 2. Reinforcement.
 - 3. Curing materials.
 - 4. Concrete protective coating.
- G. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Installer.
 - 2. Land surveyor.
- H. Concrete mix design.
- I. Select subbase job-mix design.
- J. Proposed hot and cold weather concreting methods.
- K. Land surveyor's construction staking notes, before placing concrete.
 - 1. Identify discrepancies between field conditions and Drawings.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Regularly installs specified products.

2. Installed specified products with satisfactory service on five similar installations.
 - a. Project Experience List: Provide contact names and addresses for completed projects.
- B. Land Surveyor: Professional land surveyor or engineer registered to provide land surveys in jurisdiction where project is located.
- C. Preconstruction Testing:
 1. Engage independent testing laboratory to perform tests and submit reports.
 - a. Deliver samples to laboratory in number and quantity required for testing.
 2. Concrete mix design.
 3. Select subbase job-mix design. Report the following:
 - a. Material sources.
 - b. Gradation.
 - c. Plasticity index.
 - d. Liquid limit.
 - e. Laboratory compaction curves indicating maximum density at optimum moisture content.

1.7 DELIVERY

- A. Deliver steel reinforcement to prevent damage.
- B. Before installation, return or dispose of distorted or damaged steel reinforcement.
- C. Bulk Products: Deliver bulk products away from buildings, utilities, pavement, and existing turf and planted areas. Maintain dry bulk product storage away from contaminants.

1.8 STORAGE AND HANDLING

- A. Store products indoors in dry, weathertight facility.
- B. Protect products from damage during handling and construction operations.

1.9 FIELD CONDITIONS

- A. Hot Weather Concreting Procedures: ACI 305R.
- B. Cold Weather Concreting Procedures: ACI 306R.
 1. Use non-corrosive, non-chloride accelerator admixture.
 2. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions.

1.10 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS**2.1 CONCRETE MATERIALS**

- A. Portland Cement: ASTM C150/C150M, Type I or II.
- B. Pozzolans:
1. Fly Ash: ASTM C618, Class C or F including supplementary optional physical requirements.
 2. Silica Fume: ASTM C1240.
- C. Coarse Aggregate: ASTM C33/C33M; size per drawings.
- D. Fine Aggregate: ASTM C33/C33M.
- E. Mixing Water: Fresh, clean, and potable.
- F. Air-Entraining Admixture: ASTM C260/C260M.
- G. Chemical Admixtures: ASTM C494/C494M.
- H. Reinforcing Steel: ASTM A615/A615M or ASTM A996/A996M, sized as indicated
- I. Welded Wire Fabric: ASTM A1064/A1064M, sized as indicated.
- J. Expansion Joint Filler: ASTM D1751.
- K. Sheet Materials for Curing Concrete: ASTM C171.

2.2 SELECT SUBBASE

- A. Subbase: AASHTO M147; as indicated.
1. Select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials.

SUBBASE GRADING REQUIREMENTS							
Sieve Size		Percentage Passing by Mass					
		Grades					
(mm)	(in)	A	B	C	D	E	F
50	2	100	100				
25	1		75-95	100	100	100	100
9.5	3/8	30-65	40-75	50-85	60-100		
4.47	No. 4	25-55	30-60	35-65	50-85	55-100	70-100
2.00	No. 10	15-40	20-45	25-50	40-70	40-100	55-100
0.425	No. 40	8-20	15-30	15-30	25-45	20-50	30-70

SUBBASE GRADING REQUIREMENTS							
Sieve Size		Percentage Passing by Mass					
		Grades					
0.075	No. 200	2-8	5-20	5-15	5-20	6-20	8-25

B. Other Acceptable Gradations: Materials within three to five percent, plus or minus, of specified gradation, or as recommended by the geotechnical engineer and approved by the Contracting Officer's Representative.

2.3 FORMS

- A. Forms: Wood, plywood, metal, or other materials, approved by Contracting Officer's Representative, of grade or type suitable to obtain type of finish specified.
1. Plywood: Exterior grade, free of defects and patches on contact surface.
 2. Lumber: Sound, grade-marked, S4S stress graded softwood, minimum 50 mm (2 inches) thick, free from warp, twist, loose knots, splits, or other defects.
 3. Form Coating: As recommended by Architect/Engineer.
- B. Provide forms suitable in cross-section, depth, and strength to resist springing during depositing and consolidating concrete.
1. Do not use forms varying from straight line more than 3 mm in 3000 mm (1/8 inch in 10 feet), horizontally and vertically.
- C. Provide flexible or curved forms for forming radii.

2.4 CONCRETE CURING MATERIALS

- A. Concrete curing materials, conform to one of the following:
1. Burlap: Minimum 233 g/sq. m (7 ounces/sq. yd.) dry.
 2. Sheet Materials for Curing Concrete: ASTM C171.
 3. Curing Compound: ASTM C309, Type 1 clear; liquid membrane forming type, without paraffin or petroleum.

CONCRETE MIXES

B. Design concrete mixes according to ASTM C94/C94M, Option C.

C. Concrete Type: Air-entrained. See Table I.

TABLE I - CONCRETE TYPES					
Concrete Type	Minimum 28 Day Compressive Strength f'c MPa (psi)	Non-Air-Entrained		Air-Entrained	
		Min. Cement kg/cu. m (lbs./cu. yd.)	Max. Water Cement Ratio	Min. Cement kg/cu. m (lbs./cu. yd.)	Max. Water Cement Ratio
A	35 (5000)1,3	375 (630)	0.45	385 (650)	0.40
B	30 (4000)1,3	325 (550)	0.55	340 (570)	0.50
C	25 (3000)1,3	280 (470)	0.65	290 (490)	0.55
D	25 (3000)1,2	300 (500)	*	310 (520)	*
Footnotes:					
1. If trial mixes are used, achieve compressive strength 8.3 MPa (1,200 psi) in excess of f'c. For concrete strengths greater than 35 MPa (5,000 psi), achieve compressive strength 9.7 MPa (1,400 psi) in excess of f'c.					
2. For Concrete Exposed to High Sulfate Content Soils: Maximum water cement ratio is 0.44.					
3. Laboratory Determined according to ACI 211.1 for normal weight concrete.					

D. Maximum Slump: ASTM C143/C143M. See Table II.

TABLE II - MAXIMUM SLUMP	
APPLICATION	MAXIMUM SLUMP
Curb & Gutter	75 mm (3 inches)
Pedestrian Pavement	75 mm (3 inches)
Vehicular Pavement	50 mm (2 inches) Machine Finished 100 mm (4 inches) Hand Finished
Equipment Pad	75 to 100 mm (3 to 4 inches)

2.5 ACCESSORIES

A. Equipment and Tools: Obtain Contracting Officer's Representative's, approval of equipment and tools needed for handling materials and performing work before work begins.

B. Maintain equipment and tools in satisfactory working condition.

C. Sealants:

1. Concrete Paving Expansion Joints: ASTM D5893/D5893M, Type SL, single component, self-leveling, silicone joint sealant.
 2. Concrete Paving Joints: ASTM D6690, Type IV, hot-applied, single component joint sealant.
- D. Concrete Protective Coating: AASHTO M233 linseed oil mixture.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Prepare, construct, and finish subgrade.
- D. Maintain subgrade in smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.2 SELECT SUBBASE

- A. Placing:
 1. Place subbase material on prepared subgrade in uniform layer to required contour and grades, and to maximum 200 mm (8 inches) loose depth.
 2. When required compacted thickness exceeds 150 mm (6 inches), place subbase material in equal thickness layers.
 3. When subbase elevation is 13 mm (1/2 inch) or more below required grade, excavate subbase minimum 75 mm (3 inches) deep. Place and compact subbase to required grade.
- B. Compaction:
 1. Perform compaction with approved hand or mechanical equipment well suited to the material being compacted.
 2. Maintain subbase at optimum moisture content for compaction.
 3. Compact each subbase layer to minimum 95 percent or 100 percent of maximum density as specified in Section 31 20 11, EARTH MOVING.
- C. Subbase Tolerances:
 1. Variation from Indicated Grade: Maximum 9 mm (3/8 inch).
 2. Variation from Indicated Thickness: Maximum 13 mm (1/2 inch).
- D. Protection:
 1. Protect subbase from damage until concrete is placed.
 2. Reconstruct damaged subbase before placing concrete.

3.3 SETTING FORMS

A. Form Substrate:

1. Compact form substrate to uniformly support forms along entire length.
2. Correct substrate imperfections and variations by cutting, filling, and compacting.

B. Form Setting:

1. Set forms to indicated line and grade with tight joints. Rigidly brace forms preventing movement.
2. Remove forms when removal will not damage concrete and when required for finishing.
3. Clean and oil forms before each use.
4. Correct forms, when required, immediately before placing concrete.

C. Land Surveyor: Establish control, alignment, and grade for forms and slip forming machine operations.

1. Notify Contracting Officer's Representative immediately when discrepancies exist between field conditions and drawings.
2. Correct discrepancies greater than 25 mm (1 inch) before placing concrete.

D. Form Tolerances:

1. Variation from Indicated Line: Maximum 6 mm (1/4 inch).
2. Variation from Indicated Grade: Maximum 3 mm in 3000 mm (1/8 inch in 10 feet).

3.4 PLACING REINFORCEMENT

- A. Keep reinforcement clean from contamination preventing concrete bond.
- B. Install reinforcement shown on drawings.
- C. Support and securely tie reinforcing steel to prevent displacement during concrete placement.
- D. Obtain Contracting Officer's Representative's reinforcement placement approval before placing concrete.

3.5 JOINTS - GENERAL

- A. Place joints, where shown on approved submittal Drawings.
 1. Conform to details shown.
 2. Install joints perpendicular to finished concrete surface.
- B. Make joints straight and continuous from edge to edge of pavement.

3.6 CONSTRUCTION JOINTS

- A. Place transverse construction joints of type shown, where indicated, and whenever concrete placement is suspended for more than 30 minutes.
- B. Provide butt-type joint with dowels in curb and gutter at planned joint locations.
- C. Provide keyed joints with tie bars when joint occurs in middle third of planned curb and gutter joint interval.

3.7 CONTRACTION JOINTS

- A. Tool or cut joints to width, depth, and radius edge shown on drawings using grooving tool, jointer, or saw.
- B. Construct joints in curbs and gutters by inserting 3 mm (1/8 inch) steel plates conforming to curb and gutter cross sections.
 - 1. Keep plates in place until concrete can hold its shape.
- C. Finish joint edges with edging tool.
- D. Score pedestrian pavement with grooving tool or jointer.

3.8 EXPANSION JOINTS

- A. Form expansion joints with expansion joint filler of thickness shown on drawings.
 - 1. Locate joints around perimeter of structures and features abutting site work concrete.
 - 2. Create complete, uniform separation between structure and site work concrete.
- B. Extend expansion joint material full depth of concrete with top edge of joint filler below finished concrete surface where sealant is indicated on Drawings.
- C. Cut and shape material matching cross section.
- D. Anchor with approved devices to prevent displacing during placing and finishing operations.
- E. Round joint edges with edging tool.

3.9 PLACING CONCRETE - GENERAL

- A. Preparation before Placing Concrete:
 - 1. Obtain Contracting Officer's Representative approval.
 - 2. Remove debris and other foreign material.
 - 3. Uniformly moisten substrate, without standing water.
- B. Convey concrete from mixer to final location without segregation or loss of ingredients. Deposit concrete to minimize handling.

- C. During placement, consolidate concrete by spading or vibrating to minimize voids, honeycomb, and rock pockets.
 - 1. Vibrate concrete against forms and along joints.
 - 2. Avoid excess vibration and handling causing segregation.
- D. Place concrete continuously between joints without bulkheads.
- E. Install construction joint in concrete placement suspended for more than 30 minutes.
- F. Replace concrete with cracks, chips, bird baths, and other defects to nearest joints, approved by Contracting Officer's Representative.

3.10 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS

- A. Place concrete in one layer conforming to cross section shown on Drawings after consolidating and finishing.
- B. Deposit concrete near joints without disturbing joints. Do not place concrete directly onto joint assemblies.
- C. Strike concrete surface to proper section ready for consolidation.
- D. Consolidate concrete by tamping and spading or with approved mechanical finishing equipment.
- E. Finish concrete surface with wood or metal float.
- F. Construct concrete pads and pavements with sufficient slope to drain, preventing standing water.

3.11 FORM REMOVAL

- A. Keep forms in place minimum 12 hours after concrete placement. Remove forms without damaging concrete.
- B. Do not use bars or heavy tools against concrete to remove forms. Repair damage concrete found after form removal.

3.12 CONCRETE FINISHING - GENERAL

- A. Follow operation sequence below, unless otherwise indicated on Drawings:
 - 1. Consolidating, floating, striking, troweling, texturing, and joint edging.
- B. Use edging tool with 6 mm (1/4 inch) radius, unless otherwise shown on Drawings.
- C. Keep finishing equipment and tools clean and suitable for use.

3.13 CONCRETE FINISHING - PEDESTRIAN PAVEMENT

- A. Walks, grade slabs, wheelchair curb ramps:

1. Finish concrete surfaces with metal float, troweled smooth, and finished with a broom moistened with clear water.
 2. Finish slab edges and formed transverse joints with edger.
 3. Broom surfaces transverse to traffic direction.
 - a. Use brooming to eliminate flat surface produced by edger.
 - b. Produce uniform corrugations, maximum 1.5 mm (1/16 inch) deep profile.
 4. Provide surface uniform in color and free of surface blemishes, form marks, and tool marks.
 5. Paving Tolerances:
 - a. Variation from Indicated Plane: Maximum 5 mm in 3000 mm (3/16 inch in 10 feet).
 - b. Variation from Indicated Thickness: Maximum 6 mm (1/4 inch).
 6. Replace paving within joint boundary when paving exceeds specified tolerances.
- B. Step Treads, Risers and Sidewalls: Finish as specified for pedestrian pavement, except as follows:
1. Remove riser forms sequentially, starting with top riser.
 2. Rub riser face with wood or concrete rubbing block and water. Remove blemishes, form marks, and tool marks. Use outside edger to round nosing; use inside edger to finish bottom of riser.
 3. Apply uniform brush finish to treads, risers, and sidewall.
 - a. Apply stiff brush finish to treads to provide slip resistant surface complying with ANSI B101.3.
 4. Step Tolerance:
 - a. Variation from Indicated Plane: Maximum 5 mm in 3000 mm (3/16 inch in 10 feet).

3.14 CONCRETE FINISHING - CURBS AND GUTTERS

- A. Round edges of gutter and top of curb with edging tool.
- B. Gutter and Curb Top:
 1. Float surfaces and finish with smooth wood or metal float until true to grade and section and uniform color.
 2. Finish surfaces, while still plastic, longitudinally with bristle brush.
- C. Curb Face:
 1. Remove curb form and immediately rub curb face with wood or concrete rubbing block removing blemishes, form marks, and tool marks and providing uniform color.

- 2. Brush curb face, while still plastic, matching gutter and curb top.
- D. Curb and Gutter Tolerances: Except at grade changes or curves.
 - 1. Variation from Indicated Plane and Grade:
 - a. Gutter: Maximum 3 mm in 3000 mm (1/8 inch in 10 feet).
 - b. Curb Top and Face: Maximum 6 mm in 3000 mm (1/4 inch in 10 feet).
- E. Replace curbs and gutters within joint boundary when curbs and gutters exceed specified tolerances.
- F. Correct depressions causing standing water.

3.15 CONCRETE FINISHING - EQUIPMENT PADS

- A. Strike pad surface to elevation shown on Drawings.
- B. Provide smooth, dense float finish, free from depressions or irregularities.
- C. Finish pad edges with edger.
- D. After removing forms, rub pad edge faces with wood or concrete rubbing block, removing blemishes, form marks, and tool marks and providing uniform color.
- E. Pad Tolerances:
 - 1. Variation from Indicated Plane: Maximum 3 mm in 3000 mm (1/8 inch in 10 feet).
 - 2. Variation from Indicated Elevation: Maximum 6 mm (1/4 inch).
 - 3. Variation from Indicated Thickness: Maximum 6 mm (1/4 inch).
- F. Replace pads when pads exceed specified tolerances.

3.16 CONCRETE CURING

- A. Concrete Protection:
 - 1. Protect unhardened concrete from rain and flowing water.
 - 2. Provide sufficient curing and protection materials available and ready for use before concrete placement begins.
 - 3. Protect concrete to prevent pavement cracking from ambient temperature changes during curing period.
 - a. Replace pavement damaged by curing method allowing concrete cracking.
 - b. Employ another curing method as directed by Contracting Officer's Representative.
- B. Cure concrete for minimum 7 days by one of the following methods appropriate to weather conditions preventing moisture loss and rapid temperature change:

1. Burlap Mat: Provide minimum two layers kept saturated with water during curing period. Overlap Mats at least 150 mm (6 inches).
2. Sheet Materials:
 - a. Wet exposed concrete surface with fine water spray and cover with sheet materials.
 - b. Overlap sheets minimum 300 mm (12 inches).
 - c. Securely anchor sheet materials preventing displacement.
3. Curing Compound:
 - a. Protect joints indicated to receive sealants preventing contamination from curing compound.
 - b. Insert moistened paper or fiber rope into joint or cover joint with waterproof paper.
 - c. Apply curing compound before concrete dries.
 - d. Apply curing compound in two coats at right angles to each other.
 - e. Application Rate: Maximum 5 sq. m/L (200 sq. ft./gallon), both coats.
 - f. Immediately reapply curing compound to surfaces damaged during curing period.

3.17 CONCRETE PROTECTIVE COATING

- A. Apply protective coating of linseed oil mixture to exposed-to-view concrete surfaces, drainage structures, and features that project through, into, or against concrete exterior improvements to protect the concrete against deicing materials.
- B. Complete backfilling and curing operation before applying protective coating.
- C. Dry and thoroughly clean concrete before each application.
- D. Apply two coats, with maximum coverage of 11 sq. m/L (50 sq. yds./gal.); first coat, and maximum 16 sq. m/L (70 sq. yds./gal.); second coat, except apply commercially prepared mixture according to manufacturer's instructions.
- E. Protect coated surfaces from vehicular and pedestrian traffic until dry.
- F. Do not heat protective coating, and do not expose protective coating to open flame, sparks, or fire adjacent to open containers or applicators. Do not apply material at temperatures lower than 10 degrees C (50 degrees F).

3.18 FIELD QUALITY CONTROL

- A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.
 - 1. Compaction.
 - a. Pavement subgrade.
 - b. Curb, gutter, and sidewalk.
 - 2. Concrete:
 - a. Delivery samples.
 - b. Field samples.
 - 3. Slip Resistance: Steps and pedestrian paving.

3.19 CLEANING

- A. After completing curing:
 - 1. Remove burlap and sheet curing materials.
 - 2. Sweep concrete clean, removing foreign matter from the joints.
 - 3. Seal joints as specified.

3.20 PROTECTION

- A. Protect exterior improvements from traffic and construction operations.
 - 1. Prohibit traffic on paving for minimum seven days after placement, or longer as directed by Contracting Officer's Representative.
- B. Remove protective materials immediately before acceptance.
- C. Repair damage.
 - 1. Replace concrete containing excessive cracking, fractures, spalling, and other defects within joint boundary, when directed by Contracting Officer's Representative, and at no additional cost to the Government.

- - - E N D - - -

SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Composition, mixing, and construction on prepared subgrade and protection of hot asphalt concrete pavement.
2. Pavement sealing.
3. Cold milling.
4. Patching.

1.2 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American Association of State Highway and Transportation Officials (AASHTO):

1. 2016 - Standard Specifications for Transportation Materials and Methods of Sampling and Testing, and AASHTO Provisional Standards.
2. M320-10 - Performance-Graded Asphalt Binder.
3. T283-14 - Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage.

C. Asphalt Institute:

1. Specification SS2.

D. ASTM International (ASTM):

1. C29/C29M-16 - Bulk Density ("Unit Weight") and Voids in Aggregate.
2. C977-10 - Quicklime and Hydrated Lime for Soil Stabilization.
3. D3786/D3786M-13 - Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method.
4. D4355/D4355M-14 - Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
5. D4632/D4632M-15a - Grab Breaking Load and Elongation of Geotextiles.
6. D6390-11 - Draindown Characteristics in Uncompacted Asphalt Mixtures.

E. National Asphalt Paving Association (NAPA):

1. PS-33 (2009) - Porous Asphalt Pavements.

1.3 PREINSTALLATION MEETINGS

- A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.

1. Required Participants:
 - a. Contracting Officer's Representative (COR).
 - b. Engineer.
 - c. Inspection and Testing Agency.
 - d. Contractor.
 - e. Installer.
2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
 - a. Installation schedule.
 - b. Installation sequence.
 - c. Preparatory work.
 - d. Protection before, during, and after installation.
 - e. Installation.
 - f. Terminations.
 - g. Transitions and connections to other work.
 - h. Inspecting and testing.
 - i. Other items affecting successful completion.
3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 1. Concrete wheel stops.
- C. Test Reports: Certify products comply with specifications.
 1. Aggregate Base Course.
 2. Porous Asphalt and Asphalt Base/Surface Course.
 3. Job-mix formula.
- D. Certificates: Certify products comply with specifications.
 1. Asphalt prime and tack coat material complying with State Highway Department requirements.
 2. Asphalt cement complying with State Highway Department requirements.
 3. Job-mix certification that mix equals or exceeds State Highway Specification.
- E. Qualifications: Substantiate qualifications comply with specifications.
 1. Manufacturer with project experience list.
 2. Land Surveyor.
- F. One copy of State Highway Department Specifications (Latest Edition).

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Regularly manufactures specified products.
 - 2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
- B. COR to have access to all parts of material producing plants to check mixing operations and materials and adequacy of equipment.
- C. Land Surveyor: Professional land surveyor or engineer registered to provide land surveys in jurisdiction where project is located.
- D. Preconstruction Testing:
 - 1. Engage independent testing laboratory to perform tests and submit reports.
 - 2. Asphalt Base Course:
 - a. Test sources, gradation, liquid limit, plasticity index, percentage of wear, and other properties required by State Highway Department.
 - 3. Porous Asphalt and Asphalt Base/Surface Course:
 - a. Test aggregate source, gradation, soundness loss, percentage of wear, and other properties required by State Highway Department.

1.6 FIELD CONDITIONS

- A. Environment:
 - 1. Do not begin asphaltic concrete material placement when atmospheric temperature is below 10 degrees C (50 degrees F), nor during fog, rain, or other unsuitable conditions.

1.7 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS**2.1 ASPHALT PAVING AGGREGATES**

- A. Aggregates: Crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.
- B. Subbase Aggregate: Maximum 38 mm (1-1/2 inches).
- C. Base Aggregate Maximum Size:
 - 1. Base course over 152 mm (6 inches) thick: 38 mm (1-1/2 inches).
 - 2. Other base courses: 19 mm (3/4 inch).
- D. Asphaltic Base Course:

1. Maximum Particle Size: 25 mm (1 inch).
 2. In conflicts between this specification and requirements in latest version of State Highway Specifications, State Specifications take precedence.
- E. Aggregates for Asphaltic Concrete Paving: Mixture of sand, mineral aggregate, and liquid asphalt in proportions with percentage by weight within the following:

Sieve Sizes	Percentage Passing
19 mm(3/4 inch)	100
9.5 mm(3/8 inch)	67 to 85
6.4 mm(1/4 inch)	50 to 65
2.4 mm(No. 8 mesh)	37 to 50
600 μ m(No. 30 mesh)	15 to 25
75 μ m(No. 200 mesh)	3 to 8

1. Plus 50/60 penetration liquid asphalt at 5 percent to 6-1/2 percent of combined dry aggregates.

2.2 NON-WOVEN GEOTEXTILE FABRIC

- A. Fabric: Needled nonwoven polypropylene fibers with the following properties:
1. Grab Tensile Strength (ASTM D4632) \geq 55 kg (120 lbs.).
 2. Mullen Burst Strength (ASTM D3786) \geq 1550 kPa (225 psi).
 3. Flow Rate (ASTM D4491) \geq 360 l/min/0.09 sq. m (95 gal/min/sq. ft.).
 4. UV Resistance after 500 hours (ASTM D4355) \geq 70 percent.
 5. Heat-set or heat-calendared fabrics are not acceptable.

2.3 ASPHALTS

- A. Comply with Asphalt Institute Specification SS2:
1. Asphalt cement: Penetration grade 50/60.
 2. Prime coat: Cut-back type, grade MC-250.
 3. Tack coat: Uniformly emulsified, grade SS-1H.

2.4 POROUS PAVING ASPHALT MIX

- A. Bituminous Surface Course: 64 mm (2-1/2 inches) thick with bituminous mix of 5.75 to 6 percent by weight dry aggregate. Maximum binder drain down of 0.3percent according to ASTM D6390. If more absorptive aggregates such as limestone, are used in mix, then base bitumen amount on NAPA P-33 testing procedures or DOT equivalent.

- B. Neat Asphalt Binder: Modified with elastomeric polymer to produce binder meeting AASHTO M320 PG 76-22 requirements. Apply styrene-butadiene-styrene (SBS) elastomer polymer, or approved equal, at rate of 3percent by weight of total binder. Thoroughly blend composite materials at asphalt refinery or terminal before loading transport vehicle. Polymer modified asphalt binder to be heat and storage stable.
- C. Asphalt: Minimum 90 percent crushed material with gradation as follows:
- | | |
|-----------------------------|------------------|
| 1. U.S. Standard Sieve Size | Percent Passing. |
| a. 1/2 (12.5mm) | 100. |
| b. 3/8 (9.5 mm) | 92-98. |
| c. 4 (4.75 mm) | 34-40. |
| d. 8 (2.36 mm) | 14-20. |
| e. 16 (1.18 mm) | 7-13. |
| f. 30 (0.60 mm) | 0-4. |
| g. 200 (0.075 mm) | 0-2. |
- D. Hydrated Lime: ASTM C977 Add at dosage rate of 1.0 percent by weight of total dry aggregate to mixes containing granite. Additive must prevent separation of asphalt binder from aggregate and achieve required tensile strength ratio (TSR) of minimum 80percent on asphalt mix when tested according to AASHTO T283. Test asphaltic mix for resistance to stripping by water according to ASTM D-1664. If estimated coating area is not above 95 percent, add anti-stripping agents to asphalt.
- E. Do not install pervious pavement on wet surfaces or when ambient air temperature is 10 degrees C (50 degrees F) or lower. Bituminous mix temperature to be between 148 degrees and 177 degrees C (300 degrees F and 350 degrees F), based on asphalt supplier's recommendations.

2.5 SEALER

- A. Sealer: Suitable fibrated chemical type asphalt base binders and fillers with container consistency suitable for troweling after thorough stirring, and containing no clay or other deleterious substance.
- B. In conflicts between this specification and requirements in latest version of State Highway Specifications, State Specifications take precedence.

2.6 ANCILLARY MATERIALS

- A. Herbicide: Commercial chemical for weed control, registered by EPA. Provide in granular, liquid or wettable powder form.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Land Surveyor to establish and control pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on Drawings.

3.2 MIXING ASPHALTIC CONCRETE MATERIALS

- A. Provide hot plant-mixed asphaltic concrete paving materials.
 - 1. Temperature leaving plant: 143 degrees C (290 degrees F) minimum, 160 degrees C (320 degrees F) maximum.
 - 2. Temperature at time of placing: 138 degrees C (280 degrees F) minimum.

3.3 SUBGRADE

- A. Shape to line and grade and compact with self-propelled rollers.
- B. Fill depressions developed under rolling with acceptable material and re-roll area.
- C. Remove soft areas, fill with acceptable materials and re-roll area.
- D. If subgrade becomes rutted or displaced before the placing of subbase, rework subgrade to bring to line and grade.
- E. Proof-roll subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by COR. If pumping, pushing, or other movement is observed, rework area to provide stable and compacted subgrade.
- F. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rate and written instructions. Apply to dry subgrade of surface of compacted aggregate base before applying paving materials.

3.4 BASE COURSES

- A. Subbase:
 - 1. Spread and compact to thickness shown on drawings.
 - 2. Begin rolling at sides, continue toward center, and continue until there is no movement ahead of roller.
 - 3. After completion of subbase rolling, no hauling is permitted over subbase, except top course material delivery.
- B. Base:
 - 1. Spread and compact to thickness shown on Drawings.

2. Begin rolling sides, continue toward center, and continue until there is no movement ahead of roller.
3. After completion of base rolling, no hauling is permitted over base except top course material delivery.
- C. Thickness Tolerance: Compacted thicknesses shown on Drawings within minus 0.0 mm (0.0 inches) to plus 12.7 mm (0.5 inch).
- D. Smoothness Tolerance: Lines and grades shown on Drawings within 5 mm in 3 m (3/16 inch in 10 feet).
- E. Moisture Content: Only amount required to achieve specified compaction.

3.5 ASPHALTIC CONCRETE PAVING PLACEMENT

- A. Remove all loose materials from compacted base.
- B. Apply prime coat, and tack coat where required, and allow to dry according to manufacturer's instructions as approved by Architect.
- C. Receipt of Asphaltic Concrete Materials:
 1. Do not accept material unless covered with tarpaulin until unloaded, and unless material is minimum 130 degrees C (280 degrees F).
 2. Do not begin asphaltic concrete material placement when atmospheric temperature is below 10 degrees C (50 degrees F), nor during fog, rain, or other unsuitable conditions.
- D. Spreading:
 1. Spread material with minimal handling.
 2. For finished paving 76 mm (3 inches) or less, spread in one layer.
- E. Rolling:
 1. After material has been spread to proper depth, roll until surface is hard, smooth, unyielding, and true to thickness and elevations shown on drawings.
 2. Roll in minimum two directions until no roller marks are visible.
 3. Finished paving smoothness tolerance:
 - a. No depressions which will retain standing water.
 - b. Maximum deviation: 3 mm in 1.8 m (1/8 inch in 6 feet).

3.6 SEAL COAT APPLICATION

- A. Prepare surfaces, mix seal coat material, and apply according to manufacturer's instructions as approved by Architect.
- B. Apply one coat of sealer.
- C. Finished surface seal, when dry and thoroughly set, to be smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.

3.7 COLD MILLING

- A. Clean existing pavement surface of loose or deleterious material immediately before cold milling. Remove existing asphalt pavement to grades and cross sections indicated on Drawings.
 - 1. Mill to 50 mm (2 inches).

3.8 PATCHING

- A. Hot Mix Asphalt Pavement: Sawcut patch perimeter and excavate existing pavement to sound base. Excavate rectangular or trapezoidal patches, extending 300 mm (12 inches) into adjacent sound pavement, unless otherwise indicated on drawings. Cut excavation faces vertically. Remove excavated material. Recompact existing aggregate base course to provide new subgrade.
- B. Tack Coat: Apply uniformly to vertical and horizontal surfaces abutting area to receive new hot mix asphalt paving at rate of 0.2 to 0.7 L/sq. m. (0.05 to 0.15 gal./sq.yd).
 - 1. Allow tack coat to cure before applying hot mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, remove spillage and clean affected surfaces.
- C. Patching: Fill excavated pavement with hot mix asphalt base mix for full thickness of patch; while still hot, compact flush with adjacent pavement surface.

3.9 CLEANING

- A. Remove debris, rubbish, and excess material from project site.

3.10 PROTECTION

- A. Protect asphaltic concrete paved areas from traffic until sealer is set and cured and does not pick up under foot or wheeled traffic.
- B. Repair damage.

- - - E N D - - -

SECTION 32 90 00
PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION AND REQUIREMENTS

- A. This work consists of furnishing and installing all planting materials required for landscaping at all NCA construction projects hereinafter specified in locations as shown. The landscape contractor shall be required to visit the site prior to submitting Bid Proposal to become familiar with all conditions affecting the proposed work. The contractor shall identify and review all underground utility locations prior to commencing work and shall exercise caution when working close to utilities and shall notify the Resident Engineer (RE) and/or Contracting Officer's Technical Representative (COTR) of apparent conflicts with construction and utilities so that adjustment can be planned prior to installation.
- B. Agronomic consultation on the appropriateness of all plant materials proposed for installation during this project must be obtained from the MSN Agronomist and/or NCA Chief Agronomist via coordination through the RE and/or COTR prior to project initiation and actual plant installation. In general, all plant material must be regionally adapted to the climate of the site, be of appropriate mature dimensions to fit the planting location and be low maintenance species. This requirement will generally exclude or severely limit the use of rose plants, wild flowers and ground covers.
- C. Any exceptions to these species exclusions must be approved by the MSN Agronomist and/or NCA Chief Agronomist via coordination through the RE and / COTR prior to project initiation.

1.2 EQUIPMENT

- A. Maintain all equipment, tools and machinery while on the project in sufficient quantities and capacity for proper execution of the work.

1.3 RELATED WORK

- A. Section 31 20 11, EARTH MOVING, Short Form.
- B. Section 01 45 29, TESTING LABORATORY SERVICES, Topsoil Testing.
- C. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.4 SUBMITTALS

A. Samples: Submit the following samples for approval before work is started:

Inert Mulch	2.3 kg (5 pounds) of each type to be used.
Organic Mulch	2.3 kg (5 pounds) of each type to be used.
All pesticides required such as preemergence or post emergence herbicides, insecticides, or fungicides.	EPA approved labeling and MSDS sheet for each such product selected for use.

B. Certificates of Conformance or Compliance: Before delivery, notarized certificates attesting that the following materials meet the requirements specified shall be submitted to the Resident Engineer for approval:

1. Plant Materials (Department of Agriculture certification by State Nursery Inspector from the state in which the plant material originates declaring material to be free from insects and disease).
2. Fertilizers
3. Lime
4. Peat
5. Sod
6. Membranes

C. Manufacturer's Literature and Data:

1. Antidesiccant
2. Pre-emergent herbicide

D. Soil laboratory testing results and any soil amendment recommendations from the Contractor. Submit soil test results for each variable soil type and condition that exists on the construction site.

1. Organic Soil Amendment and Imported Topsoil: The Contractor shall provide a 5 pound representative sample from each proposed source for testing, analysis, and approval. Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the Resident Engineer. Testing reports shall include the following tests and recommendations.
 - a. Mechanical gradation (sieve analysis) and chemical (pH soluble salts) shall be performed by public extension service agency or a certified private testing laboratory in accordance with the current standards of the Association of Official Agricultural Chemists. A hydrometer shall be used to determine percent of clay and silt.
 - b. Percent of organics shall be determined by the loss on ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 110 °C, plus or minus 5°C.

- c. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Soluble Salts, and acidity (pH).
 - d. Tests, as specified, for gradation, organics, soil chemistry and pH shall be performed by a testing laboratory retained by the Department of Veterans Affairs as described in Section 01410, TESTING LABORATORY SERVICES.
 - e. Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies as necessary, and for fertilizing and liming applications to support successful turfgrass growth.
 - f. All tests shall be performed in accordance with the current standards of the Association of Official Agricultural Chemists.
2. Amended soil (in place): Following the incorporation of amendments and additives, the Contractor shall provide a minimum of six (6) samples per forty thousand (40,000) square feet, six inch (6") depth by three inch (3") diameter core samples of amended soil taken from the site for testing, analysis, and approval. The location of each sample shall be as directed by the Resident Engineer from areas designated to receive turfgrass. Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the Resident Engineer. Tests shall be as directed in paragraph 1.4 E.1.d. of this Section.
3. Fertilizer: Submit four (4) certificates of analysis for each type of fertilizer.

1.5 DELIVERY AND STORAGE

A. Delivery:

- 1. Notify the Resident Engineer of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site. Remove unacceptable plant material from the job site immediately.
- 2. Protect plants during delivery to prevent damage to root balls or desiccation of leaves.
- 3. Deliver fertilizer and lime to the site in the original, unopened containers bearing the manufacturer's warranted chemical analysis, name, trade name or trademark, and in conformance to state and federal law. In lieu of containers, fertilizer and lime may be furnished in bulk and a certificate indicating the above information shall accompany each delivery.
- 4. During delivery Protect sod from drying out.

B. Storage:

- 1. Sprinkle sod with water and cover with moist burlap, straw or other approved covering, and protect from exposure to wind and direct sunlight. Covering should permit air circulation to alleviate heat development.
- 2. Keep lime and fertilizer in dry storage away from contaminants.

3. Store plants not installed on the day of arrival at the site as follows:
 - a. Shade and protect plants from the wind when stored outside.
 - b. Keep plants, including those in containers, in a moist condition until planted, by watering with fine mist spray.

1.6 PLANTING AND TURFGRASS INSTALLATION SEASONS AND CONDITIONS

- A. Perform landscape planting operations within the following dates: From [to be determined] March 1 to May 15th for spring and from [to be determined] October 15th to November 15th for fall. All planting dates for this project shall be approved through consultation with the appropriate NCA MSN Agronomist
- B. Perform turfgrass installation operations within the following dates. All planting dates for this project shall be approved through consultation with the appropriate NCA MSN Agronomist.
 1. Spring Planting: [to be determined] March 20th to May 20th.
 2. Fall Planting: [to be determined] August 10th to October 1st.
- C. No work shall be done when the ground is frozen, snow covered, too wet or in an otherwise unsuitable condition for planting. Special conditions may exist that warrants a variance in the specified planting dates or conditions. Submit a written request to the Resident Engineer stating the special conditions and proposal variance for approval.

1.7 LANDSCAPE PLANT AND TURF ESTABLISHMENT PERIOD

- A. The Establishment Period for landscape plants and turfgrass shall begin immediately after installation, with the approval of the RE, PM or COTR and continue for a period of time during the growing season sufficiently long (optimally a minimum of 3 months) for the turfgrass and landscape plant materials to achieve an establishment condition and appearance satisfactory to the MSN Agronomist and NCA. These conditions and appearance are described as follows: Turfgrass shall have obtained a minimum of 98% surface cover that is generally weed-free and Landscape Plant Materials shall be fully rooted, actively growing and healthy and planting beds generally weed-free. The contractor shall be responsible for the health and maintenance of plants and turfgrass during the establishment period. Plants and turfgrass will not be accepted until after completion of an acceptable establishment period. During the Landscape Plant and Turfgrass Establishment Period the Contractor shall:
 1. Water all plants and turfgrass to maintain a moist soil surface at all times until the plants and turfgrass are well established. An adequate supply of moisture must also be maintained within the root zone. Apply water at a moderate rate so as not to displace the mulch, create any water ponding or runoff from the soil supporting the plants and turfgrass. The actual quantity of applied water required to achieve and maintain these conditions is best determined on site by the MSN Agronomist in consultation with the Project Engineer.
 2. Prune plants and replace mulch as required.

3. Replace and restore eroded plant saucers as required.
4. In plant beds and saucers, remove grass, weeds, and other undesired vegetation, including the root growth, before they reach a height of 75 mm (3 inches). After all unwanted vegetation has been removed and proper mulch quantities have been placed/restored, treat all mulched areas with pre-emergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination.
5. Spray with approved insecticides and fungicides to control pests and ensure plant survival in a healthy growing condition, as directed by the Resident Engineer in coordination with the MSN Agronomist.
6. Provide the following during turfgrass establishment:
 - a. Eradicate all weeds. Water, fertilize, and perform any other operation necessary to promote the growth of turfgrass.
 - b. Mow the turfgrasses as often as necessary to maintain the NCA specified mowing height for each type of turfgrass prior to final acceptance. Begin mowing when cool season turfgrass is 100 mm (4 inches) high. Final mowing height is 65 mm (3.0 inch) for cool season turfgrasses and mow as often as necessary to maintain the proper height while never removing more than 1/3 of the total height of grass leaves in a single mowing. Mow any portion of the newly developing turfgrass stand that requires mowing without waiting for other areas of slowly developing seedlings to catch-up.
7. Replace dead, missing or defective plant material during the establishment period and an active growing season. Immediately replace each plant with one of the same size and species.
8. Replant any areas void of turfgrass during an active growing season only.
 - a. Sod shall be evaluated for species and health thirty (30) days after laying the last piece of sod and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from the sod operation shall be living sod uniform in color and leaf texture. Bare spots shall be a maximum two (2) square inches. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
9. Complete remedial measures directed by the RE/COTR in consultation with the MSN Agronomist to ensure plant and turfgrass survival.
10. Repair damage caused while making plant or turfgrass replacements.

1.8 LANDSCAPE PLANT AND TURFGRASS ACCEPTANCE.

- A. Landscape plant and turfgrass acceptance will occur after completion of the landscape plant and turfgrass establishment period. The Contractor shall have completed, located, and installed all plants and turfgrass according to the plans and specifications. All plants and turfgrass are expected to be living and in a healthy condition at the time of inspection and acceptance. The Contractor shall make a written request two weeks prior to final inspection

of the landscape plants and turfgrass. Upon inspection when work is found to not meet the specifications, the plant and turfgrass establishment period shall be extended at no additional cost to the Owner until work has been satisfactorily completed, inspected and accepted.

B. Criteria for acceptance of landscape plants.

1. Planter beds and earth mound water basins are properly mulched and free of weeds.
2. Total plants on site as required by specifications and required number of replacements have been installed.
3. Remedial measures directed by the Contracting Officer to ensure plant material survival and promote healthy growth have been completed.

C. Criteria for acceptance of turfgrass shall be as follows:

1. A satisfactory stand of grass plants from the sod operation shall be living sod uniform in color and leaf texture and well rooted into the soil below so that gentle pulling of the turfgrass leaves by hand does not dislodge the sod. Bare spots shall be a maximum two (2) square inches. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
2. A satisfactory stand of turfgrass plants from the seeding operation shall be 98% coverage uniform in color and leaf texture. Bare spots shall be a maximum of one-half (0.5) square foot.

1.9 PLANT AND TURFGRASS WARRANTY

A. All work shall be in accordance with the following:

1. A One Year Plant and Turfgrass Warranty will begin on the date that the owner accepts the plants and turfgrass but not before the end of the Landscape Plant and Turfgrass Establishment Period.
2. The Contractor will replace any dead plant material and any areas void of turfgrass immediately during the warranty period and during an active growing season. A one year warranty for the plants and turfgrass that are replaced will begin on the day the replacement work is completed and accepted.
3. The Owner will reinspect all replacement plants and turfgrass at the end of the One Year Warranty. The Contractor will replace any dead, missing, or defective plant material and turfgrass immediately and during an active growing season. The Warranty will end on the date of this inspection provided the Contractor has complied with the work required by this specification.

1.10 APPLICABLE PUBLICATIONS

- A. NCA Handbook 3420 - Turfgrass Maintenance in VA National Cemeteries re-certified 2011. The Agronomic and Horticultural practices specified in this handbook shall serve as the contractor's official reference guide to all establishment and preliminary maintenance practices employed during this construction project.

- B. The publications listed below, form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- C. American National Standards Institute (ANSI) Publications:
 - ANSI Z60.1-04 Nursery Stock
 - ANSI Z133.1-06 Tree Care Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush-Safety Requirements
- D. Hortus Third, most current edition. A Concise Dictionary of Plants Cultivated in the U.S. and Canada.
- E. American Society for Testing and Materials (ASTM) Publications:
 - C136-06 Sieve Analysis of Fine and Coarse Aggregates
 - C516-08 Vermiculite Loose Fill Thermal Insulation
 - C549-06 Perlite Loose Fill Insulation
 - D977-05 Emulsified Asphalt (AASHTO M140)
 - D1557-09 Test Methods for Laboratory Compaction of Soil
 - D2028-97 (Rev. 2004) ... Cutback Asphalt (Rapid-curing Type)
 - D2103-08 Polyethylene Film and Sheeting
 - D5851 (Rev 2006) Planning and Implementing a Water Monitoring Program
- F. Turfgrass Producers International: Turfgrass Sodding.
- G. U. S. Department of Agriculture Federal Seed Act.
 - Amended July 2011 Rules and Regulations

PART 2 - PRODUCTS

2.1 GENERAL

- A. All plant and turfgrass material will conform to the varieties specified or shown in the drawings and be true to botanical name as listed in Hortus Third.

2.2 ORGANIC SOIL AMENDMENT

- A. All areas to receive turfgrass sodding may require an organic soil amendment to increase organic content and water retention as well as enhance turfgrass growth. If native topsoil has an organic matter content below 4% it should be amended in-place after grading activities are completed to effectively create a satisfactory topsoil horizon.
- B. Organic soil amendment will be spread and incorporated into the finished subgrade at the depths indicated on the Contract Drawings in order to raise the organic content of the soil to a minimum of four percent (4%) and a maximum of six percent (6%). Contractor will allow for additional depth of the organic soil amendment to bring all grades to the required finished grades as per the grading plans.
 - 1. Organic Soil Amendment shall be dark brown or black in color and capable of enhancing plant growth. Ninety-eight percent (98%) of the material

should pass a one inch (1") screen. There shall be no admixture of refuse (i.e. noticeable inert contamination) or other materials toxic to plant growth.

2. Acceptable types of Organic Soil Amendments include peat moss, humus or peat, well rotted manure, various mature composts, and commercially available combinations thereof. Acceptable compost may be derived from natural organic sources such as food or animal residuals, yard trimmings, or biosolids. Organic Soil Amendment shall be free of all woody fibers, seeds, and leaf structures, plastic and other petroleum products, and free of toxic and non-organic matter. Unacceptable sole sources of organic matter include untreated sludge from wastewater treatment plants, fresh manure, sawdust, and immature composts.
3. Organic Soil Amendment shall conform to the following minimum material requirements:

Test Parameter	Acceptable Ranges
Organic Matter	27% to 80%
pH	5.5-8.5
Ash	20-65%
Nitrogen	0.4%-3.5%
Phosphorus	0.2%-1.5%
Potassium	0.4%-1.5%
C:N Ratio	25-30:1
CEC	50-150 meq/100 g
Heavy Metals	Less than max. limits established by EPA 503
Inert Contents	< 1% by weight
Water-Holding Capacity	150-200%
Pathogen/Weed Seed Destruction	Proof of EPA minimum Heating requirements

4. Organic content to be determined by the loss of ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 110 °C, plus or minus 5°C.
5. Any topsoil stripped and stockpiled on the site may be used provided that, after testing and addition of necessary additives, it meets the above specification. The Contractor shall provide additional Organic Soil Amendment as required to complete the required work.
6. All Organic Soil Amendment proposed for use shall be tested for conformance to the specifications and results provided to the RE/COTR/MSN Agronomist.

2.3 PLANTS

- A. Plants shall be in accordance with ANSI Z60.1 Where the drawings or specifications are in conflict with ANSI Z60.1, the drawings and specification shall prevail.
- B. Provide well-branched and formed planting stock, sound, vigorous, and free from disease, sunscald, windburn, abrasion, harmful insects or insect eggs with healthy, normal, and unbroken root systems. Provide evergreen shrubs with well developed symmetrical tops with typical spread of branches for each particular species or variety. Plants shall have been grown under climatic conditions similar to those in the locality of the project.
- C. The minimum acceptable sizes of all plants, measured before pruning with branches in normal position, shall conform to the measurements designated. Plants larger in size than specified may be used with the approval of the Resident Engineer, with no change in the contract price. When larger plants are used, increase the ball of earth or spread of roots in accordance with ANSI Z60.1.
- D. Provide nursery grown, Grade 1, plant material conforming to the requirements and recommendations of ANSI Z60.1. Dig and prepare plants for shipment in a manner that will not cause damage to branches, shape, and future development after planting.
- E. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.
- H. Make substitutions only when a plant (or its alternates as specified) is not obtainable and the Resident Engineer in consultation with the MSN Agronomist authorizes a change order providing for use of the nearest equivalent obtainable size or variety of plant having the same essential characteristics with an equitable adjustment of the contract price.

2.4 LABELS

- A. Each plant, or group and bundles or containers of the same species, variety, and size of plant, shall be legibly tagged with a durable, waterproof and weather-resistant label indicating the correct plant name and size specified in the plant list. Labels shall be securely attached and not be removed.

2.5 TOPSOIL

- A. Topsoil shall be a well-graded soil of good uniform quality. It shall be a natural, friable soil representative of productive soils in the vicinity. Topsoil shall be free of admixture of subsoil, foreign matter, objects larger than 25 mm (one inch) in any dimension, toxic substances, weeds and any material or substances that may be harmful to plant growth and shall have a pH value of not less than 6.0 nor more than 7.0, and should be best suited to the region, climate and plant material specific to the project.

- B. If sufficient topsoil is not available on the site to meet the depth as specified herein, the Contractor shall furnish additional topsoil. At least 10 days prior to topsoil delivery, notify the Resident Engineer of the source(s) from which topsoil is to be furnished. Obtain topsoil from well drained areas. Additional topsoil shall meet the general requirements as stated above and comply with the requirements specified in Section 01 45 29, TESTING LABORATORY SERVICES. Amend topsoil not meeting the pH range specified by the addition of pH adjusters.

2.6 LIME

- A. Lime shall be agricultural limestone containing not less than 90 percent calcium and magnesium carbonates. Lime must be ground to such fineness that not less than 90% must pass No. 8 mesh and not less than 25% must pass No. 100 mesh. Moisture is not to exceed 10%.

2.7 SOIL CONDITIONERS

- A. Peat shall be a natural product of sphagnum moss peat or peat moss derived from a fresh-water site conforming to Fed. Spec. Q-P-166, except as otherwise specified. Peat shall be shredded and granulated to pass through a 13 mm (1/2 inch) mesh screen and conditioned in storage piles for at least six months after excavation.
- B. Coarse Sand: Coarse concrete sand, ASTM C-33 Fine Aggregate, shall be clean, sharp, and free of limestone, shale and slate particles and of toxic materials.
- C. Perlite shall conform to ASTM C549.
- D. Vermiculite shall be horticultural grade and free of any toxic materials and conform to ASTM C516.
- E. Pine Bark shall be horticultural-grade milled pine bark, with 80 percent of the material by volume sized between 0.1 and 15.0 mm. (.004in. and .59in.).
1. Pine bark shall be aged sufficiently to break down all woody material.
Pine bark shall be screened
 2. pH shall range between 4.0 and 7.0.
 3. Submit manufacturer's literature for approval.
- F. Organic Matter shall be commercially prepared compost, composted sufficiently to be free of all woody fibers, seeds, and leaf structures, and free of toxic and nonorganic matter.

2.8 PLANTING SOIL MIXTURE

- A. The planting soil mixture shall be composed of 3 parts topsoil, and 1 part peat moss.

2.9 PLANT FERTILIZERS

- A. Provide plant fertilizer that is commercial grade and uniform in composition and conforms to applicable state and federal regulations.
- B. For new plant material, provide a uniform free-flowing granular complete analysis fertilizer containing a minimum of 10% by weight of nitrogen, phosphoric acid and potash with a minimum of 50% of the nitrogen from a controlled release source such as sulfur coated urea.

2.10 TURFGRASS FERTILIZER

- A. Provide turfgrass fertilizer that is commercial grade, free flowing, uniform in composition, and conforms to applicable state and federal regulations. Granular fertilizer shall bear the manufacturer's warranted statement of analysis. Granular fertilizer shall contain a minimum percentage by weight of 20% nitrogen (of which 50 percent shall be from a controlled release source such as sulfur coated urea), 5% available phosphoric acid, and 15% potash. Liquid starter fertilizer for use in the hydro mulch slurry will be commercial type with 50 percent of the nitrogen from a controlled release source.

2.11 MEMBRANES

- A. Landscape Fabric shall be a woven needle-punched polypropylene weighing 113 grams per square meter (4.8 oz. per sq. yd.) And a 950 liter per minute flow rate per sq. meter. (90 gal. per minute flow rate per sq. ft.)

2.12 MULCH

- A. Mulch shall be free from deleterious materials and shall be stored as to prevent inclusion of foreign material.
- B. Organic mulch materials shall be shredded hardwood bark.

2.13 EDGING

- A. As a general requirement no artificial or constructed product shall be used to edge landscape beds that are bordered by turfgrass. Any deviation from this requirement must be approved by the RE/COTR after consultation with both the MSN and Chief Agronomist. Properly mulched beds shall be edged by the newly established turfgrass plantings that border and/or surround them.

2.14 WATER

- A. Water shall not contain elements toxic to plant life. It shall be obtained on site from existing faucet or from water trucks.

2.15 ANTIDESICCANT

- A. Antidesiccant shall be an emulsion specifically manufactured for agricultural use that will provide a protective film over plant surfaces permeable enough to permit transpiration.

2.16 SOD

- A. All turfgrass areas shall be installed with sod, no seeding shall occur.
- B. Sod shall be nursery grown, certified sod as classified in the TPI Guideline Specifications to Turfgrass Sodding. Sod must also conform to the turfgrass species limitations as outlined in 2.16.C below in this spec.
- C. All turfgrass seed mixtures, or sod composition shall conform to the species and cultivar requirements detailed here: The seed mixtures listed below are representative of an almost endless list of acceptable seed mixtures that roughly approximate these guidelines.

Cool Season Turfgrass Seed Mixtures: Seed is % by weight

75% tall fescue and 25% perennial ryegrass

Each of these species components should be a blend composed of a minimum of 2 regionally adapted cultivars.

Any deviation from these turfgrass species requirements must be approved in

writing by the NCA Chief Agronomist and/or appropriate MSN Agronomist in coordination with the RE and/or COTR.

2.23 HERBICIDES AND OTHER PESTICIDES

- A. All herbicides and other pesticides shall be properly labeled and registered with the U.S. Environmental Protection Agency. Keep all pesticides in the original labeled containers indicating the analysis and method of use.

PART 3 - EXECUTION

3.1 LAYOUT

- A. Stake plant material locations and bed outlines on project site for approval by the Resident Engineer before any plant pits or beds are dug. The Resident Engineer may approve adjustments to plant material locations to meet field conditions.

3.2 FINE GRADING AND ORGANIC SOIL AMENDMENT INCORPORATION

- A. Contractor shall obtain Resident Engineer's written approval of previously completed rough grading work prior to commencing organic soil amendment incorporation work.
- B. Immediately prior to dumping and spreading the approved organic soil amendment, the subgrade shall be cleaned of all stones greater than two inches (2") and all debris or rubbish. Such material shall be removed from

- the site. Prior to spreading of the organic soil amendment, subgrades which are too compact to drain water and too compact based upon compaction tests shall be ripped with a claw one foot (1') deep, pulled by a bulldozer two feet (2') on center, both directions. Contractor shall then regrade surface.
- C. Organic soil amendment material shall be placed and uniformly spread over approved finish sub-grades to a depth sufficiently greater than the specified depth so that after natural settlement and light rolling, the specified minimum compacted depth will have been provided and the completed work will conform to the lines, grades and elevations indicated. Incorporate organic soil amendment by disc harrowing, rototilling or other means in a uniform manner. The depth of incorporation shall be based upon the organic content of the tested and approved organic soil amendment, so as to produce a finished soil with an organic matter content of between four (4) and six percent (6%). Supply additional organic soil amendment material, after in-place testing and approval (see paragraph 1.4.D), as may be needed to give the required organic matter content and finished grades under the Contract without additional cost to the Government.
- D. Disturbed areas outside the limit of work shall be spread with four inch (4") minimum depth of organic soil amendment material to the finished grade.
- E. No subsoil or organic soil amendment material shall be handled in any way if it is in a wet or frozen condition.
- F. Sufficient grade stakes shall be set for checking the finished grades. Connect contours and spot elevations with an even slope.
- G. After organic soil amendment material has been incorporated into the subsoil, it shall be carefully prepared by scarifying or harrowing and hand raking. Remove all large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove all stones over one and one half inch (1-1/2") diameter from the amended soil bed. The amended soil shall also be free of smaller stones in excessive quantities as determined by the Resident Engineer.

3.3 EXCAVATION FOR PLANTING

- A. The whole surface shall then be compacted with a roller or other suitable means to achieve a maximum dry density of 88 to 90 percent in accordance with compaction standards of ASTM D1557 Method D. During the compaction process, all depressions caused by settlement or rolling shall be filled with additional organic soil amendment and the surface shall be regraded and rolled until presenting a smooth and even finish corresponding to the required grades. The acceptable condition of the finished soil grade for all areas that are to be established to turfgrass is best described as "fine textured and firm". The test for satisfactory firmness requires that the surface soil not be fluffy or powdery and will support the weight of an average adult person without creating a visible depression.

- B. Prior to excavating for plant pits and bed, verify the location of any underground utilities. Damage to utility lines will be repaired at the Contractor's expense. Where lawns have been established prior to planting operation, cover the surrounding turfgrass before excavations are made in a manner that will protect turfgrass areas. Barricade existing trees, shrubbery, and beds that are to be preserved in a manner that will effectively protect them during the project construction.
- C. Remove rocks and other underground obstructions to a depth necessary to permit proper planting according to plans and specifications. Where underground utilities, construction, or solid rock ledges are encountered, the Resident Engineer may select other locations for plant material.
- D. Dig plant pits by any approved method so that they have vertical sides and flat bottoms. When pits are dug with an auger and the sides of the pits become glazed, scarify the glazed surface.
- E. Where planting beds occur in existing turfgrass areas, remove turfgrass to a depth that will ensure the removal of the entire root system, with additional bed preparation as specified in the next paragraph.
- F. Where existing soil is to be used in place, till new ground cover and plant beds to a depth of 100 mm (4 inches). Spread peat soil amendment uniformly over the bed to depth of 50 mm (2 inches) and thoroughly incorporate it into the existing soil to a depth of 100 mm (4 inches) using a roto-tiller or similar type of equipment to obtain a uniform and well pulverized soil mix. Where existing soil is compacted (former roadways, parking lots, etc.) till the soil down to a depth necessary to support the growth of new planting. During tillage operations, remove all sticks, stones, roots, and other objectionable materials. Bring plant beds to a smooth and even surface conforming to established grades.
- G. In areas of new grading where existing soil is being replaced for the construction of new ground cover and plant beds, remove 100 mm (4 inches) of existing soil and replace with topsoil. Plant beds shall be brought to a smooth and even surface conforming to established grades. Till 50 mm (2 inches) of peat soil amendment into the topsoil as specified.
- H. Using topsoil, form earth saucers or water basins for watering around plants. Basins to be 2" high for shrubs and 4" high for trees.
- I. Treat plant saucers, shrub, and ground cover bed areas, after mulching, with preemergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination. Plant ground cover in areas to receive erosion control material through that material after material is in place.

3.4 SETTING PLANTS

- A. Handle container-grown plants only by the container. Remove container-grown plants in such a way to prevent damage to plants or root system. Set plants

plumb and hold in position until sufficient soil has been firmly placed around the roots. Set plants so that the root crown is 1" higher than the surrounding grade. Avoid contaminating the mulch with the planting soil.

- B. Backfill container-grown plants with the native soil removed from the planting hole to approximately half the depth of the ball and then tamp and water. It is desirable to use 100% percent native soil to backfill the hole, but do not use unsuitable fill containing clay, rock or other unsuitable material. Tamp and water remainder of backfill native soil; then form earth saucers or water basins around isolated plants with topsoil.

3.5 EDGING PLANT BEDS

- A. Uniformly edge beds using a sharp tool to provide a clear cut division line between the planted area and the adjacent turfgrass. Do not use any type of manufactured edging material. The properly mowed and maintained turfgrass will serve as edging for all landscape beds.

3.6 MULCHING PLANTS

- A. Mulch within 48 hours after planting and apply a preemergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination. Do not mulch in ground cover areas that shall have organic material placed before planting.
- B. Placing Inert Material: Place polyethylene sheet fiberglass mat Landscape fabric with edges lapped 150 mm to 300 mm (6 inches to 12 inches) to receive inert mulch material. Punch a grid of 6 mm (1/4 inch) holes for drainage in the polyethylene sheet fiberglass mat 300 mm (one foot) on centers over the entire area. Spread inert mulch to a uniform thickness over the membrane as shown.
- C. Placing Organic Material: Spread a mulch of wood based origin to a uniform minimum thickness of 50-75 mm (2-3 inches).
- D. Keep mulch out of the crowns of shrubs and off buildings, sidewalks, light standards, and other structures.

3.8 PRUNING

- A. Prune new plant material and indicated existing plant material in the following manner: Remove dead, broken and crossing branches. Make cuts with sharp instruments as close as possible to the branch collar. Do not make flush cuts. Do not make "Headback" cuts at right angles to line of growth. Remove trimmings from the site. Do not use any type of wound dressing on pruning cuts.

3.9 TILLAGE FOR TURFGRASS AREAS

- A. Thoroughly till the soil to a depth of at least 150 mm (6 inches) by scarifying, disking, harrowing, or other approved methods. This is particularly important in areas where heavy equipment has been used. Remove all debris and stones larger than 25 mm (one inch) remaining on the surface after tillage in preparation for finish grading. To minimize erosion, do not till areas of 3:1 slope ratio or greater. Scarify these areas to a 50 mm (one inch) depth and remove debris and stones.

3.10 FINISH GRADING

- A. After tilling the soil for bonding of topsoil with the subsoil, spread the topsoil evenly to a minimum depth of 150 mm (6 inches). Incorporate topsoil at least 50 to 75 mm (2 to 3 inches) into the subsoil to avoid soil layering. Do not spread topsoil when frozen or excessively wet or dry. Correct irregularities in finished surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic. Complete lawn work only after areas are brought to finished grade.

3.11 APPLICATION OF FERTILIZER AND LIME FOR TURFGRASS AREAS

- A. Apply turfgrass fertilizer at a rate that will deliver 1 pound of nitrogen per 1000 sq.ft. In addition, adjust soil acidity as recommended by soil test results and add any soil conditioners.
- B. Spread lime as recommended by the soil test results.
- C. Incorporate lime into the soil to a depth of at least 100 mm (4 inches) as part of the finish grading operation. Starter fertilizer should be lightly mixed with the top ½ inch of soil. Immediately restore the soil to an even condition before any seeding or sod placement.

3.12 SODDING

- A. Accomplish sodding in accordance with the ASPA Guideline Specifications for sodding. Lay sod at right angles to slope or the flow of water. On slope areas, start at the bottom of the slope.
- B. After completing the sodding operation, blend the edges of the sodded area smoothly into the surrounding area. All sod should be rolled with a light-weight roller after being laid to eliminate air spaces between the sod and the firmed soil.

3.13 WATERING

- A. Apply water to the turfgrass areas immediately following installation at a rate sufficient to ensure thorough wetting of the soil to a depth of at least 50 mm (2 inches). Supervise watering operation to prevent run-off. Supply all pumps, hoses, pipelines, and sprinkling equipment. Repair all areas damaged

by water operations. Keep soil surface constantly moist, not wet, until turfgrass plants are well established.

3.14 PROTECTION OF TURFGRASS AREAS

- A. Immediately after installation of the turfgrass areas, protect against traffic or other use by erecting barricades, as required, and placing approved signs at appropriate intervals until final acceptance.

3.20 RESTORATION AND CLEAN-UP

- A. Where existing or new turfgrass areas have been damaged or scarred during planting and construction operations, restore disturbed area to their original condition. Keep at least one paved pedestrian access route and one paved vehicular access route to each building clean at all times. In areas where planting and turfgrass work have been completed, clear the area of all debris, spoil piles, and containers. Clear all other paved areas when work in adjacent areas are completed. Remove all debris, rubbish and excess material from the station.

--END--

**SECTION 33 40 00
STORM SEWER UTILITIES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures for construction of outside, underground storm sewer systems that are complete and ready for operation. This includes piping, structures, and all other incidentals.

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES: Materials and Testing Report Submittals.
- C. Section 01 42 19, REFERENCE STANDARDS.
- D. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS: Erosion and Sediment Control.
- E. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- F. Section 31 20 11, EARTH MOVING: (Short Form).

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - HB-17-2002.....Standard Specifications for Highway Bridges,
17th Edition
 - M190-2004.....Standard Specification for Bituminous-Coated
Corrugated Metal Culvert Pipe and Pipe Arches
 - M252-2009.....Standard Specification for Corrugated
Polyethylene Drainage Pipe
 - M294-2015.....Standard Specification for Corrugated
Polyethylene Pipe, 300 to 1500 mm (12 to 60
In.) Diameter
- C. American Concrete Institute (ACI):
 - 318-2014.....Building Code Requirements for Structural
Concrete and Commentary

350-2006.....Code Requirements for Environmental Engineering
Concrete Structures and Commentary

D. American Society of Mechanical Engineers (ASME):

A112.6.3-2016.....Floor and Trench Drains

A112.14.1-2003.....Backwater Valves

A112.36.2M-1991.....Cleanouts

E. American Society for Testing and Materials (ASTM):

A48/A48M-2003 (R2012)...Standard Specification for Gray Iron Castings

A242/A242M-2013.....Standard Specification for High-Strength Low-
Alloy Structural Steel

A536-1984 (R2014).....Standard Specification for Ductile Iron
Castings

A615/A615M-2016.....Standard Specification for Deformed and Plain
Carbon-Steel Bars for Concrete Reinforcement

A760/A760M-2015.....Standard Specification for Corrugated Steel
Pipe, Metallic-Coated for Sewers and Drains

A762/A762M-2015.....Standard Specification for Corrugated Steel
Pipe, Polymer Precoated for Sewers and Drains

A798/A798M-2013.....Standard Specification for Installing Factory-
Made Corrugated Steel Pipe for Sewers and Other
Applications

A849-2015.....Standard Specification for Post-Applied
Coatings, Pavings, and Linings for Corrugated
Steel Sewer and Drainage Pipe

A929/A929M-2001(2013)...Standard Specification for Steel Sheet,
Metallic-Coated by the Hot-Dip Process for
Corrugated Steel Pipe

A1064/A1064M-2016.....Standard Specification for Carbon-Steel Wire
and Welded Wire Reinforcement, Plain and
Deformed, for Concrete

B745/B745M-2015.....Standard Specification for Corrugated Aluminum
Pipe for Sewers and Drains

B788/B788M-2009 (R2014).Standard Specification for Installing Factory-
Made Corrugated Aluminum Culverts and Storm
Sewer Pipe

C14-2015a.....Standard Specification for Nonreinforced
Concrete Sewer, Storm Drain, and Culvert Pipe

C33/C33M-2016.....Standard Specification for Concrete Aggregates

C76-2015a.....	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
C150/C150M-2016.....	Standard Specification for Portland Cement
C443-2012.....	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
C478-2015.....	Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
C506-2016a.....	Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
C507-2015.....	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
C828-2011.....	Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines
C890-2013.....	Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
C891-2011.....	Standard Practice for Installation of Underground Precast Concrete Utility Structures
C913-2008.....	Standard Specification for Precast Concrete Water and Wastewater Structures
C923-2008 (R2013)e1.....	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
C990-2009 (R2014).....	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
C1103-2014.....	Standard Specification for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
C1173-2010 (R2014).....	Standard Specification for Flexible Transition Couplings for Underground Piping Systems
C1433-2016a.....	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
C1479-2013.....	Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations

D448-2012.....Standard Classification for Sizes of Aggregate
for Road and Bridge Construction

D698-2012e2.....Standard Test Methods for Laboratory Compaction
Characteristics of Soil Using Standard Effort
(12,400 ft-lbf/ft³ (600 kN-m/m³))

D1056-2014.....Standard Specification for Flexible Cellular
Materials—Sponge or Expanded Rubber

D2321-2014e1.....Standard Practice for Underground Installation
of Thermoplastic Pipe for Sewers and Other
Gravity-Flow Applications

D2661-2014.....Standard Specification for Acrylonitrile-
Butadiene-Styrene (ABS) Schedule 40 Plastic
Drain, Waste, and Vent Pipe and Fittings

D3034-2015.....Standard Specification for Type PSM Poly(Vinyl
Chloride) (PVC) Sewer Pipe and Fittings

D3350-2014.....Standard Specification for Polyethylene
Plastics Pipe and Fittings Materials

D3753-2012e1.....Standard Specification for Glass-Fiber-
Reinforced Polyester Manholes and Wetwells

D4101-2014.....Standard Specification for Polypropylene
Injection and Extrusion Materials

D5926-2015.....Standard Specification for Poly (Vinyl
Chloride) (PVC) Gaskets for Drain, Waste, and
Vent (DWV), Sewer, Sanitary, and Storm Plumbing
Systems

F477-2014.....Standard Specification for Elastomeric Seals
(Gaskets) for Joining Plastic Pipe

F679-2015.....Standard Specification for Poly(Vinyl Chloride)
(PVC) Large-Diameter Plastic Gravity Sewer Pipe
and Fittings

F714-2013.....Standard Specification for Polyethylene (PE)
Plastic Pipe (DR-PR) Based on Outside Diameter

F794-2003 (R2014).....Standard Specification for Poly(Vinyl Chloride)
(PVC) Profile Gravity Sewer Pipe and Fittings
Based on Controlled Inside Diameter

F891-2010.....Standard Specification for Coextruded
Poly(Vinyl Chloride) (PVC) Plastic Pipe With a
Cellular Core

- F894-2013.....Standard Specification for Polyethylene (PE)
Large Diameter Profile Wall Sewer and Drain
Pipe
- F949-2015.....Standard Specification for Poly(Vinyl Chloride)
(PVC) Corrugated Sewer Pipe With a Smooth
Interior and Fittings
- F1417-2011a (R2015).....Standard Practice for Installation Acceptance
of Plastic Non-Pressure Sewer Lines Using Low-
Pressure Air
- F1668-2008.....Standard Guide for Construction Procedures for
Buried Plastic Pipe
- F. American Water Works Association (AWWA):
- C105-2010.....Polyethylene Encasement for Ductile-Iron Pipe
Systems
- C110-2012.....Ductile-Iron and Gray-Iron Fittings
- C219-2011.....Bolted, Sleeve-Type Couplings for Plain-End
Pipe
- C600-2010.....Installation of Ductile iron Mains and Their
Appurtenances
- C900-2007.....Polyvinyl Chloride (PVC) Pressure Pipe and
Fabricated Fittings, 4 In. Through 12 In. (100
mm Through 300 mm), for Water Transmission and
Distribution
- M23-2002.....PVC Pipe: Design And Installation, Second
Edition
- G. National Stone, Sand and Gravel Association (NSSGA):
-Quarried Stone for Erosion and Sediment Control

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 33 40 00, STORM SEWER UTILITIES", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights,

materials, applications, standard compliance, model numbers, size, and capacity.

- D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.5 QUALITY ASSURANCE

A. Products Criteria:

- 1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
- 2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Handle manholes, catch basins, stormwater inlets according to manufacturer's written rigging instructions.

1.7 COORDINATION

- A. Coordinate connection to storm sewer main with the Public Agency providing storm sewer off-site drainage.
- B. Coordinate exterior utility lines and connections to building services up to the actual extent of building wall.

1.8 WARRANTY

- A. Guaranty: Warranty of Construction, FAR clause 52.246-21.
- B. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the

Contractor will furnish all manufacturers' and suppliers' written guarantees and warranties covering materials and equipment furnished under this Contract.

1.9 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in electronic version on CD or DVD inserted into a three ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD provided on CD or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS**2.1 FACTORY-ASSEMBLED PRODUCTS**

- A. Standardization of components shall be maximized to reduce spare part requirements. Guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.2 ABS PIPE AND FITTINGS

- A. ABS Sewer Pipe and Fittings: Pipe and fittings, DN 80 to DN 150 (NPS 3 to NPS 6) shall conform to ASTM D2661, with ends suitable for solvent cement joints.

2.3 HDPE PIPE AND FITTINGS

- A. Smoothwall HDPE drainage pipe and fittings, DN 80 to DN 250 (NPS 3 to NPS 10); ASTM F714, DR 21 with smooth waterway for coupling joints.

1. Silt-tight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

- B. Corrugated PE pipe and fittings, DN 300 to DN 1500 (NPS 12 to NPS 60); AASHTO M294, Type S with smooth waterway for coupling joints. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.

1. Silt-tight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

2. Soil-tight Couplings: AASHTO M252, corrugated, matching tube and fittings.

3. Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.

- C. Profile Wall PE Pipe: Pipe shall comply with ASTM F894, RSC 160 with bell and spigot ends.

1. Profile Wall PE Plastic Pipe Joints: Joints shall be as per ASTM F894, gasketed type with integral bell.

2.4 NONPRESSURE TRANSITION COUPLINGS

- A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined, and corrosion resistant metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 - 1. For concrete pipes: ASTM C443, rubber.
 - 2. For plastic pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
 - 3. For dissimilar pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings: Couplings shall be an elastomeric sleeve with corrosion resistant metal tension band and tightening mechanism on each end.
- D. Shielded, flexible couplings shall be elastomeric or rubber sleeve with full length, corrosion resistant outer shield and corrosion resistant metal tension band and tightening mechanism on each end.
- E. Ring-type, flexible couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.5 EXPANSION JOINTS AND DEFLECTION FITTINGS

- A. Ductile iron flexible expansion joints: Compound fitting with combination of flanged and mechanical joint ends complying with AWWA C110. Include two gasketed ball joint sections and one or more gasketed sleeve sections, rated for 1724 kPa (250 psi) minimum working pressure and for offset and expansion indicated.
- B. Ductile iron expansion joints: Three piece assemblies of telescoping sleeve with gaskets and restrained-type, bell-and-spigot end sections complying with AWWA C110. Include rating for 1724 kPa (250 psi) minimum working pressure and for expansion indicated.
- C. Ductile iron deflection fittings: Compound coupling fitting, with ball joint, flexing section, gaskets, and restrained joint ends, complying with AWWA C110. Include rating for 1724 kPa (250 psi) minimum working

2.6 CLEANOUTS

- A. Cast Iron Cleanouts: ASME A112.36.2M, round, gray iron housing with clamping device and round, secured, scoriated, gray iron cover. Include

gray iron ferrule with inside calk or spigot connection and countersunk, tapered thread, brass closure plug.

1. Top-Loading Classification(s): Medium Duty and Heavy Duty. Medium duty in pedestrian areas and Heavy Duty in Vehicular areas.
 2. Pipe fitting and riser to cleanout shall be same material as main pipe line.
- B. Plastic Cleanouts shall have PVC body with PVC threaded plug. Pipe fitting and riser to cleanout shall be of same material as main line pipe.

2.7 DRAINS

- A. Cast Iron Area Drains: ASME A112.6.3, gray iron round body with anchor flange and round secured grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.
1. Top-Loading Classification(s): Medium and Heavy Duty. Medium duty in pedestrian locations, heavy duty in all vehicular locations.

2.8 MANHOLES AND CATCH BASINS

- A. Standard Precast Concrete Manholes:
1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 2. Diameter: 1200 mm (48 inches) minimum unless otherwise indicated.
 3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
 4. Base Section: 150 mm (6 inch) minimum thickness for floor slab and 100 mm (4 inch) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
 5. Riser Sections: 100 mm (4 inch) minimum thickness, and lengths to provide depth indicated.
 6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
 7. Joint Sealant: ASTM C990, bitumen or butyl rubber.
 8. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.

9. Steps: If total depth from floor of manhole to finished grade is greater than 1500 mm (60 inches), width of 400 mm (16 inches) minimum, spaced at 300 to 400 mm (12 to 16 inch) intervals.
 10. Adjusting Rings: Reinforced concrete rings, 150 to 225 mm (6 to 9 inch) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.
- B. Manhole Frames and Covers:
1. Description: Ferrous; 600 mm (24 inch) ID by 175 to 225 mm (7 to 9 inch) riser with 100 mm (4 inch) minimum width flange and 660 mm (26 inch) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
 2. Material: ASTM A536, Grade 60-40-18 ductile unless otherwise indicated.

2.9 CONCRETE FOR MANHOLES AND CATCH BASINS

- A. General: Cast-in-place concrete according to ACI 318, ACI 350, and the following:
1. Cement: ASTM C150/C150M, Type II.
 2. Fine Aggregate: ASTM C33/C33M, sand.
 3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
 4. Water: Potable.
- B. Concrete Design Mix: 27.6 MPa (4000 psi) minimum, compressive strength in 28 days.
1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A615/A615M, Grade 60 420 MPa (60,000 psi) deformed steel.
- C. Manhole Channels and Benches: Channels shall be the main line pipe material. Include benches in all manholes and catch basins.
1. Channels: Main line pipe material or concrete invert. Height of vertical sides to 3/4 of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert Slope: Same slope as the main line pipe. Bench to be concrete, sloped to drain into channel.

2.10 PIPE OUTLETS

- A. Head walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

1. Average Size: NSSGA No. R-5, screen opening 125 mm (5 inches).

C. Filter Stone: NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, 6 mm (No. 4) screen opening, average size graded stone.

D. Energy Dissipaters: To be as per NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 2721 kg (3 ton) average weight armor stone, unless otherwise indicated.

2.11 HEADWALLS

A. Headwalls: Cast-in-place concrete with a minimum compressive strength of 20 MPa (3000 psi) at 28 days.

2.12 FLARED END SECTIONS

A. Flared End Sections: Sections shall be of standard design in accordance with DOT standards.

2.13 PRECAST REINFORCED CONCRETE BOX CULVERT

A. Precast Reinforced Concrete Box Culvert: Designed for highway loadings with 600 mm (2 feet) of cover or more subjected to dead load only, conforming to ASTM C1433. For less than 600 mm (2 feet) of cover, subjected to highway loading, conform to ASTM C1433.

2.14 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS FOR BUILDING ROOF DRAINS

A. Resilient connectors and downspout boots: Flexible, watertight connectors used for connecting pipe to manholes and inlets, and shall conform to ASTM C923.

2.15 WARNING TAPE

A. Standard, 4-Mil polyethylene 75 mm (3 inch) wide tape detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

PART 3 - EXECUTION**3.1 GENERAL**

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 PIPE BEDDING

- A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest 1/4 of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798/A798M.

3.3 PIPING INSTALLATION

- A. Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping with 36 inch minimum cover as shown on the Drawings.
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 1. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
 - 2. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
 - 3. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the

- site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
4. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
 5. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
 6. Do not walk on pipe in trenches until covered by a depth of 300 mm (12 inches) over the crown of the pipe.
 7. Warning tape shall be continuously placed 300 mm (12 inches) above storm sewer piping.
- D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- F. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- G. Install gravity-flow, nonpressure drainage piping according to the following:
1. Install piping pitched down in direction of flow.
 2. Install corrugated steel piping according to ASTM A798/A798M.
 3. Install corrugated aluminum piping according to ASTM B788/B788M.
 4. Install ABS sewer piping according to ASTM D2321 and ASTM F1668.

3.4 REGRADING

- A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed

above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

3.5 CONNECTIONS TO EXISTING VA-OWNED MANHOLES

- A. Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

3.6 MANHOLE INSTALLATION

- A. Install manholes, complete with appurtenances and accessories indicated. Install precast concrete manhole sections with sealants according to ASTM C891.
- B. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.
- C. Circular Structures:
 - 1. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 15 mm (1/2 inch) or cement mortar applied with a trowel and finished to an even glazed surface.
 - 2. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
 - 3. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.
- D. Rectangular Structures:
 - 1. Precast concrete structures shall be placed on a 200 mm (8 inch) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on a 200 mm (8 inch) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set

- precast section true and plumb. Seal all joints with preform flexible gasket material.
2. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
 3. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
 - a. Forming directly in concrete base of structure.
 - b. Building up with brick and mortar.
 4. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1 to 12 or more than 1 to 6. Bottom slab and benches shall be concrete.
 5. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.
 6. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
 7. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inch) thick, by 300 mm (12 inch) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.7 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.8 STORMWATER INLET AND OUTLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete.
- B. Construct riprap of broken stone.
- C. Install outlets that spill onto grade, anchored with concrete.
- D. Install outlets that spill onto grade, with flared end sections that match pipe.

E. Construct energy dissipaters at outlets.

3.9 CONNECTIONS

- A. Encase entire connection fitting, plus 150 mm (6 inch) overlap, with not less than 150 mm (6 inches) of concrete with 28-day compressive strength of 20 MPa (3000 psi).
- B. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping.
 - 2. Make branch connections from side into existing piping, DN 100 to DN 500 (NPS 4 to NPS 20). Remove section of existing pipe, install wye fitting into existing piping.
 - 3. Make branch connections from side into existing piping, DN 525 (NPS 21) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 75 mm (3 inches) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - 4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. Shielded flexible couplings for same or minor difference OD pipes.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 - 2. Use pressure-type pipe couplings for force main joints.

3.10 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 - 1. Close open ends of piping with at least 200 mm (8 inch) thick, brick masonry bulkheads.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
 - 1. Remove manhole or structure and close open ends of remaining piping.
 - 2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to Section 31 20 11, EARTH MOVING.

3.11 IDENTIFICATION

- A. Install green warning tape directly over piping and at outside edge of underground structures.

3.12 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

3.13 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. Submit separate report for each test.
- C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
 4. Submit separate report for each test.
 5. Air test gravity sewers. Concrete pipes conform to ASTM C924, plastic pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or ASTM C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.
 6. Test force main storm drainage piping. Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 1034 kPa (150 psi).
 - a. Ductile Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
 - b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
- D. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government. Leaks and loss in test pressure constitute defects that must be repaired. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.14 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with water.

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SECTION 33 41 13
FOUNDATION DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Foundation drainage system, including installation, backfill, and cleanout extensions.

1.2 RELATED REQUIREMENTS

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Trenching and Excavation: Section 31 20 11, EARTH MOVING.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American Association of State Highway and Transportation Officials (AASHTO):
1. M006-13-UL - Fine Aggregate for Hydraulic Cement Concrete.
 2. M252-09-UL - Corrugated Polyethylene Drainage Pipe.
 3. M288-15-UL - Geotextile Specification for Highway Applications.
- C. ASTM International (ASTM):
1. A74-16 - Cast Iron Soil Pipe and Fittings.
 2. A746-09 (2014) - Ductile Iron Gravity Sewer Pipe.
 3. D448-12 - Sizes of Aggregate for Road and Bridge Construction.
 4. D2321-14 - Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 5. D2729-11 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 6. D2737-12 - Polyethylene (PE) Plastic Tubing.
 7. D3034-14 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 8. D4216-13 - Rigid Poly (Vinyl Chloride) (PVC) and Related PVC and Chlorinated Poly (Vinyl Chloride) (CPVC) Building Products Compounds.
 9. F477-14 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 10. F758-14 - Smooth-Wall Poly (Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage.
 11. F810-12 - Smooth-Wall Polyethylene (PE) Pipe for Use in Drainage

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Description of each product.
 - 2. Filter fabric indicating manufacturer recommendation for each application.
 - 3. Installation instructions.
 - 4. Warranty.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Regularly manufactures specified products.

1.6 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

- A. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify field conditions affecting drainage installation. Show field measurements on Submittal Drawings.
 - 1. Coordinate field measurement and fabrication schedule to avoid delay.

1.9 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Pipes: Type and size indicated. Make transitions, adapters, or joint details for dissimilar materials.
- B. Underslab Header:
 - 1. DN 100 to DN 375 (NPS 4 to NPS 15):

- a. Pipe and Fittings: Cast-iron, ASTM A74 or ASTM A746.
 - b. Joints: Hub-and-spigot, gasket type.
- 2. DN 100 to DN 250 (NPS 4 to NPS 10) DN 300 to DN 900 (NPS 12 to NPS 36):
 - a. Pipe and Fittings: PE, ASTM D2737.
 - b. Joints: Coupling type.
- 3. DN 100 to DN 375 (NPS 4 to NPS 15):
 - a. Pipe and Fittings: PVC, ASTM D3034.
 - b. Joints: Bell-and-spigot.
 - c. Seal Gaskets: ASTM F477, elastomeric.
- C. Perforated Drainage Pipe:
 - 1. DN 100 to DN 150 (NPS 4 to NPS 6) DN 200 to DN 600 (NPS 8 to NPS 24):
 - a. Pipe and Fittings: PE, ASTM F810.
 - b. Joints: Coupling type.
- D. Cleanout Extension: ASTM A74, cast iron pipe or ASTM A746 ductile iron.
 - 1. Gravity Sewer Pipes: Provide neoprene gasket joints and long sweep elbow fittings.
- E. Drainage Conduit:
 - 1. Pipe: ASTM F810, PE, perforated.
 - 2. Fittings and Couplings: PE.
- F. Filter Fabric: Woven pervious filament sheet polyester, nylon or polypropylene in accordance with manufacturer specifications.
- G. Drainage Material:
 - 1. Bedding: Crushed stone, 20 mm (3/4 inch) to 25 mm (No. 4), ASTM D448.
 - 2. Pipe Fill 300 mm (1 Foot) Above: Crushed stone, 20 mm (3/4 inch) to 25 mm (No. 4) per ASTM D448.
- H. Concrete Sand: AASHTO M006.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation in the presence of Contracting Officer's Representative (COR).
- B. Correct substrate deficiencies.
 - 1. Fill.
 - 2. Level.
- C. Keep trenches dry during drainage system installation.

- D. Clean interior of pipe before installation.

3.2 INSTALLATION - FOUNDATION DRAINAGE

- A. Install products according to manufacturer's instructions and approved submittal drawings.
 - 1. When manufacturer's instructions deviate from specifications, submit proposed resolution for COR consideration.
- B. Trenching, Excavation and Backfilling:
 - 1. Perform trenching, excavation and backfilling according to Section 31 20 11 EARTH MOVING. Make 1/8 bends changes in direction of drain lines. Use wye fittings at intersections.
- C. Bedding:
 - 1. Place and compact graded bedding at bottom trench, minimum 6 inches deep. Rest section firmly through entire length, with recesses formed for bell joints. Fully support pipe lower quadrant with bedding, except bell joint recesses.
- D. Filter Fabric: Place drainage pipe on filter fabric.
- E. Pipe Laying:
 - 1. Install PE and PVC Pipe according to ASTM D2321 and ASTM F758.
 - 2. Lay drain lines to grades and alignment, with continuous fall in flow direction and as indicated on Drawings.
 - 3. Place bells ends, face upgrade.
 - 4. Lay drain lines and firmly bed in granular material minimum 75 mm (3 inches) below invert to top of pipe true to grades and alignment, and slope uniformly between elevations shown on foundation drainage drawings. Keep trenches dry until pipe is in place and granular material backfill is completed, 300 mm (1 foot) above top of pipe, unless otherwise noted.
 - 5. Lay perforated pipe, perforations down. Lay plain end pipe, closed joints, held in place with two No. 9 spring steel wire clips at joint or standard clay collars.
 - 6. Foundation Subdrainage: Install pipe pitched down in flow direction, minimum slope 0.5 percent, minimum cover 900 mm (3 feet), unless otherwise indicated.
 - 7. Underslab subdrainage: Install piping pitched down in flow direction, minimum slope of 0.5 percent.
 - 8. Install gaskets, seals, sleeves, and couplings according to manufacturer's instructions and as follows:

- a. PE Joint: ASTM D2737 and AASHTO HB17, Division II, Section 26.4.2.4, "Joint Properties".
 - b. PVC Joint: ASTM D3034 with elastomeric seals gaskets, ASTM D2321.
 - c. Perforated PVC Joint: ASTM D2729, with loose bell and spigot joints.
9. Install cleanout extensions as indicated on Drawings and as follows:
- a. Pre-placed Crypt Field Underdrain Cleanouts: Install as indicated on Drawings and set not to interfere with mowing operations. Provide concrete anchorage for plastic tops. Check drain lines before backfilling. Remove obstructions and recheck lines.

3.3 FIELD QUALITY CONTROL

- A. Field Inspections:
- B. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.

3.4 PROTECTION

- A. Protect pipe from and aggregate cover from damage and displacement until backfilling operation begins.

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