

**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.

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2	X1.1	OVERALL LEGEND
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SECTION 01 00 00
GENERAL REQUIREMENTS

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1.1 GENERAL INTENTION

- A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor, materials, equipment and services and perform and complete all work for the Columbarium Expansion and Memorial Wall for the National Memorial Cemetery of Arizona, Phoenix, AZ, Project No. 914CM3008, as required by drawings and specifications.
- B. Visits to the site by Bidders may be made only by appointment with the Cemetery Director.
- C. Offices of SmithGroupJJR, 201 Depot Street, Ann Arbor, MI (Telephone 734-662-4457) as Architect-Engineers (A/E), may render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by RE/COTR or his duly authorized representative.
- D. All Testing Laboratory services will be retained and paid for by the Contractor (see Spec Section 01 45 29, Testing Laboratory Services). However, the Department of Veterans Affairs may elect to retain its own Testing Laboratory for any purpose. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the Resident Engineer/Contracting Officers Technical Representative (RE/COTR) in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three work days unless otherwise designated by the RE/COTR.
- E. All employees of general contractor and subcontractors shall comply with VA security management program, be identified by employer, and restricted from unauthorized access.
- F. 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.
- G. Training:
 - 1. All employees of general contractor or subcontractors shall have the 30-hour OSHA certified Construction Safety course and /or other relevant competency training, as determined by VA CP.

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2. Submit training records of all such employees for approval before the start of work.

1.2 STATEMENT OF BID ITEM(S)

ITEM I, GENERAL CONSTRUCTION: Installation of all work shown on the plans and described in the specifications including but not limited to: Demolition and alteration necessary to completely or partially remove existing structures, Site preparation and erosion control, Earthwork, grading and drainage, Pedestrian paving, Precast columbarium structures (includes installation of niche covers but not the niche covers themselves), Steel trellis structure, Precast bridge, Landscape planting, Signage and site furnishings, Irrigation system, and construction of certain other items.

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT, one bond paper set of specifications and drawings will be furnished.
- B. Additional sets of drawings may be made by the Contractor, at Contractor's expense, from digital files furnished by the Issuing Office.

1.4 FIRE SAFETY

- A. Applicable Publications: Publications listed below form part of this Article to the extent referenced. Publications are referenced in text by basic designations only.
 1. American Society for Testing and Materials (ASTM):
 - E84-2009a.....Surface Burning Characteristics of Building Materials
 2. National Fire Protection Association (NFPA):
 - 10-2010Standard for Portable Fire Extinguishers
 - 30-2008Flammable and Combustible Liquids Code
 - 51B-2009Standard for Fire Prevention During Welding, Cutting and Other Hot Work
 - 70-2008National Electrical Code
 - 241-2009Standard for Safeguarding Construction, Alteration, and Demolition Operations
 3. Occupational Safety and Health Administration (OSHA):
 - 29 CFR 1926Safety and Health Regulations for Construction
- B. Fire Safety Plan: Establish and maintain a fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to RE/COTR/Cemetery Director for review for compliance with contract requirements in accordance with Section 01 33

23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Prior to any worker for the contractor or subcontractor's beginning work, they shall undergo a safety briefing provided by the General Contractor's competent person per OSHA requirements. This briefing shall include information on the construction limits, safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of NCA equipment, etc. Documentation shall be provided to the RE/COTR that individuals have undergone the Contractor's safety briefing.

- C. Site and Building Access: Maintain free and unobstructed access to emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.
- D. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).
- E. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- F. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with RE/COTR/Cemetery Director.
- G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to RE/COTR.
- H. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- I. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- J. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with RE/COTR.
- K. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to RE/COTR.
- L. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.
- M. Dispose of waste and debris in accordance with NFPA 241. Remove from site weekly.

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- N. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.

1.5 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 RE/COTR. 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.
- B. Temporary buildings (e.g., storage trailers, office trailers) and utilities may be erected by the Contractor only with the approval of the RE/COTR and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work.
- C. The Contractor shall, under regulations prescribed by the RE/COTR, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the RE/COTR. 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.

(FAR 52.236-10)

- D. Working space and space available for storing materials shall be as shown on the drawings and as determined by the RE/COTR with agreement of the Cemetery.
- E. Contractor parking will be only in areas and on roadways designated and agreed by the RE/COTR in agreement of the Cemetery.
- F. Workmen are subject to rules of the Cemetery applicable to their conduct.
- G. Execute work so as to interfere as little as possible with normal functioning of Cemetery as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others.
1. Do not store materials and equipment in other than assigned areas.
 2. Provide unobstructed access to the Cemetery areas required to remain in operation.
- H. Construction Fence: Before construction operations begin, the Contractor shall provide, per the contract documents, a temporary construction

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fence encompassing the construction work area(s) to serve as a pedestrian barrier to alert cemetery patrons of the construction site. Remove the fence when directed by RE/COTR.

- I. Utilities Services: Maintain existing utility services for the Cemetery at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by RE/COTR. All such actions shall be coordinated with the Utility Company involved.
1. 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 RE/COTR. 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 the RE/COTR, and Cemetery Director's prior knowledge and written approval.
 2. The Contractor shall submit a request to interrupt any such services to both RE/COTR and the Cemetery Director in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
 3. The 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 the Cemetery. Interruption time approved by the Cemetery and RE/COTR may occur at other than Contractor's normal working hours.
 4. 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 RE/COTR.
 5. In case of a contract construction emergency, service will be interrupted on approval of RE/COTR. Such approval will be confirmed in writing as soon as practical.
- J. 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. 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.

- K. To 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. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times.
 - 2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the RE/COTR.
- L. Coordinate the work for this contract with other construction operations as directed by RE/COTR. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.
- M. Coordination of Construction with Cemetery Director: The burial activities at a National Cemetery shall take precedence over construction activities. The Contractor must cooperate and coordinate with the Cemetery Director, through the RE/COTR, in arranging construction schedule to cause the least possible interference with Cemetery activities in actual burial areas. Construction noise during the committal 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, Veterans 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.

1.6 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the RE/COTR of areas in which alterations occur and areas which are anticipated routes of access, and furnish a signed report, to the Contracting Officer. This report shall list:
 - 1. Existing condition and types of surfaces not required to be altered throughout affected areas.
 - 2. Existence and conditions of items required by drawings to be either reused or relocated, or both.

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3. Shall note any discrepancies between drawings and existing conditions at site.
 4. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and RE/COTR.
- B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of RE/COTR, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by the Contractor with new items in accordance with specifications which will be furnished by the Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).
- C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and RE/COTR together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing of surfaces as compared with conditions of same as noted in first condition survey report.
1. Re-survey report shall also list any damage caused by the Contractor to such flooring and other surfaces, despite protection measures; and, will form the basis for determining extent of repair work required of the Contractor to restore damage caused by the Contractor's workmen in executing work of this contract.
- D. Protection: Provide the following protective measures:
1. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.
 2. Wherever work is performed, surfaces that are to remain in place shall be adequately protected prior to starting work, and this protection shall be maintained intact until all work in the area is completed.

1.7 DISPOSAL AND RETENTION

- A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:
1. Reserved items which are to remain property of the Government are noted on drawings or in specifications as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which

would be detrimental to re-installation and reuse. Store such items where directed by RE/COTR.

2. Items not reserved shall become property of the Contractor and be removed by Contractor from the Cemetery.

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 turf) 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 RE/COTR.
- 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 RE/COTR may have the necessary work performed and charge the cost to the Contractor.

(FAR 52.236-9)

- C. Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to Articles, "Alterations", "Restoration", and "Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.
- D. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. The contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements and shall file the application on behalf of VA. Many of the permit requirements will be satisfied by completing

GENERAL REQUIREMENTS

construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:

1. Designating areas for equipment maintenance and repair;
2. Providing waste receptacles at convenient locations and provide regular collection of wastes;
3. Locating equipment wash-down areas on site, and provide appropriate control of wash-waters;
4. Providing protected storage areas for chemicals, paints, solvents, fertilizers, and other potentially toxic materials; and
5. Providing adequately maintained sanitary facilities.

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 water/irrigation or electric work without approval of the RE/COTR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the RE/COTR 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, landscape stone, 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 the Contractor's own expense, the Contractor shall immediately restore to service and repair any damage caused by the Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services and systems (including irrigation) which are indicated on drawings and 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 PHYSICAL DATA

- A. Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.
1. The indications of physical conditions on the drawings and in the specifications are the result of site investigations by SmithGroupJJR, 201 Depot Street, Ann Arbor, MI 48104, (Telephone 734-662-4457).
- (FAR 52.236-4)**
- B. Subsurface conditions have been developed by core borings and test pits investigated by Speedie and Associates, 3331 East Wood Street, Phoenix, AZ 85040, Telephone (602) 997-6391. Logs of subsurface exploration conducted October 3, 2011 are shown diagrammatically on drawings.
- C. A copy of the geotechnical investigation report by Speedie and Associates is an appendix to these specifications and shall be considered part of the contract documents.
- D. The Government does not guarantee that other materials will not be encountered nor that proportions, conditions or character of several materials will not vary from those indicated by explorations. Bidders are expected to examine the site of work and logs of borings and, after investigation, decide for themselves the character of materials and make their bids accordingly. Upon proper application to the Department of Veterans Affairs, bidders will be permitted to make subsurface explorations of their own at site.

1.11 PROFESSIONAL SURVEYING SERVICES

A registered professional land surveyor or registered civil engineer whose services are retained and paid for by the Contractor shall perform services specified herein and in other specification sections. The Contractor shall certify that the land surveyor or civil engineer is not one who is a regular employee of the Contractor, and that the land surveyor or civil engineer has no financial interest in this contract.

1.12 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 the Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work and/or as requested by the RE/COTR. The Contractor shall be responsible for executing the work to the lines and

grades that may be established or indicated by the RE/COTR. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the surveyor and/or the RE/COTR until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the RE/COTR may request the contractor and surveyor to replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor. No additional payment will be provided for survey work required and/or requested by the RE/COTR for the completion of the services noted above.

(FAR 52.236-17)

- B. Establish and plainly mark center lines for each building and/or addition to each existing building, lines for each gravesite control monument, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and/or addition, roads, parking lots, gravesite control monuments, are in accordance with lines and elevations shown on contract drawings.
- C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. The Survey shall include, but not be limited to, location of lines and grades of footings, exterior walls, center lines of columns in both directions, major utilities and elevations of floor slabs:
 - 1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land surveyor or registered civil engineer. Furnish such certification to the RE/COTR before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.
- D. During progress of work, the Contractor shall have line grades and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the RE/COTR before any major items of concrete work are placed. In addition, the Contractor shall also furnish to the RE/COTR certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.
 - 1. Lines of each building and/or addition.

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2. Elevations of bottoms of footings and tops of floors of each building and/or addition.
 3. Lines and elevations of sewers and of all outside distribution systems.
 4. Lines of elevations of all swales.
 5. Lines and elevations of roads, streets and parking lots.
 6. Lines and elevations of columbarium walls and plaza.
 7. Lines and elevations of stormwater channel and retaining walls.
 8. Lines and elevations of bridge and associated structures.
 9. Northing/Easting coordinate locations of all water, sanitary, storm, gas and irrigation structures, directional fittings, control wire and lines.
- E. Upon completion of the work, the Contractor shall furnish the RE/COTR with reproducible drawings, in Autocad form, at the scale of the contract drawings, showing the finished grade on the grid developed for constructing the work. These drawings shall bear the seal of the registered land surveyor or registered civil engineer.
- F. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.13 AS-BUILT DRAWINGS

- A. The Contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, which will include all contract changes, modifications and clarifications.
- B. All variations shall be shown in the same general detail as used in the contract drawings. To insure compliance, as-built drawings shall be made available for the RE/COTR's review, as often as requested.
- C. The Contractor shall deliver two approved completed sets of as-built drawings to the RE/COTR within 15 calendar days after acceptance of the project by the RE/COTR.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.

1.14 USE OF ROADWAYS

For hauling, use only established public roads and roads on Cemetery property and, when authorized by the RE/COTR, such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed by the Contractor at the Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.

1.15 RE FIELD OFFICE

- A. The Contractor shall, within fifteen (15) days after receipt of Notice to Proceed, provide where shown on the drawings a temporary field office, furniture, and two inch deep gravel surfaced area for use of the RE/COTR. Office and furniture shall be like new.
- B. The field office shall provide not less than 50 square meters (528 gross square feet) of floor area in one unit. Installation of the office shall meet all local codes.
- C. Provide office with two, 900 mm (three foot) wide exterior doors, including hardware and OSHA approved platform and stairs leading to grade.
- D. Exterior finishes shall be manufacturer's standards.
- E. Provide floor, wall, and roof with not less than R5 insulation.
- F. Interior finishes shall consist of resilient flooring, plywood paneling or painted wallboard on walls, and acoustical tile ceilings. Interior doors may be either painted or stained.
- G. Interior shall be subdivided with full height partitions to provide one office, one conference room, one toilet. Provide each space with 900 mm (three foot) wide door with master keyed locks.
- H. Provide 750 mm (2-1/2 feet) wide by 900 mm (3 feet) high operable windows; two in each room, except provide only one 600 mm (2 foot) high window in toilet room. Window openings shall be fitted with security bars to prevent any forced entry. The doors of field office shall have a hasp and padlock and also deadbolts keyed from both sides.
- I. Provide sufficient fluorescent lighting in each room to deliver 750 lux (70 foot-candles) of light at desk top height without the aid of daylight. Provide one light switch in each room.
- J. Provide one duplex receptacle in each wall of each room. If a wall is 3.0 m (10 feet) long or more, provide two receptacles for each 3.0 m (10 feet), or portion thereof, of wall.
- K. The Contractor shall provide the following:
 - 1. Electricity, hot and cold water, and necessary utility services (except telephone).
 - 2. All necessary piping, power circuits, network cabling, patch panels, equipment racks, cat 5e or better cabling for phones and computers, electrical fixtures, lighting, and other items necessary to provide a habitable structure for the purpose intended. Provide minimum of 3 network receptacles and 8 electrical receptacles located as approved by Resident Engineer upon review of the Contractor's submitted plan.

3. Thermostatically controlled, centralized heating and air conditioning system designed to maintain the temperature between 21 and 27 degrees C (70 and 80 degrees F) with 50 percent relative humidity maintained during the air conditioning season. Thermostats shall be energy saving programmable type with a minimum of three temperature settings for each day of the week.
4. One water closet, lavatory, mirror, toilet paper dispenser, paper towel dispenser, soap dispenser, towel bar, and two-prong coat hooks for toilet room. Provide holding tank for sanitary sewer, including periodic pumping as required
5. One (1) wall mounted first aid kit that meets or exceeds current OSHA and ANSI Z.803-1 requirements.
6. One (1) wall mounted key safe with push-button combination lock sized for 12 keys.
7. One (1) wall mounted 10 pound Tri-Class (ABC) dry chemical fire extinguishers.
8. Two (2) hard hats, white, full brim with ratchet headband system.
9. Two (2) ANSI 207 Class 2 safety vest in lime color with two pockets, size extra large.
10. The Contractor shall install a suitable security system for the field office and provide alarm monitoring services for the duration of the RE's occupancy.
- L. The Contractor shall, for the duration of the RE/COTR's occupancy, provide the following:
 1. Satisfactory conditions in and around the field office and parking area.
 2. Maintenance of gravel surfaced area, including the area for parking, in an acceptable condition for vehicle and foot traffic at all times.
 3. Maintenance of utility services.
 4. Potable water, fuel and electric power for normal office uses, including lights, heating and air conditioning.
 5. Photocopier/Printer/Scanner/Fax Machine (complete with installation, service, maintenance, supplies and payment of all monthly usages charges):
 - a. Minimum Photocopier/Printer requirements:
 - 1) Collating/sorting/stapling.
 - 2) Enlarging/reducing
 - 3) Multi-size sheet feeder.
 - 4) Four paper tray sizes and bypass tray.
 - 5) Two-sided and single-sided copying.

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- 6) Network capability/connectivity
- b. Minimum Scanner requirements:
 - 1) Scan to email and scan to folder capability.
 - 2) PDF, TIFF, JPEG output format capability
 - 3) Network capability/connectivity.
- c. Minimum Fax Machine requirements:
 - 1) Plain paper copies.
 - 2) Memory feature with fifty documents.
 - 3) Automatic document feeder with 50 page capacity.
 - 4) Memory storage for twenty or more numbers.
 - 5) Network capacity/connectivity.
- d. All services, maintenance and supplies shall be same day service
- 6. Contractor shall provide two-way radios (2 each) Motorola DTR650 (or equal) with rechargeable batteries and charging stations. These radios will remain the property of Contractor.
- 7. Internet, Data and Voice Equipment/Connection and Communications (complete installation, maintenance and payment of all monthly usage charges).
 - a. 2 Voice lines (one dedicated phone line for FAX machine and one dedicated phone line for communications)
 - b. Voice line numbers must have local area code.
 - c. One (1) desk telephone, with speaker, answering machine and long telephone cord.
 - d. One (1) conference room telephone set with conference speaker(s) and extra long telephone cord.
 - e. Indoor equipment: Must provide separate RJ45 connections for data communications (CAT5 cabling) and RJ11 connections for analog voice communications in quantities specified in General Requirements paragraph 1.17.L.2 above. Provide central location for termination of the CAT5 cabling.
 - f. Data Connection: Provide T-1 connection lines. Methods and material shall be per ANSI/EIA/TIA-568-1991 Standard. Install (1) four pair Category 5e/6 cable unshielded twisted pair (total of 8 conductors) (UTP) Category 5e/6 IEEE 802.3 100BaseT UTP Level 5e/6, 24 AWG cables. Contractor shall supply 100BaseT, Category 5e or Category 6 certified rack-mounted modular RJ45 punch down block/panel as required (24/48 ports) for jacks meeting the ANSI/EIA/TIA-568-A-5 category 5e/6 standards.
 - g. 24/7 live phone-base technical support.
 - h. Next business day on-site support, maintenance and service.

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M. The Contractor shall provide the following like-new items in quantities listed:

1. (1) Desk/Workstation with adjustable keyboard drawer 738 mm H x 1.5 m W x 760 mm D (size 29-1/2" H x 60" W x 30" D) and two pedestals each with box drawer and file drawer
2. (1) Printer stand 663 mm H x 1.5 m W x 750 mm D (size 26-1/2" H x 60" W x 30" D)
3. (1) Conference table 900 mm x 1.8 m (size 3' x 6')
4. (1) Plan table 1.2 m x 2.1 m (4' x 7')
5. (2) Work tables 750 mm x 1.8 m (folding 30" x 72")
6. (1) Swivel chair with arms
7. (6) Conference chairs (armless & folding)
8. (2) Arm Chairs
9. (2) Lockable 5-drawer file cabinets, letter size
10. (1) Drawing rack, with 12-750 mm (12-30 inch) "Plan Hold" drawing holders, freestanding
11. (1) Metal Bookcase/Shelf Unit, 6 adjustable Shelves, 305 mm W x 900 mm L (36" x 12" x 72") or (36" x 12" x 72")
12. (1) Metal storage cabinet, 900 mm x 450 mm x 1.8 m (36" x 18" x 72") with six shelves
13. (1) Electric water cooler and provide a contract for water for the duration of the project.

N. At the completion of all work, including the punch list, the RE/COTR's field office and facilities shall become the property of the Contractor and the Contractor shall remove same, including utility connections, from the Cemetery. The site shall be restored to original condition and finished in accordance with contract requirements. All 5-drawer file cabinets provided shall become the property of the Government.

O. The Contractor shall furnish floor plans for approval by the RE/COTR prior to furnishing the field office.

1.16 TEMPORARY TOILETS

Provide where directed, (for use of all Contractor's workers) ample temporary sanitary toilet accommodations with suitable sewer and water connections, or when approved by RE/COTR provide suitable dry closets where directed. Keep such places clean and free from flies, and all connections and appliances connected therewith are to be removed prior to completion of contract, and premises left perfectly clean.

1.17 AVAILABILITY AND USE OF UTILITY SERVICES

A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as

GENERAL REQUIREMENTS

specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.

- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the RE/COTR, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.
- C. The Contractor shall install meters at the Contractor's expense and furnish the Cemetery a monthly record of the Contractor's usage of electricity as hereinafter specified.
- D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:
- E. Electricity (for Construction and Testing): Furnish all temporary electric services.
 - 1. Obtain electricity by connecting to the Cemetery electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Where not available or not convenient to connect to the Cemetery distribution system, the contractor shall supply power via portable generators at own expense. Generators shall be acoustically screened so as not to disturb committal services and/or visitation to the adjacent columbarium.
- F. Water (for Construction and Testing): Furnish temporary water service.
 - 1. Obtain water by connecting to the Cemetery irrigation distribution system. Backflow preventer may not be required at connections to the irrigation system. Water is available at no cost to the Contractor.
 - 2. If potable water is required and convenient connection is available the contractor may connect to the Cemetery potable water distribution system. The contractor shall install reduced pressure backflow preventer at each connection at own expense.
 - 3. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes

GENERAL REQUIREMENTS

will be cause for revocation (at RE/COTR's discretion) of use of water from the Cemetery's system.

4. Where not available or not convenient to connect to the Cemetery distribution system, the contractor shall supply water via portable means at own expense.

1.18 INSTRUCTIONS

- A. The Contractor shall furnish Maintenance and Operating manuals and verbal instructions when required by the various sections of the specifications and as hereinafter specified.
- B. Manuals: Maintenance and operating manuals (three copies each) for each separate piece of equipment shall be delivered to the RE/COTR coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.
- C. Instructions: the Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed instructions to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different items of equipment that are component parts of a complete system; shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the RE/COTR

and shall be considered concluded only when the RE/COTR is satisfied in regard to complete and thorough coverage. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the RE/COTR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

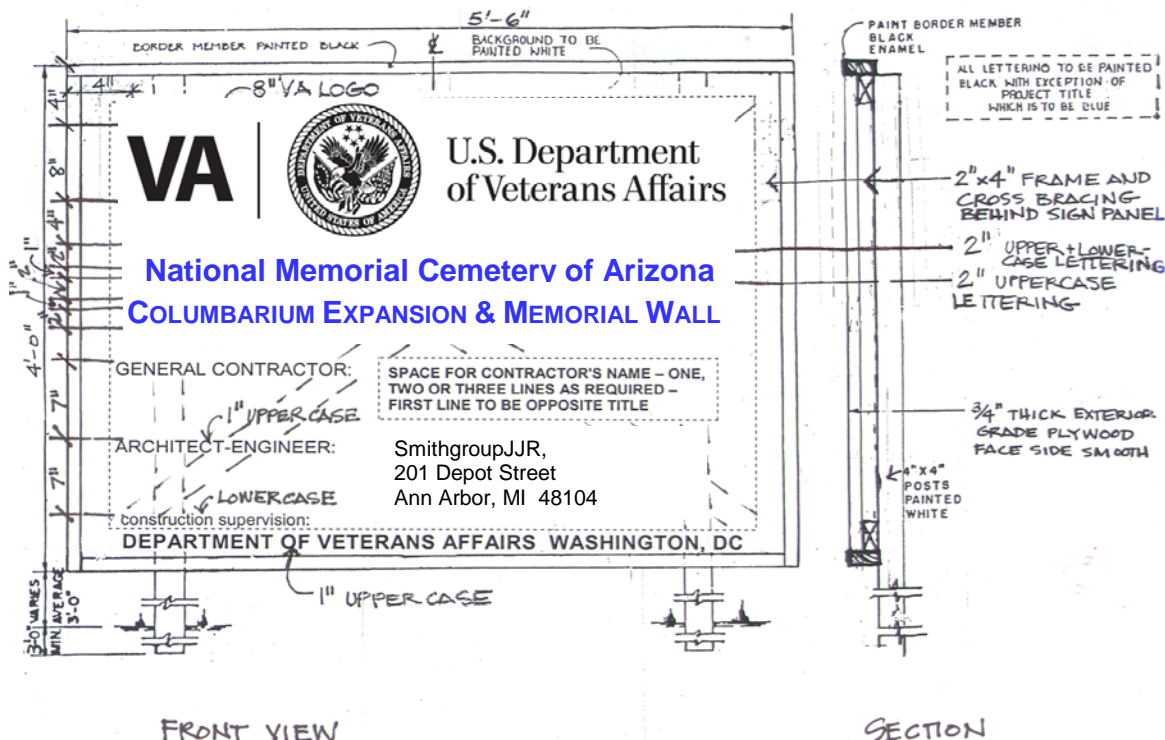
1.19 GOVERNMENT-FURNISHED PROPERTY

- A. The Government shall deliver to the Contractor, the Government-furnished property shown on drawings.
- B. Materials furnished by the Government to be installed by the Contractor will be furnished to the Contractor at the Cemetery.
- C. Storage space for materials will be provided by the Contractor and the Contractor shall be prepared to unload and store such equipment therein upon its receipt at the Cemetery.
- D. Notify RE/COTR in writing, 60 days in advance, of date on which Contractor will be prepared to receive materials furnished by Government. Arrangements will then be made by the Government for delivery of materials.
 - 1. Immediately upon delivery of materials, the Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of materials described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
 - 2. The Contractor thereafter is responsible for such material until such time as acceptance of contract work is made by the Government.
- E. Completely assemble and install the Government-furnished equipment in place ready for proper installation in accordance with specifications and drawings.

1.20 CONSTRUCTION SIGN

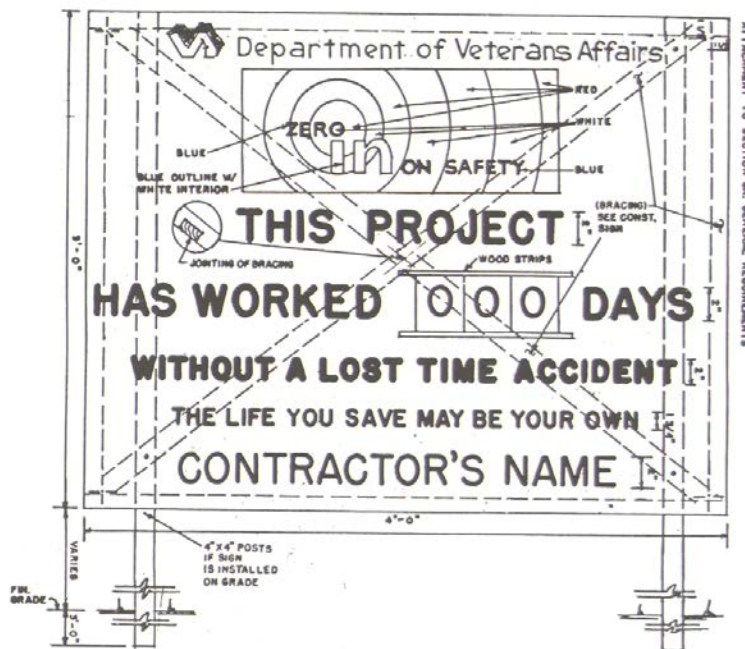
- A. Provide a Construction Sign where directed by the RE/COTR. All wood members shall be of framing lumber. Cover sign frame with 0.7 mm (24 gage) galvanized sheet steel nailed securely around edges and on all bearings. Signface shall be 4 feet x 5 feet and 6 inches. Provide two 100 by 100 mm (4 inch by 4 inch) posts (or equivalent round posts) set 900 mm (three feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50mm x 100 mm (two by four inch) material as directed.

- B. Paint all surfaces of sign and posts two coats of white semi-gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.
- C. Maintain sign and remove it when directed by the RE/COTR.
- D. Detail Drawing of construction sign showing required legend and other characteristics of sign is a part of this specification.



1.21 SAFETY SIGN

- A. Provide a Safety Sign where directed by RE/COTR. Signboard shall be shall be thB. Paint all surfaces of Safety Sign and posts with one prime coat and two coats of white gloss paint. Letters and design shall be painted with gloss paint of colors noted.
- B. Maintain sign and remove it when directed by RE/COTR.
- C. Detail Drawing of safety sign showing required legend and other characteristics of sign is included in this specification.
- D. Post the number of accident free days on a daily basis.



SAFETY SIGN

NOTES

BOARD TO BE MADE OF 3/4" EXTERIOR PLYWOOD.
BOARD TO BE PAINTED WITH ONE PRIME COAT AND
TWO COATS OF WHITE ENAMEL LETTERING TO BE IN
BLACK ENAMEL EXCEPT AS NOTED. THREE (S) SETS
OF REMOVABLE NUMERALS PAINTED ON 1/8" TEMPERED
PRESSED HARDBOARD SHALL BE PROVIDED. SIGN TO BE
LOCATED ON OR NEAR THE PRIME CONTRACTOR'S OFFICE.

TITLE

1.22 CONSTRUCTION DIGITAL IMAGES

- A. During construction period through completion, furnish Department of Veterans Affairs weekly color digital photographs of construction progress (8 to 10 images per week.) Photographs of the reinforcing steel shall be taken after all reinforcing steel, sleeves, inserts, etc. are in place but prior to setting of runways. Photographs must show distinctly, at as large a scale as possible, all parts of work embraced in picture.
- B. Photographs are to be taken with a high-resolution digital camera, minimum 6 megapixels, with good wide-angle capability. The images shall be recorded in JPEG format with a minimum of 24-bit color and no reduction in actual picture size.
1. Compressed size of the file shall be no less than 80% or the original with no loss of information.
 2. File names shall contain the Project number, the date the image was taken, and a unique sequential identifier, for example:
914CM3008_10-01-2013_0001. Use underscore, not spaces in digital file names.

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- C. The digital photo files shall become property of Government and will be both e-mailed and submitted on CD-ROM.
 - 1. The images shall be forwarded electronically to the COTR/Project Manager via email to margaret.jensen@va.gov within 2 days of when the photo was taken. Identify the content of each picture by a caption incorporated in the photo.
 - 2. The digital photo files shall also be submitted on CD-ROM to the COTR/Project Manager at the conclusion of the project. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.

1.23 FINAL ELEVATION PHOTOGRAPHS

- A. Final photographs shall be taken by a commercial/professional photographer. They shall be taken upon completion, including landscaping. They shall be taken on a clear sunny day at as large a scale as possible to obtain sufficient detail to show depth and to provide clear, sharp pictures. All images shall become property of the Government.
- B. Photographs shall be artistically composed showing full front elevations of new columbarium court(s), memorial wall, ossuary, bridge, site features and surrounding landscapes. A minimum of thirty six (36) images shall be taken as per these specifications.
- C. Minimum digital photo file size for final photos is 20 mb uninterpolated, preferably 52 mb. Submit proofs, via e-mail or webphotogallery, from which the COTR/Project Manager will select the final images for printing.
- D. Pictures selected by the COTR/Project Manager for printing shall be printed on regular weight paper, matte finish archival grade photographic paper and produced by a RA4 process from the digital image with a minimum 300 PPI. Photographs shall have full picture print with no margin.
- E. Submit two (2) 400 mm x 500 mm (16 x 20) framed prints and three (3) 8 x 10 prints of the final selected photos. Deliver to the COTR/Project Manager, in boxes suitable for shipping,
- F. Submit a CD-ROM to the COTR/Project Manager containing all (minimum 36) final digital photo files.
 - 1. Images on CD-ROM shall be recorded in JPEG format with a minimum of 24 bit color and no reduction in actual picture size. Compressed size of the file shall be no less than 80% of the original with no loss of information.

2. File names shall contain the date the image was taken, the Project number and a unique sequential identifier.
3. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.
- G. Each of the selected 16 x 20 prints shall be placed in a frame with a minimum 2 inches, maximum 3 inches, of appropriate matting as a border. Provide a selection of 3 different mats and 3 different frames from which the COTR will select one mat and one frame style to frame both prints. Preferred frame style is wood molding, matte black finish, box frame, 1-1/8" wide x 7/8-inch deep.
- H. Place a typewritten self-adhesive identity label on the back of each final print without damage to photograph. PHOTO NUMBER shall be included in both the digital file name on the CD and on the photo print label.
- I. The following information shall be on the identity-label for photographs:
 1. PHOTO NUMBER;
 2. CEMETERY: National Memorial Cemetery of Arizona
 3. LOCATION: Phoenix, AZ
 4. PROJECT TITLE: Columbarium Expansion & Memorial Wall;
 5. PROJECT NUMBER: 914CM3008;
 6. DATE TAKEN;
 7. CONSTRUCTION COMPANY;
 8. CONTRACT NUMBER.

1.24 HISTORIC PRESERVATION

Where the Contractor or any of the Contractor's employees, prior to, or during the construction work, are advised of or discover any possible archeological, historical and/or cultural resources, the Contractor shall immediately notify the RE/COTR verbally, and then with a written follow up.

1.25 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

- - - E N D - - -

SECTION 01 32 17
NETWORK ANALYSIS SCHEDULES
(MICROSOFT PROJECT GANTT CHART)

1.1 DESCRIPTION:

The Contractor shall develop a Microsoft Project 2003 (or later) Gantt Chart (bar chart) schedule demonstrating fulfillment of the contract requirements. The Contractor shall keep the network up-to-date in accordance with the requirements of this section. The Contractor shall utilize the plan for scheduling, coordinating and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers). The Gantt Chart will be utilized to satisfy time applications.

1.2 CONTRACTOR'S REPRESENTATIVE:

- A. The Contractor shall designate a representative who will be responsible to prepare the schedule, review the schedule and report progress of the project to the Contracting Officer's Representative.
- B. The Contractor's representative shall be given authority to act on behalf of the Contractor in fulfilling the requirements of this specification section. Such authority shall not be interrupted throughout the duration of the project.

1.3 COMPUTER PRODUCED SCHEDULES:

- A. The contractor shall provide to VA monthly computer processing of all computer produced schedules generated from monthly project updates. The Contractor shall provide to VA two (2) copies of the updated Microsoft Project Gantt Chart and an electronic copy of this data. This must be submitted with and substantively support the contractor's monthly payment request.
- B. The Contractor is responsible for the correctness and timeliness of the computer-produced reports. The Contractor is also responsible for the accurate and timely submittal of the updated project schedule.
- C. The Contractor shall reprocess the Gantt Chart and associated CDs, when requested by the Contracting Officers Representative, to correct errors that affect the schedule for the project.

1.4 THE COMPLETE PROJECT GANTT CHART SUBMITTAL:

- A. The Complete Project Microsoft Project Gantt Chart will contain work activities/events as necessary to fully detail the project schedule.

- B. Within ten (10) calendar days after receipt of the Notice to Proceed, the Contractor shall submit for the Contracting Officer's review, a Microsoft Project Gantt Chart and a CD. Each activity/event on the Gantt Chart schedule shall contain as a minimum, but not limited to, activity/event description, duration, start dates and finish dates. Activity constraints, not required by the contract, will not be accepted. Logic events (non-work) will be permitted where necessary to reflect proper sequence among work events, but must have zero duration.
- C. The complete working Gantt Chart shall reflect the Contractor's approach to scheduling the complete project. The final Gantt Chart in its original form shall contain no contract changes or delays that may have been incurred during the final Gantt Chart development period. It shall reflect the Contractors "AS BID" or "DAY 1" schedule. Changes and /or delays shall be entered at the first monthly update after the final Gantt Chart has been approved. The Contractor should provide their requests for time and supporting time extension analysis for contract time as a result of contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION.
- D. Within ten (10) calendar days after receipt of the complete project Gantt Chart, the Contracting Officer or his representative, will do one or both of the following:
 - 1. Notify the Contractor concerning his actions, opinions, and objections.
 - 2. Schedule a meeting with the Contractor at, or near the job site, for joint review, correction or adjustment of the proposed plan. Within ten (10) calendar days after the joint review, the Contractor shall revise and shall submit two (2) copies of the revised Gantt Chart and a revised CD as specified to the Contracting Officer. The revised submission will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved.

1.5 WORK ACTIVITY/EVENT AND COST DATA INFORMATION:

- A. The Contractor shall not be required to "cost load" the computerized Microsoft Project Gantt Chart. As part of this submission, the Contractor shall provide a separate **Schedule of Costs** on AIA document G703. This Schedule of Costs shall reflect and contain all the same activities/events identified on the Gantt Chart.

- B. The Contractor and the Contracting Officer shall use this Schedule of Costs for monthly payment purposes as referenced in the General Conditions of this agreement.
- C. The Contractor and Contracting Officer shall agree on percentages for monthly work accomplished. The cumulative total amount of all cost loaded activities/events (including alternates) shall equal the total contract price.
- D. Prorate overhead, profit and general conditions on all work activities/events for the entire project. Negative work activity/event cost data will not be acceptable, except on VA issued contract changes.

1.6 GANTT CHART REQUIREMENTS:

- A. Show on the Gantt Chart the sequence and interdependence of work activities/events required for complete performance of all items of work. In preparing the Gantt Chart, the Contractor shall:
 - 1. Show the following on each work activity/event:
 - a. Concise description of the work represented by the activity/event.
 - b. Duration (in work days.)
 - 2. Show activities/events as:
 - a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
 - b. Contracting Officer Representative's and Architect-Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
 - c. Interruption of VA Cemetery utilities, delivery of Government furnished property, project phasing and any other specification requirements.
 - d. Test, balance and adjust various systems and pieces of equipment.
 - 3. Break up the work into activities/events of durations no longer than thirty (30) work days each, except as to non-construction activities/events (i.e., procurement of materials, delivery of equipment, concrete and asphalt curing) and any other activities/events for which the Contracting Officer may approve the showing of a longer duration. [The duration for VA approval of any required submittal, shop drawing, or other submittals shall not be less than ten (10) workdays.] The construction time as determined by the Gantt Chart schedule from start to finish for any sub-phase,

phase or the entire project shall not exceed the total contract duration. Describe work activities/events clearly, so the work is readily identifiable for assessment of completion.

Activities/events labeled "start," "continue," or "completion," are not specific and will not be allowed. Lead and lag time activities will not be acceptable.

4. Exterior Label Information: Provide the following information on an external label attached to each diskette(s):
 - a. Project number, cemetery name and project location.
 - b. Name and telephone number of a point of contact, preferably the person who created the CD
 - c. The CD number and total number of CDs in the set
 - d. The project data status date.

1.7 PAYMENT TO THE CONTRACTOR:

- A. Monthly, the contractor shall submit the Gantt Chart updated for remaining activity durations and a Schedule of Costs updated for costs. AIA application and certification for payment documents G702 and G703 will be used. The payment request should reflect and be in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article, PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS of Section GENERAL CONDITIONS. The Contractor is entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated Schedule of Costs unless, in special situations, the Contracting Officer permits an exception to this requirement. Monthly payment requests shall include: two (2) copies of the updated Microsoft Project Gantt Chart, a listing of all project schedule changes, and associated data, made at the update. These must be submitted with and substantively support the contractor's monthly application and certificate for payment request documents.
- B. When the Contractor fails or refuses to furnish to the Contracting Officer the information and the associated updated Gantt Chart data, which, in the sole judgment of the Contracting Officer, are necessary for validating the monthly progress payment, the Contractor shall not be deemed to have provided supporting schedule data upon which progress payment may be reasonably determined.

1.8 PAYMENT AND PROGRESS REPORTING:

- A. Monthly job site progress meetings shall be held on dates mutually agreed to by the Contracting Officer (or Contracting Officer's Representative) and the Contractor. Presence of subcontractors during the progress meeting is optional unless required by the Contracting Officer (or Contracting Officer's Representative). Job progress will be reviewed to verify:
1. Actual start and/or finish dates for updated/completed activities/events.
 2. Remaining duration, required to complete each activity/event started, or scheduled to start, but not completed.
 3. Time and cost data for change orders, and supplemental agreements that are to be incorporated into the Gantt Chart.
 4. Percentage for completed and partially completed activities/events.
 5. Logic and duration revisions required by this section of the specifications.
 6. Activity/event duration and percent complete shall be updated independently.
- B. The Contractor shall submit a narrative report as a part of his monthly review and update, in a form agreed upon by the Contracting Officer. The narrative report shall include a description of problem areas; current and anticipated delaying factors and their estimated impact on performance of other activities/events and completion dates; and an explanation of corrective action taken or proposed. This report is in addition to the daily reports pursuant to the provisions of Article, DAILY REPORT OF WORKERS AND MATERIALS in the GENERAL CONDITIONS.
- C. As part of the monthly jobsite progress meeting, the General Contractor, specifically requested subcontractors and the Contracting Officers Representative shall meet to discuss the monthly updated schedule. The main emphasis shall be to address work activities to avoid slippage of project schedule and to identify any necessary actions required to maintain project schedule during the reporting period.

1.9 RESPONSIBILITY FOR COMPLETION:

- A. Whenever it becomes apparent from the monthly progress review meeting or the monthly computer-produced Gantt Chart schedule that phasing or contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:

1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
 2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
 3. Reschedule the work in conformance with the specification requirements.
- B. Prior to proceeding with any of the above actions, the Contractor shall notify and obtain approval from the Contracting Officer for the proposed schedule changes. If such actions are approved, the revisions shall be incorporated by the Contractor into the Gantt Chart before the next update, at no additional cost to the Government.

1.10 CHANGES TO GANTT CHART SCHEDULE:

- A. Within ten (10) calendar days after VA acceptance and approval of any updated computer-produced schedule, the Contractor shall submit a revised Gantt Chart, the associated CDs, and a list of any activity/event changes including predecessors and successors for any of the following reasons:
1. Delay in completion of any activity/event or group of activities/events, which indicate an extension of the project completion by twenty (20) working days or 10 percent of the remaining project duration, whichever is less. Such delays which may be involved with contract changes, strikes, unusual weather, and other delays will not relieve the Contractor from the requirements specified unless the conditions are shown on the Gantt Chart as the direct cause for delaying the project beyond the acceptable limits.
 2. Delays in submittals, or deliveries, or work stoppage are encountered which make rescheduling of the work necessary.
 3. The schedule does not represent the actual prosecution and progress of the project.
 4. When there is, or has been, a substantial revision to the activity/event costs of the network diagram regardless of the cause for these revisions.
- B. Revisions made under this paragraph, which affect the previously approved computer-produced schedules for Government furnished property, contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or any other previously contracted item, must be furnished in writing to the Contracting Officer for approval.

- C. Contracting Officer's approval for the revised Gantt Chart and all relevant data is contingent upon compliance with all other paragraphs of this section and any other previous agreements by the Contracting Officer or the Contracting Officer's Representative.
- D. The cost of revisions to the Gantt Chart resulting from contract changes will be included in the cost of the change.
- E. The cost of revisions to the Gantt Chart not resulting from contract changes is the responsibility of the Contractor.

1.11 ADJUSTMENT OF CONTRACT COMPLETION:

- A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a justification, Gantt Chart data and supporting evidence as the Contracting Officer may deem necessary for determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in work days) and costs is obligatory to any approvals.
- B. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current computer-produced Gantt Chart schedule for the time period when the change took place and all other relevant information. The Contracting Officer will, within thirty (30) calendar days after receipt of such justification and supporting evidence, advise the Contractor in writing of his decision on the matter.
- C. The Contractor shall submit each request for a change in the contract completion date to the Contracting Officer in accordance with the provisions specified under Article, CHANGES, in the Section, GENERAL CONDITIONS. The Contractor shall include, as a part of each change order proposal, a sketch showing all revisions, duration (in work days) changes, and cost changes, for work in question and its relationship to other activities on the approved network diagram.
- D. All delays due to non-work activities/events such as RFI's, WEATHER, STRIKES, and similar non-work activities/events shall be analyzed on a month by month basis.

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

- 1.1 Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.
- 1.2 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.
- 1.3 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.
- 1.4 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.
- 1.5 Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by Resident Engineer (RE)/Contracting Officer's Technical Representative (COTR) on behalf of the Contracting Officer.
- 1.6 The Contractor shall prepare and submit to the RE/COTR a complete submittal list of all required documents that will be required for review and approval at the first construction meeting. The Contractor shall maintain and update the submittal list for the duration of construction and shall provide an updated submittal list at each construction progress meeting and when requested by the Engineer.

- A. Upon distribution of submittals, the Contractor 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.
- 1.7 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 Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.
- 1.8 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.
- 1.9 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 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. If requested by the COTR, the Contractor shall submit documentation in digital PDF format to the COTR, Architect/Engineer, and other parties as designated. Shop drawings and large format drawings shall be scanned by the Contractor at their expense into a digital PDF format for distribution. Physical Samples that cannot be transmitted digitally shall be shipped and/or transported to the location(s) designated by the COTR at the Contractor's expense. The Contractor shall provide at a minimum and when requested three duplicate physical samples. Additional copies of submittal documents shall be provided when requested by the COTR. In addition to the digital PDF copies, the Contractor shall provide three original hardcopies of submittal documentation requiring certification, seals, signatures, etc. to the COTR .
 - C. Forward submittals in sufficient time to permit proper consideration and approvals. 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.

- D. Submittal documentation shall be clearly HIGHLIGHTED to definitively identify the particular model numbers, sizes, products, materials, components, options, accessories, and other associated appurtenances. Documentation that is not provided in this fashion will be returned to the Contractor for correction and resubmission. The additional labor and expenses incurred by VA and/or their Consultants that is required for reviews and approvals for rejected and/or submittal documentation that requires resubmission more than once will be paid for by the Contractor.
- E. 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.
- F. 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.

- G. Approved samples will be kept on file by the Resident Engineer/COTR 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.
- H. 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.
- 1.10 Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to:

SmithGroupJJR, Inc.
201 Depot Street, 2nd Floor
Ann Arbor, MI 48104

- 1.11 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/COTR.

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SECTION 01 42 19
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

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)

The specifications and standards cited in this solicitation can be examined at the following location:

DEPARTMENT OF VETERANS AFFAIRS
Office of Construction & Facilities Management
Facilities Standards Service [003C2B]
425 I Street NW
Washington, DC 20001
Telephone Number: (202) 632-4607
Between 9:00 AM - 3:00 PM

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)

The specifications cited in this solicitation may be obtained from the associations or organizations listed below.

AA	Aluminum Association Inc. http://www.aluminum.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.aashto.org
ACGIH	American Conference of Governmental Industrial Hygienists http://www.acgih.org
ACI	American Concrete Institute http://www.aci-int.net
ACPA	American Concrete Pipe Association http://www.concrete-pipe.org
AGC	Associated General Contractors of America http://www.agc.org
AISC	American Institute of Steel Construction http://www.aisc.org
AISI	American Iron and Steel Institute http://www.steel.org
ANLA	American Nursery & Landscape Association http://www.anla.org
ANSI	American National Standards Institute, Inc. http://www.ansi.org
ASAE	American Society of Agricultural Engineers http://www.asae.org

ASCE	American Society of Civil Engineers http://www.asce.org
ASTM	American Society for Testing and Materials http://www.astm.org
AWS	American Welding Society http://www.aws.org
AWWA	American Water Works Association http://www.awwa.org
CLFMI	Chain Link Fence Manufacturers Institute http://www.chainlinkinfo.org
CRSI	Concrete Reinforcing Steel Institute http://www.crsi.org
EPA	Environmental Protection Agency http://www.epa.gov
ETL	ETL Testing Laboratories, Inc. http://www.etl.com
FCC	Federal Communications Commission http://www.fcc.gov
FM	Factory Mutual Insurance http://www.fmglobal.com
GSA	General Services Administration http://www.gsa.gov
HI	Hydraulic Institute http://www.pumps.org
ICBO	International Conference of Building Officials http://www.icbo.org
NAAMM	National Association of Architectural Metal Manufacturers http://www.naamm.org
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
OSHA	Occupational Safety and Health Administration Department of Labor http://www.osha.gov
PCA	Portland Cement Association http://www.portcement.org
PCI	Precast Prestressed Concrete Institute http://www.pci.org
PPI	The Plastic Pipe Institute http://www.plasticpipe.org
PTI	Post-Tensioning Institute http://www.post-tensioning.org
RMA	Rubber Manufacturers Association, Inc. http://www.rma.org
SJI	Steel Joist Institute http://www.steeljoist.org
SMACNA	Sheet Metal and Air-Conditioning Contractors National Association, Inc. http://www.smacna.org
SSPC	The Society for Protective Coatings http://www.sspc.org
UL	Underwriters' Laboratories Incorporated http://www.ul.com

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SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

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. The Contractor is responsible for all tests required to complete the project at no additional cost to the Government with no limit on the number of tests.

1.2 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
- T27-06.....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
 - T99-01 (R2004).....The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
 - T104-99 (R2003).....Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
 - T180-01 (R2004).....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):
- A325-09.....Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - A370-09.....Definitions for Mechanical Testing of Steel Products
 - A490-08.....Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
 - C31/C31M-08.....Making and Curing Concrete Test Specimens in the Field
 - C33-08.....Concrete Aggregates
 - C39/C39M-05.....Compressive Strength of Cylindrical Concrete Specimens
 - C109/C109M-08.....Compressive Strength of Hydraulic Cement Mortars

C138-08.....	Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
C140-08.....	Sampling and Testing Concrete Masonry Units and Related Units
C143/C143M-08.....	Slump of Hydraulic Cement Concrete
C172-08.....	Sampling Freshly Mixed Concrete
C173-08.....	Air Content of freshly Mixed Concrete by the Volumetric Method
C330-05.....	Lightweight Aggregates for Structural Concrete
C567-05.....	Density Structural Lightweight Concrete
C780-08.....	Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C1019-09.....	Sampling and Testing Grout
C1064/C1064M-08.....	Freshly Mixed Portland Cement Concrete
C1077-08.....	Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
C1314-07.....	Compressive Strength of Masonry Prisms
D698-07.....	Laboratory Compaction Characteristics of Soil Using Standard Effort
D1143-07.....	Piles 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
D1557-07.....	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
D2216-05.....	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2922-05.....	Density of soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D2974-07.....	Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
D3666-07.....	Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials
D3740-08.....	Minimum Requirements for Agencies Engaged in the Testing and Inspecting Road and Paving Material

E94-04.....Radiographic Testing
E164-08.....Ultrasonic Contact Examination of Weldments
E329-08.....Agencies Engaged in Construction Inspection
and/or Testing
E543-08.....Agencies Performing Non-Destructive Testing
E709-08.....Guide for Magnetic Particle Examination
E1155-96(R2008).....Determining FF Floor Flatness and FL Floor
Levelness Numbers

D. American Welding Society (AWS):

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

1.3 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/COTR 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/COTR 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 shall meet the requirements of ASTM E329.
2. Laboratories engaged in testing of concrete and concrete aggregates shall meet the requirements of ASTM C1077.
3. Laboratories engaged in testing of bituminous paving materials shall meet the requirements of ASTM D3666.
4. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, shall 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) shall meet the requirements of ASTM E543.
7. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA.

B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests

requested by RE/COTR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of RE/COTR to such failure.

- C. Written Reports: Testing laboratory shall submit test reports to RE/COTR, Contractor, and Local Building Authority within 24 hours after each test is completed unless other arrangements are agreed to in writing by the RE/COTR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to RE/COTR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK

A. General: The Testing Laboratory shall 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 shall be as identified herein and shall include 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/COTR 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/COTR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
- 2. Provide part time observation of fill placement and compaction and field density testing in pavement areas and bridge 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 ASTM D698 and/or ASTM D1557.
- 2. Make field density tests in accordance with the primary testing method following ASTM D6938 wherever possible. Field density tests utilizing ASTM D1556 shall 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 should provide satisfactory explanation to the RE/COTR before the tests are conducted.

- a. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
 - b. Pavement Subgrade: One test for each 335 m² (400 square yards), but in no case fewer than two tests.
 - c. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
 - d. 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.
 - e. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to RE/COTR. In each compacted fill layer below wall footings, perform one field density test for every 30 m (100 feet) of wall. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.
- 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/COTR.

3.2 FOUNDATION PILES

- A. Witness load test procedure for conformance with ASTM D1143 and interpret test data to verify geotechnical recommendations for pile capacity. Submit load test report in accordance with ASTM D1143.
- B. Review Contractor's equipment, methods, and procedures prior to starting any work on site. Provide continuous inspection of pile installation. Maintain a record of all pertinent phases of operation for submittal to RE/COTR.
- C. Cast-in-Place Concrete Piles: Test concrete including materials for concrete as required in Article CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.

3.3 LANDSCAPING

- A. Test topsoil as indicated in 32 90 00, PLANTING.
- B. Submit laboratory test report of topsoil to RE/COTR.

3.4 SITE WORK CONCRETE

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

3.5 CONCRETE

A. Batch Plant Inspection and Materials Testing:

1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of RE/COTR with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by RE/COTR.
2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to RE/COTR.
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. Label each cylinder with an identification number. RE/COTR 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/COTR 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/COTR. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall 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/COTR. 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.

3.6 REINFORCEMENT

- A. Perform sampling at fabricating plant. Take two samples from each 23 t (25 tons) or fraction thereof of each size of reinforcing steel No. 10 thru No. 57 (No. 3 thru No. 18).
- B. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.
- C. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.
- D. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

3.7 PRESTRESSED CONCRETE

- A. Inspection at Plant: Forms, placement and concrete cover of reinforcing steel and tendons, placement and finishing of concrete, and tensioning of tendons.
- B. Concrete Testing: Test concrete including materials for concrete required in Article, CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.
- C. Test tendons for conformance with ASTM A416 and furnish report to RE/COTR.
- D. Inspect members to insure that specification requirements for curing and finishes have been met.

3.8 ARCHITECTURAL PRECAST CONCRETE

- A. Inspection at Plant: Forms, placement of reinforcing steel, concrete cover, and placement and finishing of concrete.
- B. Concrete Testing: Test concrete including materials for concrete as required in Article CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.

- C. Inspect members to insure specification requirements for curing and finishes have been met.

3.9 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.

3.10 STRUCTURAL STEEL

- A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS D1.1 Structural Welding Code.

B. Prefabrication Inspection:

- 1. Review design and shop detail drawings for size, length, type and location of all welds to be made.
- 2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
- 3. Approve welder qualifications by certification or retesting.
- 4. Approve procedure for control of distortion and shrinkage stresses.
- 5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.

C. Fabrication and Erection:

- 1. Weld Inspection:

- a. Inspect welding equipment for capacity, maintenance and working condition.
 - b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
 - c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
 - d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
 - e. Measure 25 percent of fillet welds.
 - f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
 - 1) 20 percent of all shear plate fillet welds at random, final pass only.
 - 2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
 - 3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
 - 4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
 - 5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
 - g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.
 - h. Verify that correction of rejected welds are made in accordance with AWS D1.1.
 - i. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
2. Bolt Inspection:
- a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 - b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.

- c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
 - d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
 - e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
 - f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.
- D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to RE/COTR.

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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 effect human health or welfare.
 - 2. Unfavorably alter ecological balances of importance to human life.
 - 3. Effect 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. Contractor shall establish and maintain quality control for the environmental protection of all items set forth herein.
- B. Contractor shall record on daily reports any problems in complying with laws, regulations, ordinances and note any corrective action taken.

1.4 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- 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. Arizona Department of Environmental Quality.
2. City of Phoenix and Maricopa County Departments 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 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, the Contractor shall meet with the Resident Engineer/COTR 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, the Contractor shall prepare and submit to the Resident Engineer/COTR 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) 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, stormwater channel crossings, material storage areas, structures, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by 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 Resident Engineer/COTR 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.

1.6 PROTECTION OF ENVIRONMENTAL RESOURCES

- A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the duration of this contract. 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 Resident Engineer/COTR. 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. Mark/fence/protect monuments, works of art, and markers prior to construction. 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. See Section 02 41 10.
 - 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 2-year (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, draining from the surface.
 - b. Reuse or conserve the collected topsoil sediment as directed by the Resident Engineer/COTR. 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 on the Demolition and Site Preparation Plans. Maintain temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, 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 Resident Engineer/COTR.
- 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 and/or stormwater channel crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.
- 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 Arizona Department of Environmental Quality 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 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, 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/COTR. 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 7:00 a.m. and 6:00 p.m. unless otherwise permitted by local ordinance or the Resident Engineer/COTR. Repetitive impact noise on the property shall not exceed the following dB limitations:

Time Duration of Impact Noise	Sound Level in dB
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 at 15 m (50 feet) (dBA):

EARTHMOVING		MATERIALS HANDLING	
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
PUMPS	75	SAWS	75
GENERATORS	75	VIBRATORS	75
COMPRESSORS	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/COTR 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 Resident Engineer/COTR. 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 02 41 10
DEMOLITION AND SITE CLEARING

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 11, EARTH MOVING (SHORT FORM).
- B. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- C. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

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 00, GENERAL REQUIREMENTS, 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. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
 - 1. 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.
 - 2. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.

- E. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Cemetery Property; any damaged items shall be repaired or replaced as approved by the Resident Engineer (RE)/ Contracting Officer's Technical Representative (COTR). The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall 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 Repairs, reinforcement, or structural replacement must have RE/COTR's approval.
- F. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- G. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7 INFECTION PREVENTION MEASURES.

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: Contractor shall 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. Contractor shall 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 RE/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 6 inches. On-site topsoil in the project area is negligible.

- 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 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 surface stabilization. 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 structures, including all appurtenances related or connected thereto, as noted below:
 - 1. As required for installation of new bridge.
 - 2. To full depth within an area defined by hypothetical lines located 1500 mm (5 feet) outside building lines of new structures.
- B. Debris, including brick, concrete, stone, aggregate base, 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/COTR. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.
- C. 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 become property of contractor and 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 1500mm (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 1500 mm (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.

- D. 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/COTR. When Utility lines are encountered that are not indicated on the drawings, the RE/COTR shall be notified prior to further work in that area.

3.3 CLEAN-UP

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to RE/COTR. 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

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 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Concrete Mix Design.
- C. Shop Drawings: Reinforcing steel: Complete shop drawings.
- D. Manufacturer's Certificates: Air-entraining admixture, chemical admixtures, curing compounds.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Concrete Institute (ACI):
 - 117R-06.....Tolerances for Concrete Construction and Materials
 - 211.1-91(R2002).....Proportions for Normal, Heavyweight, and Mass Concrete
 - 301-05.....Specification for Structural Concrete
 - 305R-06.....Hot Weather Concreting
 - 306R-2002.....Cold Weather Concreting
 - SP-66-04ACI Detailing Manual

- 318/318R-05.....Building Code Requirements for Reinforced
Concrete
- 347R-04.....Guide to Formwork for Concrete
- C. American Society for Testing And Materials (ASTM):
- A185-07.....Steel Welded Wire, Fabric, Plain for Concrete
Reinforcement
- A615/A615M-08.....Deformed and Plain Billet-Steel Bars for
Concrete Reinforcement
- A996/A996M-06.....Standard Specification for Rail-Steel and Axle-
Steel Deformed Bars for Concrete Reinforcement
- C31/C31M-08.....Making and Curing Concrete Test Specimens in
the Field
- C33-07.....Concrete Aggregates
- C39/C39M-05.....Compressive Strength of Cylindrical Concrete
Specimens
- C94/C94M-07.....Ready-Mixed Concrete
- C143/C143M-05.....Standard Test Method for Slump of Hydraulic
Cement Concrete
- C150-07.....Portland Cement
- C171-07.....Sheet Material for Curing Concrete
- C172-07.....Sampling Freshly Mixed Concrete
- C173-07.....Air Content of Freshly Mixed Concrete by the
Volumetric Method
- C192/C192M-07.....Making and Curing Concrete Test Specimens in
the Laboratory
- C231-08.....Air Content of Freshly Mixed Concrete by the
Pressure Method
- C260-06.....Air-Entraining Admixtures for Concrete
- C494/C494M-08.....Chemical Admixtures for Concrete
- C618-08.....Coal Fly Ash and Raw or Calcined Natural
Pozzolan for Use in Concrete
- D1751-04.....Preformed Expansion Joint Fillers for Concrete
Paving and Structural Construction (Non-
extruding and Resilient Bituminous Types)
- D4397-02.....Polyethylene Sheeting for Construction,
Industrial and Agricultural Applications

E1155-96(2008).....Determining F_F Floor Flatness and F_L Floor
Levelness Numbers

PART 2 PRODUCTS

2.1 FORMS

Wood, plywood, metal, or other materials, approved by Resident Engineer (RE)/Contracting Officer's Technical Representative (COTR), of grade or type suitable to obtain type of finish specified.

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. Coarse aggregate for applied topping and metal pan stair fill shall be Size 7.
- D. Fine Aggregate: ASTM C33.
- E. Mixing Water: Fresh, clean, and potable.
- F. Air-Entraining Admixture: ASTM C260.
- G. Chemical Admixtures: ASTM C494.
- H. Vapor Barrier: ASTM D4397, 0.25 mm (10 mil).
- I. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. See structural drawings for grade.
- J. Welded Wire Fabric: ASTM A185.
- K. Expansion Joint Filler: ASTM D1751.
- L. Sheet Materials for Curing Concrete: ASTM C171.
- M. Abrasive Aggregates: Aluminum oxide grains or emery grits.
- N. 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.
- O. Liquid Densifier/Sealer: 100 percent active colorless aqueous silicate solution.
- P. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout shall show no settlement or vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement, and produce a compressive strength of at least 18mpa (2500 psi) at 3 days and 35mpa (5000 psi) at 28 days.

2.3 CONCRETE MIXES

- A. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.
- B. Compressive strength at 28 days shall be not less than 30mpa (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
28 (4000) ^{1,3}	325 (550)	0.55	340 (570)	0.50
21(3000) ^{1,3}	280 (470)	0.65	290 (490)	0.55
21 (3000) ^{1,2}	300 (500)	*	310 (520)	*

1. If trial mixes are used, the proposed mix design shall 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 shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.
 2. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
 3. * 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 shall conform with the following table:

**TABLE I - TOTAL AIR CONTENT
FOR VARIOUS SIZES OF COARSE AGGREGATES (NORMAL CONCRETE)**

Nominal Maximum Size of Coarse Aggregate	Total Air Content Percentage by Volume
10 mm (3/8 in)	6 to 10
13 mm (1/2 in)	5 to 9
19 mm (3/4 in)	4 to 8
25 mm (1 in)	3 1/2 to 6 1/2
40 mm (1 1/2 in)	3 to 6

2.4 BATCHING & MIXING

- A. Store, batch, and mix materials as specified in ASTM C94.
 - 1. Job-Mixed: Concrete mixed at job site shall be mixed in a batch mixer in manner specified for stationary mixers in ASTM C94.
 - 2. Ready-Mixed: Ready-mixed concrete 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 shall furnish, in duplicate, certification as required by ASTM C94.

PART 3 EXECUTION

3.1 FORMWORK

- A. Installation conform to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection, 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 and required to be in their final position at time

concrete is placed shall be properly located, accurately positioned and built into construction, and maintained securely in place.

D. Construction Tolerances:

1. Contractor is responsible for setting and maintaining concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials. Remedial work necessary for correcting excessive tolerances is the responsibility of the Contractor. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
2. 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

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 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/COTR before placing concrete. Provide screeds at required elevations for concrete slabs.
- B. Before placing new concrete on or against concrete which has set, existing surfaces shall be roughened and cleaned free from all laitance, foreign matter, and loose particles.
- 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. Vibration shall be carried on 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.

3.4 PROTECTION AND CURING

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 shall be subject to approval by RE/COTR.

3.5 FORM REMOVAL

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.

3.6 SURFACE PREPARATION

Immediately after forms have been removed and work has been examined and approved by RE/COTR, remove loose materials, 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.

3.7 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 shall be knocked off flush by mechanical means approved by RE/COTR 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): Finished areas, unless otherwise shown, shall be given a grout finish of uniform color and shall have a 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 shall all be thoroughly raked or wire broomed after partial setting (within 2 hours after placing) to roughen surface to insure 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: Ramps, stair treads, and platforms, both interior and exterior, equipment pads, and slabs to receive non-cementitious materials, except as specified, shall be screened and floated to a smooth dense finish. After first floating, while surface is still soft, surfaces shall be checked for alignment using a straightedge or template. 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 shall be steel

troweled. Final steel troweling to secure a smooth, dense surface shall be delayed 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 shall 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.

3.8 SURFACE TREATMENTS

- A. Surface treatments shall be mixed and applied in accordance with manufacturer's printed instructions.
- B. Liquid Densifier/Sealer: Use on all exposed concrete floors and concrete floors to receive carpeting except those specified to receive non-slip finish.
- C. 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. Aggregate shall be broadcast 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.

3.9 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.

3.10 PRECAST CONCRETE ITEMS

Precast concrete items, not specified elsewhere, shall be cast using 28 MPa (4000 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.

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SECTION 03 37 13
SHOTCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes shotcrete applied by dry-mix or wet-mix process.

1.3 DEFINITIONS

- A. Shotcrete: Mortar or concrete pneumatically projected onto a surface at high velocity.
- B. Dry-Mix Shotcrete: Shotcrete with most of the mixing water added at nozzle.
- C. Wet-Mix Shotcrete: Shotcrete with ingredients, including mixing water, mixed before introduction into delivery hose.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at the project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product including reinforcement and forming accessories, shotcrete materials, admixtures, and curing compounds.
- B. Design Mixtures: For each shotcrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. For predampened dry-mix mixtures, indicate amounts of mixing water to be added to the dry-mix materials before mixing and conveying through the delivery hose.
- C. Shop Drawings: For shotcrete installation. Include support and anchor details; reinforcement materials and grades and details of fabricating, bending, and placing reinforcement; number and location of splices; special reinforcement required for openings through shotcrete structures; and locations of proposed construction joints.
- D. Samples: For each exposed product and for each color and finish specified, approximately 24 by 24 by 2 inches in size.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installer.
- B. Material Certificates: For each of the following:
 - 1. Cementitious materials.

- 2. Admixtures.
- 3. Form materials.
- C. Preconstruction Test Reports: For shotcrete.
- D. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer employing nozzle operators for the Project, each of whom **is** ACI Shotcrete Nozzleman certified in Dry-Mix Process for Vertical Position, is ACI Shotcrete Nozzleman certified in Wet-Mix Process for Vertical Position, as appropriate to the required shotcrete work.
- B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- C. ACI Publications: Comply with ACI 506.2, "Specification for Shotcrete," unless modified by requirements in the Contract Documents.
- D. Shotcrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design shotcrete mixtures.
- E. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups for each finish required and for each design mixture, shooting orientation, and nozzle operator.
 - 2. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 - 3. Demonstrate curing and protecting of shotcrete, finishes, and joints, as applicable.
 - 4. In presence of Architect, damage part of the exposed-face surface for each color and finish, and demonstrate materials and techniques proposed for repair of holes and surface blemishes to match adjacent undamaged surfaces.
 - 5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service Contractor to engage a qualified independent testing agency to perform preconstruction testing and inspections indicated below:

1. Produce shotcrete test panels before shotcrete placement according to requirements in ACI 506.2 and ASTM C 1140 for each design mixture, shooting orientation, and nozzle operator. Produce test panels with dimensions of 24 by 24 inches minimum and of average thickness of shotcrete, but not less than 3-1/2 inches.
2. From each test panel, testing agency will obtain six test specimens: one set of three specimens unreinforced and one set of three specimens reinforced. Agency will perform the following:
 - a. Strength Testing: Test each set of unreinforced specimens for compressive strength according to ASTM C 42/C 42M.
 - b. Core Grading: Visually inspect each set of reinforced shotcrete cores taken from test panels and determine mean core grades according to ACI 506.2.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms: Form-facing panels that will provide continuous, straight, smooth, concrete surfaces. Furnish panels in largest practical sizes to minimize number of joints.

2.2 REINFORCING MATERIALS

- A. Plain-Steel Wire: ASTM A 82/A 82M, galvanized.
- B. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from galvanized-steel wire into flat sheets.
- C. Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufactured according to CRSI's "Manual of Standard Practice" and as follows:
 1. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
- D. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

2.3 SHOTCRETE MATERIALS

- A. Source Limitations for Shotcrete: Obtain each color, size, type, and variety of shotcrete material and shotcrete mixture from single manufacturer with resources to provide shotcrete of consistent quality in appearance and physical properties.
- B. Portland Cement: ASTM C 150, Type I. Use only one brand and type of cement for Project.
 1. Fly Ash: ASTM C 618, Class C or Class F.

- 2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or Grade 120.
- C. Silica Fume: ASTM C 1240, amorphous silica.
- D. Normal-Weight Aggregates: ASTM C 33, from a single source, and as follows:
 - 1. Combined Aggregate Size: ACI 506R or ASTM C 1436, Grading No. 2 sieve analysis.
 - 2. Deleterious Substances: Coarse-aggregate Class 1N according to ASTM C 33.
- E. Coloring Agent: ASTM C 979, synthetic mineral-oxide pigments or colored, water-reducing admixtures, free of carbon black; color stable, nonfading, and resistant to lime and other alkalis.
- F. Water: Potable, complying with ASTM C 94/C 94M, free from deleterious materials that may affect color stability, setting, or strength of shotcrete.
- G. Ground Wire: High-strength steel wire, 0.8 to 1.0 mm in diameter.
- H. Joint Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

2.4 ADMIXTURES

- A. General: ASTM C 1141, Class A (liquid) or Class B (non-liquid)], but limited to the following admixture materials. Provide admixtures for shotcrete that contain not more than 0.1 percent chloride ions. Certify compatibility of admixtures with each other and with other cementitious materials.
 - 1. Accelerating Admixture, Conventional: ASTM C 494/C 494M, Type C or Type E.
 - 2. Pozzolan Admixture: Fly ash, ground granulated blast-furnace slag, and silica fume as limited in "Shotcrete Materials" Article.
 - 3. Coloring Admixture: Coloring agent as limited in "Shotcrete Materials" Article.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry, or cotton mats.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.6 SHOTCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of shotcrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 506.2.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based laboratory trial mixture or field test data, or both.
- B. Cementitious Materials: Limit use of fly ash, ground granulated blast-furnace slag and silica fume to not exceed, in combination, 30 percent of portland cement by weight.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement or cementitious materials permitted by ACI 301.
- D. Admixtures: When included in shotcrete design mixtures, use admixtures according to manufacturer's written instructions.
- E. Design-Mixture Adjustments: Subject to compliance with requirements, shotcrete design-mixture adjustments may be proposed when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.7 SHOTCRETE MIXTURES

- A. Shotcrete Mixture: Proportion mixture to provide shotcrete with the following properties:
 - 1. Compressive Strength (28 Days): 2500 psi.
 - 2. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight wet-mix shotcrete having an air content before pumping of 6 percent with a tolerance of plus or minus 1-1/2 percent.
 - 3. Color: Match existing channel.

2.8 SHOTCRETE EQUIPMENT

- A. Mixing Equipment: Capable of thoroughly mixing shotcrete materials in sufficient quantities to maintain continuous placement.
- B. Dry-Mix Delivery Equipment: Capable of discharging aggregate-cement mixture into delivery hose under close control and maintaining continuous stream of uniformly mixed materials at required velocity to discharge nozzle. Equip discharge nozzle with manually operated water-injection system for directing even distribution of water to aggregate-cement mixture.

1. Provide uniform, steady supply of clean, compressed air to maintain constant nozzle velocity while simultaneously operating blow pipe for cleaning away rebound.
 2. Provide water supply with uniform pressure at discharge nozzle to ensure uniform mixing with aggregate-cement mix. Provide water pump to system if line water pressure is inadequate.
- C. Wet-Mix Delivery Equipment: Capable of discharging aggregate-cement-water mixture accurately, uniformly, and continuously.

2.9 BATCHING AND MIXING

- A. Dry-Mix Process: Measure mixture proportions by weight batching according to ASTM C 94/C 94M or by volume batching complying with ASTM C 685/C 685M requirements.
1. In volume batching, adjust fine-aggregate volume for bulking. Test fine-aggregate moisture content at least once daily to determine extent of bulking.
 2. Prepackaged shotcrete materials may be used at Contractor's option. Predampen prepackaged shotcrete materials and mix before use.
- B. Wet-Mix Process: Measure, batch, mix, and deliver shotcrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M and furnish batch ticket information.
1. Comply with ASTM C 685/C 685M when shotcrete ingredients are delivered dry and proportioned and mixed on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Concrete or Masonry: Before applying shotcrete, remove unsound or loose materials and contaminants that may inhibit shotcrete bonding. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders. Dampen surfaces to saturated, surface-dry condition before shotcreting.
1. Abrasive blast or hydroblast existing surfaces that do not require chipping to remove paint, oil, grease, or other contaminants and to provide roughened surface for proper shotcrete bonding.
- B. Earth: Compact and trim to line and grade before placing shotcrete. Do not place shotcrete on frozen surfaces. Dampen surfaces to saturated, surface-dry condition before shotcreting.

- C. Rock: Clean rock surfaces of loose materials, mud, and other foreign matter that might weaken shotcrete bonding. Dampen surfaces to saturated, surface-dry condition before shotcreting.
- D. Steel: Clean steel surfaces by abrasive blasting according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

3.2 FORMS

- A. General: Design, erect, support, brace, and maintain forms, according to ACI 301, to support shotcrete and construction loads and to facilitate shotcreting. Construct forms so shotcrete members and structures are secured to prevent excessive vibration or deflection during shotcreting.
 - 1. Fabricate forms to be readily removable without impact, shock, or damage to shotcrete surfaces and adjacent materials.
 - 2. Construct forms to required sizes, shapes, lines, and dimensions using ground wires and depth gages to obtain accurate alignment, location, and grades in finished structures. Construct forms to prevent mortar leakage but permit escape of air and rebound during shotcreting. Provide for openings, offsets, blocking, screeds, anchorages, inserts, and other features required in the Work.
- B. Form openings, chases, recesses, bulkheads, keyways, and screeds in formwork. Determine sizes and locations from trades providing such items. Accurately place and securely support items built into forms.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that weaken shotcrete bonding.
- C. Securely embed reinforcing anchors into existing substrates, located as required.
- D. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports, bolsters, chairs, spacers, and other devices as required to maintain minimum concrete cover.
- E. Set wire ties with ends directed into shotcrete, not toward exposed shotcrete surfaces.
- F. Install welded wire reinforcement in longest practical lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths

to prevent continuous laps in either direction. Lace overlaps with wire.

- G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.4 JOINTS

- A. General: Construct joints at locations indicated or as approved by Architect.
- B. Construction Joints: Locate and install construction joints tapered to a 1:1 slope where joint is not subject to compression loads and square where joint is perpendicular to main reinforcement. Continue reinforcement through construction joints unless otherwise indicated.
- C. Contraction Joints: Construct contraction joints in shotcrete using saw cuts 1/8-inch- wide by 1/3 slab depth or joint-filler strips 1/4-inch-wide by 1/3 shotcrete depth unless otherwise indicated.
1. After shotcrete has cured, remove strip inserts and clean groove of loose debris.
 2. Space joints at centers indicated horizontally and vertically.
 3. Tool edges round on each side of strip inserts if floated or troweled finishes are required.
 4. Where shooting over an existing substrate joint, align new shotcrete joint with existing joint.

3.5 ALIGNMENT CONTROL

- A. Ground Wires: Install ground wires to establish thickness and planes of shotcrete surfaces. Install ground wires at corners and offsets not established by forms. Pull ground wires taut and position adjustment devices to permit additional tightening.

3.6 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by shotcrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.7 APPLICATION

- A. Apply temporary protective coverings and protect adjacent surfaces against deposit of rebound and overspray or impact from nozzle stream.
- B. Moisten wood forms immediately before placing shotcrete where form coatings are not used.
- C. Apply shotcrete according to ACI 506.2.

- D. Apply dry-mix shotcrete materials within 45 minutes after predampening and wet-mix shotcrete materials within 90 minutes after batching.
- E. Deposit shotcrete continuously in multiple passes, to required thickness, without cold joints and laminations developing. Place shotcrete with nozzle held perpendicular to receiving surface. Begin shotcreting in corners and recesses.
 - 1. Remove and dispose of rebound and overspray materials during shotcreting to maintain clean surfaces and to prevent rebound entrapment.
- F. Maintain reinforcement in position during shotcreting. Place shotcrete to completely encase reinforcement and other embedded items. Maintain steel reinforcement free of overspray, and prevent buildup against front face during shotcreting.
- G. Do not place subsequent lifts until previous lift of shotcrete is capable of supporting new shotcrete.
- H. Do not permit shotcrete to sag, slough, or dislodge.
- I. Remove hardened overspray, rebound, and laitance from shotcrete surfaces to receive additional layers of shotcrete; dampen surfaces before shotcreting.
- J. Do not disturb shotcrete surfaces before beginning finishing operations.
- K. Remove ground wires or other alignment-control devices after shotcrete placement.
- L. Shotcrete Core Grade: Apply shotcrete to achieve mean core grades not exceeding 2.5 according to ACI 506.2, with no single core grade exceeding 3.0.
- M. Installation Tolerances: Place shotcrete without exceeding installation tolerances permitted by ACI 117, increased by a factor of two.
- N. Cold-Weather Shotcreting: Mix, place, and protect shotcrete according to ACI 306.1 and as follows. Protect shotcrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. Discontinue shotcreting when ambient temperature is 40 deg F and falling.
 - 2. Uniformly heat water and aggregates before mixing to obtain a shotcrete shooting temperature of not less than 50 deg F and not more than 90 deg F.
 - 3. Do not use frozen materials or materials containing ice or snow.

4. Do not place shotcrete on frozen surfaces or surfaces containing frozen materials.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
- O. Hot-Weather Shotcreting: Mix, place, and protect shotcrete according to recommendations of ACI 305R when hot-weather conditions and high temperatures would seriously impair quality and strength of shotcrete, and as follows:
 1. Cool ingredients before mixing to maintain shotcrete temperature at time of placement below 100 deg F for dry mix or 90 deg F for wet mix.
 2. Reduce temperature of reinforcing steel and receiving surfaces below 100 deg F before shotcreting.

3.8 SURFACE FINISHES

- A. General: Finish shotcrete according to descriptions in ACI 506R.
- B. Natural Finishes:
 1. Gun Finish: Natural undisturbed finish as sprayed.
 2. Rod Finish: Rough-textured finish obtained by screeding or cutting exposed face of shotcrete to plane with cutting rod, edge of trowel, or straightedge after initial set. Do not push or float with flat part of trowel.
 3. Broom Finish: Rough-textured finish obtained by screeding or cutting exposed face of shotcrete to plane with cutting rod, edge of trowel, or straightedge after initial set; followed by uniform brooming.
- C. Flash-Coat Finish: After screeding or cutting exposed face of shotcrete to plane after initial set, apply up to 1/4-inch coat of shotcrete using ACI 506R, Grading No. 1, fine-screened sand modified with maximum aggregate size not exceeding No. 4 sieve to provide a finely textured finish.
- D. Flash-Coat with Final Finish: After screeding or cutting exposed face of shotcrete to plane after initial set, apply up to 1/4-inch coat of shotcrete using ACI 506R, Grading No. 1, fine-screened sand modified with maximum aggregate size not exceeding No. 4 sieve, and apply [**wood-float**] [**rubber-float**] [**brush-float**] [**steel-trowel**] finish.
- E. Finish-Coat Finish: After screeding or cutting exposed face of shotcrete to plane after initial set, apply shotcrete finish coat, 1/4 to 1 inch thick, using ACI 506R, Grading No. 1, fine-screened sand

modified with maximum aggregate size not exceeding No. 4 sieve to provide a finish of uniform texture and appearance.

- F. Finish-Coat with Final Finish: After screeding or cutting exposed face of shotcrete to plane after initial set, apply shotcrete finish coat, 1/4 to 1 inch thick, using ACI 506R, Grading No. 1, fine-screened sand modified with maximum aggregate size not exceeding No. 4 sieve, and apply [wood-float] [rubber-float] [brush-float] [steel-trowel] finish.

3.9 CURING

- A. Protect freshly placed shotcrete from premature drying and excessive cold or hot temperatures.
- B. Begin curing immediately after placing and finishing but not before free water, if any, has disappeared from shotcrete surface.
- C. Curing Exposed Surfaces: Cure shotcrete by one of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Water-saturated absorptive covers or moisture-retaining covers.
Lap and seal sides and ends of covers with 12-inch lap over adjacent covers.
 2. Curing Compound: Apply uniformly in continuous operation by power spray according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Apply curing compound to natural gun finish or flash-coat shotcrete at rate of 1 gal./100 sq. ft..
- D. Curing Formed Surfaces: Cure formed shotcrete surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

3.10 FORM REMOVAL

- A. Forms not supporting weight of shotcrete may be removed after curing for 24 consecutive hours at not less than 50 deg F, provided shotcrete is hard enough not to be damaged by form-removal operations and provided curing and protecting operations are maintained.

1. Leave forms supporting weight of shotcrete in place until shotcrete has attained design compressive strength. Determine compressive strength of in-place shotcrete by testing representative field-cured specimens of shotcrete.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing materials are unacceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor to engage a qualified testing agency to sample materials, visually grade cores, perform tests, and submit reports during shotcreting.
- B. Air Content: ASTM C 173/C 173M, volumetric method or ASTM C 231, pressure method; one test for each compressive-strength test for each mixture of air-entrained, wet-mix shotcrete measured before pumping.
- C. Shotcrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of compressive-strength specimens.
- D. Test Panels: Make a test panel, reinforced as in structure, for each shotcrete mixture and for each workday or for every 6 cu. yd. of shotcrete placed, whichever is less. Produce test panels with dimensions of 24 by 24 inches minimum and of average thickness of shotcrete, but not less than 4-1/2 inches. Testing agency will obtain sets of test specimens from each test panel.
1. Compressive Strength Testing: One set of three unreinforced specimens. Test each set of unreinforced specimens for compressive strength according to ASTM C 1140 and construction testing requirements in ACI 506.2.
 2. Visual Core Grading: One set of three reinforced specimens. Visually inspect each set of reinforced shotcrete cores taken from test panels and determine mean core grades according to ACI 506.2.
- E. In-Place Shotcrete Testing: One set of three unreinforced cores for each mixture and for each workday or for every 6 cu. Yd of shotcrete placed, whichever is less. Test cores for compressive strength according to ACI 506.2 and ASTM C 42. Do not cut steel reinforcement.

F. Strength of shotcrete will be considered satisfactory according to the following:

1. Specimen Cores: Mean compressive strength of each set of three unreinforced cores equals or exceeds 85 percent of specified compressive strength, with no individual core less than 75 percent of specified compressive strength.
2. Specimen Cubes: Mean compressive strength of each set of three unreinforced cubes shall equal or exceed design compressive strength with no individual cube less than 88 percent of specified compressive strength.

3.12 REPAIRS

- A. Remove and replace shotcrete that is delaminated or exhibits laminations, voids, or sand/rock pockets exceeding limits for specified core grade of shotcrete.
 1. Remove unsound or loose materials and contaminants that may inhibit bond of shotcrete repairs.
 2. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders.
 3. Dampen surfaces and apply new shotcrete. Match adjacent color and finish.
- B. Repair core holes from in-place testing according to repair provisions in ACI 301, except do not use shotcrete. Match adjacent color and finish.

3.13 CLEANING

- A. Immediately remove and dispose of rebound and overspray materials from final shotcrete surfaces and areas not intended for shotcrete placement.

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SECTION 03 41 33
PRECAST STRUCTURAL PRETENSIONED CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section specifies precast prestressed concrete construction including design not shown, fabrication, erection, transportation, and other related items including bearing pads and anchorage.
- B. Precast prestressed concrete includes voided slabs.

1.2 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).
- C. Sealants and Caulking: Section 07 92 00, JOINT SEALANTS.
- D. Repair of abraded galvanized and painted surfaces: Section 09 91 00, PAINTING.

1.3 QUALITY ASSURANCE:

- A. The Contractor shall perform quality control inspection. The manufacturing plant of prestressed concrete girders shall be certified by the Precast/Prestressed Concrete Institute's Plant Certification Program for the type of prestressed member to be produced and shall be approved by ADOT as a Certified Prestress Concrete Fabricator prior to the start of production. ADOT certification will be granted at, and renewed during, the annual prestressed plant review and approval process.
- B. Prior to the start of production of girders, the Contractor shall advise the Resident Engineer (RE)/Contracting Officer's Technical Representative (COTR) of the production schedule. The Contractor shall give the Inspector safe and free access to the Work. If the Inspector observes any nonspecification Work or unacceptable quality control practices, the Inspector will advise the plant manager. If the corrective action is not acceptable to the RE/COTR, the girder(s) will be subject to rejection by the RE/COTR.
- C. The Contracting Agency intends to perform Quality Assurance Inspection. By its inspection, the Contracting Agency intends only to facilitate the Work and verify the quality of that Work. This inspection shall not relieve the Contractor of any responsibility for identifying and replacing defective material and workmanship.

1.4 SUBMITTALS:

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

B. Shop Drawings:

1. Erection Drawings:

- a. Plans and/or elevations locating and defining material furnished by manufacturer.
- b. Sections and details showing connections, cast-in items and their relation to structure.
- c. Description of all loose, cast-in and field hardware.
- d. Field installed anchor location drawings.
- e. Erection sequences and handling requirements.

2. Production drawings:

- a. Shop drawings shall be as required in section 6-02.3(25)A of the ADOT Standard Specifications for Road, Bridge, and Municipal Construction 2010.
- b. Elevation view of each member.
- c. Sections and details to indicate quantities and position of reinforcing steel, anchors, inserts, and essential embedded hardware.
- d. Lifting and erection inserts.
- e. Dimensions and finishes.
- f. Prestress for strand and concrete strengths.
- g. Estimated cambers.
- h. Method of transportation.

C. Mix Designs: Submit proposed concrete mix designs and appropriate test data as specified in Part 2 of this section.

D. Permissible Design Deviations:

1. Design connections according to the conceptual details shown in the contract documents.
2. Design deviations will be permitted only after RE/COTR's written approval of manufacturer's proposed design supported by complete design calculations and drawings.
3. Design deviations shall provide an installation equivalent to basic intent without incurring additional cost to the Government.

E. Test Reports: Concrete and other material. Concrete strength shall be measured according to section 6-02.3(25)E of the ADOT Standard Specifications for Road, Bridge, and Municipal Construction 2010.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Handling and storage shall be in accordance with section 6-02.3(25)L of the ADOT Standard Specifications for Road, Bridge, and Municipal Construction 2010.
- B. Shipping shall conform to section 6-02.3(25)M of the ADOT Standard Specifications for Road, Bridge, and Municipal Construction 2010.

1.6 APPLICABLE PUBLICATIONS:

- A. ADOT Standard Specifications for Road, Bridge, and Municipal Construction 2010.
- B. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- C. American Society for Testing and Materials (ASTM):

A36/A36M-08.....Standard Specifications for Carbon Structural Steel

A82-07.....Standard Specifications for Steel Wire, Plain, for Concrete Reinforcement

A123/A123M-09.....Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A153/A153M-09.....Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A185-07.....Standard Specifications for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement

A307-10.....Standard Specifications for Carbon Steel Bolts and Studs

A325-10.....Standard Specifications for Structural Bolts, Steel, Heat Treated

A416/A416M-10.....Standard Specifications for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

A615/A615M-09.....Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

A706/A706M-09.....Standard Specifications for Low-Allow Steel Deformed and Plain Bars for Concrete Reinforcement

A767/A767M-09.....Standard Specifications for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

A775/A775M-03(R2008)....Standard Specifications for Epoxy-Coated Reinforcing Steel Bars

C33-03.....Standard Specifications for Concrete Aggregates

C88-05.....Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

C150-07.....Standard Specifications for Portland Cement

C260-10.....Standard Specifications for Air-Entraining Admixtures for Concrete

- C330-05.....Standard Specifications for Lightweight
Aggregates for Structural Concrete
- C494/C494M-10.....Standard Specification for Chemical Admixtures
for Concrete
- D. American Concrete Institute (ACI):
- 117-10.....Standard Specifications for Tolerances for
Concrete Construction and Materials
- 318-08.....Building Code Requirements for Structural
Concrete and Commentary
- E. Prestressed Concrete Institute (PCI):
- MNL-116-99.....Manual for Quality Control for Plants and
Production of Precast Concrete Products Fourth
Edition
- MNL-127-99.....Erector's Manual: Standards and Guidelines for
the Erection of Precast Concrete Products
- F. American Welding Society (AWS):
- D1.1/D1.1M-10.....Structural Welding Code - Steel
- D1.4-11.....Structural Welding Code - Reinforcing Steel

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Portland Cement: ASTM C150, Type I or III.
- B. Aggregates: ASTM C33, Coarse and Fine.
- C. Lightweight Coarse Aggregate: ASTM C330, maximum size 19mm (3/4 inch),
maximum 15 percent loss when tested in accordance with ASTM C88.
- D. Air-entraining Admixture: ASTM C260.
- E. Chemical Admixtures: ASTM C494.
- F. Mixing Water: Fresh, clean, and potable.
- G. Reinforcing Steel: ASTM A615M, Grade 400 MPa (ASTM A615, Grade 60),
deformed.
- H. Weldable Reinforcing Steel: ASTM A706M, Grade 400 MPa, (ASTM A706 Grade
60).
- I. Galvanized Reinforcing Steel: ASTM A767M, Grade 400 MPa, (ASTM A767,
Grade 60) Class II, hot-dipped galvanized after fabrication and bending.
- J. Epoxy-Coated Reinforcing Steel: ASTM A775M, Grade 400 MPa, (ASTM A775,
Grade 60).
- K. Anchor Bolts: ASTM A307, low-carbon steel bolts, regular hexagon nuts
and carbon steel washers, galvanized.
- L. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy
hexagon bolts, and hardened washers complying with ASTM A325,
galvanized.
- M. Welded Wire Fabric: ASTM A185.

- N. Wire Reinforcement: ASTM A82.
- O. Prestressing Steel: ASTM A416, Grade 250K or 270K, uncoated, 7-wire, stress-relieved strand.
- P. Anchors and Inserts: ASTM A36 structural steel plates and shapes, ASTM A153 or ASTM A123 hot dipped galvanized finish.
- Q. Non-metallic Shrinkage-Resistant Grout: Proprietary pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CRD-C-621. Minimum cube strength of 62 MPa (9000 psi) at 28 days when placed at flowable consistency.
- R. Bearing Pads:
 - 1. Elastomeric Pads: Vulcanized, chloroprene elastomeric compound, molded to size or cut from a molded sheet, 50-60 shore A durometer conforming to section 9-31 of the ADOT Standard Specification for Road, Bridge, and Municipal Construction 2010.
- S. Welded Studs: AWS D1.1.
- T. Welded Rebar: AWS D1.4.
- U. Caulking and Sealants: Specified under Section 07 92 00, JOINT SEALANTS.
- V. Accessories: Provide clips, hangers, and other accessories required for installation of project units and for support of subsequent construction or finishes.

2.2 CONCRETE MIXES:

- A. Normal-Weight Concrete:
 - 1. Compressive Strength: 7000 psi minimum at 28 days.
 - 2. Release Strength: 4000 psi minimum at transfer of prestress.
- B. Do not use calcium chloride, chloride ions or other salts.

2.3 FABRICATION:

- A. Fabrication Procedures: PCI MNL-116.
- B. Fabrication Tolerances shall be per section 6-02.3(25)I of the ADOT Standard Specifications for Road, Bridge, and Municipal Construction 2010.
- C. Finishes shall be per section 6-02.3(25)H of the ADOT Standard Specifications for Road, Bridge, and Municipal Construction 2010.
- D. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing, complying with CRSI recommendations. For exposed-to-view concrete surfaces, shear legs of supports are in contact with forms, provide supports with legs that are plastic protected or stainless steel protected.

- E. Use epoxy coated reinforcing whenever concrete cover is less than 50 mm (2 inches) for top surfaces exposed to deicing salts, brackish water or salt spray, such as in parking garage decks.
- F. Patching: Patching will be acceptable providing structural adequacy of product and appearance are not impaired.
- G. Defective Work: Precast concrete units which do not conform to specified requirements, including strength, tolerances, and finishes, shall be removed and replaced with precast concrete units that meet the requirements of this section. Contractor is also responsible for cost of corrections to other work affected by or resulting from corrections to precast concrete work.
- H. Fasteners: Cast in galvanized hardware such structural inserts, bolts and plates as required by drawings.

PART 3 - EXECUTION

3.1 CASTING:

Casting shall be per section 6-02.3(25)B of the ADOT Standard Specification for Road, Bridge, and Municipal Construction 2010.

3.2 PRESTRESSING:

Prestressing shall conform to section 6-02.3(25)C of the ADOT Standard Specification for Road, Bridge, and Municipal Construction 2010.

3.3 CURING:

Curing shall conform to section 6-02.3(25)D of the ADOT Standard Specification for Road, Bridge, and Municipal Construction 2010.

3.4 PRESTRESS RELEASE:

Prestress release shall be per section 6-02.3(25)F of the ADOT Standard Specification for Road, Bridge, and Municipal Construction 2010.

3.5 PROTECTION OF EXPOSED REINFORCEMENT:

Protection of exposed reinforcement shall be per section 6-02.3(25)G of the ADOT Standard Specification for Road, Bridge, and Municipal Construction 2010.

3.6 GIRDER DEFLECTION:

Girder deflection shall be checked in accordance with section 6-02.3(25)K of the ADOT Standard Specification for Road, Bridge, and Municipal Construction 2010.

3.7 ERECTION:

- A. Erection shall be per section 6-02.3(25)N of the ADOT Standard Specification for Road, Bridge, and Municipal Construction 2010.
- B. Site Access: Provide suitable access to building, proper drainage, and firm, level bearing for hauling and erection equipment to operate under their own power.

C. Preparation:

1. Provide true, level surfaces on field placed bearing walls and other field placed supporting members.
2. Place and accurately align anchor bolts, plates or dowels in column footings, grade beams and other field placed support members.

D. Installation: Installation of precast prestressed concrete shall be performed by the fabricator or a competent erector in accordance with PCI MNL-127. Lift members with suitable lifting devices at points provided by manufacturer. Temporary shoring and bracing, when necessary, shall comply with manufacturer's recommendations.

E. Alignment: Align and level precast members as required by the approved shop drawings. Level out variations between adjacent members by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to RE/COTR. Individual pieces are considered plumb, level, and aligned if the error does not exceed 1:500 excluding structural deformation caused by loads. Horizontal alignment shall be checked in accordance with 6-02.3(25)J of the ADOT Standard Specification for Road, Bridge, and Municipal Construction 2010.

3.8 FIELD WELDING:

- A. Field welding is to be done by qualified welders using equipment and materials compatible to base material in accordance with AWS D1.1 and AWS D1.4.
- B. Field coat with galvanized paint specified under Section 09 91 00, PAINTING all welded connections.

3.9 ATTACHMENTS:

Do not use powder-actuated or air-driven fasteners or drill the precast units for surface attachment of accessory items unless otherwise accepted by the precast manufacturer.

3.10 INSPECTION AND ACCEPTANCE:

Final inspection and acceptance of erected precast prestressed concrete shall be made by RE/COTR to verify conformance with drawings and specifications.

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SECTION 03 45 00
PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes the performance criteria, materials, production, and erection of architectural precast concrete units. The work performed under this section includes all labor, material, equipment, related services, and supervision required for the manufacture and erection of the architectural precast concrete work shown on the contract drawings and includes the following:
1. Caps for the columbarium walls including cast column numbering.
 2. Caps for columbarium plaza seat walls.
 3. Caps for memorial wall including cast column numbering.
 4. Caps for bridge planter walls.
 5. Ossuary Cap.
 6. Sign posts.
 7. Post for water spigot at Flower Watering Station.

1.2 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete: Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.
- C. Precast pre-stressed structural building elements: Section 03 41 33, PRECAST STRUCTURAL PRETENSIONED CONCRETE.
- D. Precast Columbarium Units and mock-ups: Section 03 48 24 PRECAST CONCRETE COLUMBARIUM UNITS
- E. Concrete Memorial Wall and mock-up: Section 03 48 26, CONCRETE MEMORIAL WALL
- F. Mortar: Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING
- G. Back-up wall: Section 04 20 00, UNIT MASONRY.
- H. Sealants and Caulking: Section 07 92 00, JOINT SEALANTS.
- I. Water spigot: Section 32 30 00, SITE FURNISHINGS

1.3 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that complies with PCI MNL 117 and the following requirements and is experienced in producing units similar to those indicated for this Project and with a record of successful in-service performance:
1. Assumes responsibility for engineering units to comply with performance requirements. A Comprehensive Engineering Analysis shall be performed by a qualified professional engineer who is legally

qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.

2. Participating member of PCI and PCI Plant Certified, Category A1, and MNL-117 at the time of bidding.
3. Has sufficient production capacity to produce required units without delaying the work.

B. Erector Qualifications:

1. An erector with a minimum of 2 years of experience who has completed architectural precast concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance and who meets the following requirements:
 - a. Retains a nationally recognized Certified Field Auditor, at erector's expense, to conduct a field audit of a project in the same category as this Project prior to start of erection. Submits Erectors Post Audit Declaration.
 - b. The basis of the audit is the PCI MNL 117.

C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117.

D. Sample Panels: After sample approval and before fabricating units, produce a minimum of two sample panels approximately 1.5 sq. m. (16 sq. ft.) in size for review by Resident Engineer (RE)/ Contracting Officer's Technical Representative(COTR). Incorporate full scale details of architectural features, finishes, textures, and transitions in the sample panels. Approved sample panel may be used for mockup and range sample.

1. Locate panels where indicated or, if not indicated, as directed by RE/COTR.
2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
3. After acceptance of repair technique, maintain one sample panel at the manufacturer's plant and one at the project site in an undisturbed condition as a standard for judging the completed work.
4. When back face of precast concrete unit is to be exposed, show samples of the workmanship, color, and texture of the backup concrete as well as the facing.
5. Demolish and remove sample panels only when directed by RE/COTR.

- E. Range Samples: After sample panel approval and before production of units, produce a minimum of three samples, approximately 1.5 sq. m. (16 sq. ft.) in size, representing anticipated range of color and texture on project's units. Following range sample acceptance by the RE/COTR, maintain samples at the manufacturer's plant as color and texture acceptability reference.
- F. Mockups: After sample approval but before production of units, construct full sized mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Mockup to be representative of the finished work in all respects including sealants and architectural precast concrete complete with all anchors, connections, flashings, joint fillers, and cast column numbers as accepted on the final shop drawings. Build mockups to comply with the following requirements, using materials indicated for the completed work:
1. Build mockups in the location and of the size indicated or, if not indicated, as directed by RE/COTR.
 2. Notify RE/COTR in advance of dates and times when mockups will be constructed.
 3. Obtain RE/COTR's approval of mockups before starting fabrication.
 4. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 5. Demolish and remove mockups when directed.
- G. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01, GENERAL REQUIREMENTS.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide units and connections capable of withstanding: the design criteria specified on the drawings, self weights and weights of materials supported or attached, for the conditions indicated.
1. Design Standards: Comply with ACI 318 (ACI 318M) and the design recommendations of PCI MNL 120, applicable to types of units indicated.
 2. Limit deflection of precast members as follows:
 - a. Vertical live load - $\text{Span} / 360$.
 - b. Wind load - Floor to floor height times 0.0025.
 3. Design for handling, transportation and erection stresses.
- B. Design framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live load deflection, shrinkage and creep of primary building structure, and other building movements.

- C. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 19 deg C (65 deg F). Use other values, greater or smaller, whenever justified by climatic conditions at the project site.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Retain quality control records and certificates of compliance for 5 years or period of warranty, whichever is greater.
- B. Design Mixes: For each concrete mix along with compressive strength and water-absorption tests.
- C. Shop (Erection) Drawings: Detail fabrication and installation of units.
1. Indicate member locations with distinctive marks that match marks placed on the panels. Provide plans, elevations, dimensions, corner details, shapes, cross sections and relationships to adjacent materials including special reinforcement and lifting devices necessary for handling and erection.
 2. Indicate aesthetic intent including joints, reveals, and extent and location of each surface finish.
 3. Indicate Columbarium wall column numbering and Memorial Wall column numbering that is to be cast into each cap segment as detailed in the drawings.
 4. Indicate separate face and backup mix locations, and thicknesses. Indicate locations, extent and treatment of dry joints if two-stage casting is proposed.
 5. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, and connections.
 6. Indicate locations, tolerances and details of anchorage devices to be embedded in or attached to structure or other construction.
 7. Indicate sequence of erection.
 8. Coordinate joint pattern in columbaria caps with center of solid vertical sections of precast columbarium niche units. Joints in cap stones may not be directly over joints between the columbarium unit installations.
 9. Indicate locations and details of facing materials, anchors, and joint widths.
 10. Design Modifications:
 - a. If design modifications are necessary to meet the performance requirements and field conditions, submit design calculations and drawings. Do not adversely affect the appearance, durability or strength of units when modifying details or materials and maintain the general design concept.

- D. Comprehensive Engineering Analysis: Provide calculations signed and sealed by the qualified professional engineer responsible for the product design. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate design criteria and loads. Indicate the location, type, magnitude and direction of all imposed loadings from the precast system to the building structural frame.
- E. Samples: Design reference samples for initial verification of design intent, approximately 300 mm by 300 mm by full depth (12 in. by 12 in. by full depth, representative of finishes, color, and textures of exposed surfaces of units.
- F. Full-size samples for each mock-up cap required, showing the full range of color and texture expected. Supply sketch of each corner or special shape with dimensions. Supply sample showing color and texture of joint treatment.
 - 1. Precast units will be inspected at the site. Units which demonstrate lesser quality than accepted samples (outside the ranges established by the submitted and approved samples) shall not be acceptable.
 - 2. Submit non-shrink grout and sealants and caulk to be used with approved cap stones and obtain approval before manufacture of cap stones starts.
 - 3. Submit samples for anchors and ties, dowels, and other connectors indicated in the shop drawings.
- G. Welding Certificates: Copies of certificates for welding procedure specifications (WPS) and personnel.
- H. Qualification Data for fabricator and professional engineer: List of completed projects with project names and addresses, names and addresses of engineers and owners, and other information specified.
- I. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
 - 1. Concrete strengths and mix designs.
- J. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements.
 - 1. Concrete materials.
 - 2. Reinforcing materials and pre-stressing tendons.
 - 3. Admixtures.
 - 4. Anchors.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Product handling requirements of PCI MNL 117 shall be followed at the plant and project site.

- B. Deliver all units to the project site in such quantities and at such times to assure compliance with the agreed project schedule and proper setting sequence so as to limit unloading units temporarily on the ground.
- C. Lift and support units only at designated points shown on the Shop Drawings.
- D. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.
- E. Carefully handle, transport, and store precast members to prevent damage of any kind. Broken, chipped, stained, or damaged units will be subject to rejection unless permission to repair such defects is obtained in writing from the RE/COTR. Members may be shipped after attaining 90% of specified ultimate compressive strength, but not before reaching an age of 7 days.
- F. Units damaged after erection shall be either repaired or replaced as determined by the RE/COTR. No repairs shall be made until the damaged unit has been examined by the RE/COTR and a proposed repair procedure has been submitted to, and accepted by, the RE/COTR in writing. The RE/COTR may require that repairs be made by the manufacturer. Costs for repair work shall be borne by the Contractor.
- G. Cover precast units to protect from soiling or damage by subsequent building operations, using reinforced building paper or other material acceptable to the RE/COTR.

1.7 WARRANTY

- A. Warranty of precast concrete work, including anchorage, joint treatment and related components to be free from defects in materials and workmanship, including cracking and spalling.
- B. After erection, completed work will be weathertight, subject to terms of Article "Warranty of Construction" FAR clause 52.246-21, except warranty period is extended to five years.

1.8 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):
 - A27/A27M-08.....Steel Castings, Carbon, for General Application
 - A36/A36M-08.....Carbon Structural Steel
 - A47/A47M-99(R2009).....Ferritic Malleable Iron Castings
 - A82-07.....Steel Wire, Plain, for Concrete Reinforcement

A108-07.....Steel Bar, Carbon and Alloy, Cold-Finished
A123/A123M-09.....Zinc (Hot-Dip Galvanized) Coatings on Iron and
Steel Products
A153/A153M-09.....Zinc Coating (Hot-Dip) on Iron and Steel
Hardware
A167-99(R2009).....Stainless and Heat-Resisting Chromium-Nickel
Steel Plate, Sheet, and Strip
A184/A184M-05.....Fabricated Deformed Steel Bar Mats for Concrete
Reinforcement
A185-07.....Steel Welded Wire Fabric, Plain, for Concrete
Reinforcement
A276-10.....Stainless Steel Bars and Shapes
A283/A283M-03(R2007)....Low and Intermediate Tensile Strength Carbon
Steel Plates
A307-07.....Carbon Steel Bolts and Studs, 60 000 PSI Tensile
Strength
A325/A325M-10.....Structural Bolts, Steel, Heat Treated, 120/105
ksi Minimum Tensile Strength
A416/A416M-10.....Steel strand, Uncoated Seven-Wire for
Prestressed Concrete
A490/A490M-10.....Structural Bolts, Alloy Steel, Heat Treated, 150
ksi Minimum Tensile Strength
A496-07.....Steel Wire, Deformed, for Concrete Reinforcement
A497-07.....Steel Welded Wire Reinforcement, Deformed, for
Concrete
A500-10.....Cold-Formed Welded and Seamless Carbon Steel
Structural Tubing in Rounds and Shapes
A563/A563M-07.....Carbon and Alloy Steel Nuts
A572/A572M-07.....High-Strength Low-Alloy Columbium-Vanadium
Structural Steel
A615/A615M-09a.....Deformed and Plain Billet-Steel Bars for
Concrete Reinforcement
A666-03.....Annealed or Cold-Worked Austenitic Stainless
Steel Sheet, Strip, Plate, and Flat Bar
A675/A675M-03(R2009)....Steel Bars, Carbon, Hot-Wrought, Special
Quality, Mechanical Properties
A706/A706M-09.....Low-Alloy Steel Deformed and Plain Bars for
Concrete Reinforcement
A767/A767M-09.....Zinc-Coated (Galvanized) Steel Bars for Concrete
Reinforcement
A775/A775M-07.....Epoxy-Coated Steel Reinforcing Bars

A780-09.....Repair of Damaged and Uncoated Areas of Hot-Dip
Galvanized Coatings
A884/A884M-06.....Epoxy-Coated Steel Wire and Welded Wire Fabric
for Reinforcement
A934/A934M-07.....Epoxy-Coated Prefabricated Steel Reinforcing
Bars
B227-04.....Hard-Drawn Copper-Clad Steel Wire
B633-07.....Electrodeposited Coatings of Zinc on Iron and
Steel
C33-08.....Concrete Aggregates
C40-04.....Organic Impurities in Fine Aggregate for
Concrete
C150-09.....Portland Cement
C260-06.....Air-Entraining Admixtures for Concrete
C330-09.....Lightweight Aggregates for Structural Concrete
C373-88(R2006).....Test Method for Water Absorption, Bulk Density,
Apparent Porosity, and Apparent Specific Gravity
of Fired Whiteware Products
C494/C494M-10.....Chemical Admixtures for Concrete
C618-08a.....Coal Fly Ash and Raw or Calcined Natural
Pozzolan for Use as a Mineral Admixture in
Concrete
C881/C881M-02.....for Epoxy-Resin-Base Bonding Systems for
Concrete
C979-05.....Pigments for Integrally Colored Concrete
C989-09.....Ground Granulated Blast-Furnace Slag for Use in
Concrete and Mortars
C1017/C1017M-07.....Chemical Admixtures for Use in Producing Flowing
Concrete
C1107-08.....Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
C1218/C1218M-99(R2008)Test Method for Water-Soluble Chloride in Mortar
and Concrete
C1240-05.....Silica Fume Used in Cementitious Mixtures
D412-06ae2.....Test Methods for Vulcanized Rubber and
Thermoplastic Elastomers—Tension
D2240-05.....Test Method for Rubber Property—Durometer
Hardness
F436/F436M-09.....Hardened Steel Washers
F568M-07.....Carbon and Alloy Steel Externally Threaded
Metric Fasteners
F593-02(R2008).....Stainless Steel Bolts, Hex Cap Screws, and Studs

- F844-07a.....Washers, Steel, Plain (Flat), Unhardened for
General Use
- C. American Concrete Institute (ACI):
- ACI 211.1-91.....Selecting Proportions for Normal, Heavyweight
and Mass Concrete (Reapproved 2002)
- ACI 318/318M-08 (318R/318RM-08)Building Code Requirements for Structural
Concrete
- D. American Association of State Highway and Transportation Officials
- AASHTO LRFD-2010.....LRFD Bridge Design Specifications, U.S., 5th
Edition
- AASHTO M251-06.....Elastomeric Bearings
- E. Precast/Pre-stressed Concrete Institute (PCI):
- MNL-117-96.....Quality Control for Plants and Production of
Architectural Precast Concrete Products
- MNL-120-04.....Design Handbook - Precast and Prestressed
Concrete
- MNL-124-04.....Design for Fire Resistance of Precast
Prestressed Concrete.
- MNL-127-99.....Erector's Manual - Standards and Guidelines for
the Erection of Precast Concrete Products
- MNL-135-00.....Tolerance Manual for Precast and Prestressed
Concrete Construction
- TR-6-03.....Interim Guidelines for the Use of Self-
Consolidating Concrete
- F. Military Specifications (MIL. Spec):
- MIL-C882E-89.....Cloth, Duck, Cotton or Cotton-Polyester Blend
Synthetic Rubber, Impregnated, and Laminated,
Oil Resistant.
- G. Structural Steel Painting Council (SSPC):
- SSPC-Paint 20 (2002)....Zinc-Rich Primers (Type I, Inorganic, and Type
II, Organic).

PART 2 - PRODUCTS

2.1 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and
buckle free, that will provide continuous and true precast concrete
surfaces within fabrication tolerances indicated; non-reactive with
concrete and suitable for producing required finishes:
1. Mold-Release Agent: Commercially produced liquid-release agent.
- B. Form Liners: Units of face design, texture, arrangement, and
configuration indicated.

- C. Reinforcement dowels and connections shall be securely and accurately placed as shown on the Drawings. Connection hardware shall be rigidly attached to the forms, or otherwise positively prevented from moving in any direction. Means of support shall be subject to the approval of the RE/COTR.
- D. In general, forms may be designed with a draft of 1/8" in 12", and all forms may have 1/8" radius corners to facilitate removal and reduce breakage.

2.2 REINFORCING MATERIALS

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (Grade 420), deformed.
- B. Weldable Reinforcing Bars: ASTM A706/A706M, deformed.
 - 1. Deformed-Steel Welded Wire Reinforcement: ASTM A497, flat sheet.
- C. Plain Steel Wire: ASTM A 82, as drawn
- D. Plain Steel Welded Wire Fabric: ASTM A185
- E. Supports: Place reinforcement according to PCI MNL 117.

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150, Type I or III.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C33, with coarse aggregates complying with Class 5S
- C. Fine aggregate: ASTM C33; Washed, inert sand with color characteristics to produce concrete of a color which exactly matches the designated sample (silica sands required). The designated sample for color only is the existing cap for columbarium wall D9/D10.
- D. Admixtures: Admixtures containing calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture are not permitted.
 - 1. Coloring Admixture: ASTM C979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable and non-fading. Admixture to produce a color which exactly matches the designated sample. The designated sample for color only is the existing cap for columbarium wall D9/D10. The closest approximation of color is Yosemite Brown (641) or Sequoia Sand (641) by Davis Colors, 800-356-4848 <http://www.daviscolors.com>.
 - 2. Air Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.
 - 3. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 4. Retarding Admixture: ASTM C494/C494M, Type B.
 - 5. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
 - 6. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 - 7. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.

8. Plasticizing Admixture for Flowable Concrete: ASTM C1017/C1017M.

2.4 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A36/A36M.
- B. Carbon-Steel Headed Studs: ASTM A108, Grades 1018 through 1020, cold finished of PCI MNL 117, Table 3.2.3.; AWS D1.1, Type A or B, with arc shields.
- C. Carbon-Steel Plate: ASTM A283/A283M.
- D. Malleable Iron Castings: ASTM A47/A47M. Grade 32510.
- E. Carbon-Steel Castings: ASTM A27/A27M, Grade U-60-30 (Grade 415-205).
- F. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.
- G. Carbon-Steel Structural Tubing: ASTM A500, Grade B.
- H. Wrought Carbon-Steel Bars: ASTM A675/A675M, Grade 65 (Grade 450).
- I. Deformed-Steel Wire or Bar Anchors: ASTM A496 or ASTM A706/A706M.
- J. Carbon-Steel Bolts and Studs: ASTM A307, Grade A (ASTM F568M, Property Class 4.6) carbon-steel, hex-head bolts and studs; carbon-steel nuts (ASTM A563/A563M, Grade A); and flat, unhardened steel washers (ASTM F844).
- K. High-Strength Bolts and Nuts: ASTM A325/A325M or ASTM A490/A490M, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, (ASTM A563/A563M) and hardened carbon-steel washers (ASTM F436/F436M).
- L. Finish: For exterior steel items and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A123/A123M, after fabrication, or ASTM A153/A153M, as applicable.
 - 1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with SSPC-Paint 20.
- M. Welding Electrodes: Comply with AWS standards.

2.5 GROUT MATERIALS

Non-metallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, non-staining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107, Grade A for drypack and Grades B and C for flowable grout and of a consistency suitable for application within a 30-minute working time.

2.6 CONCRETE MIXES

- A. Prepare design mixes to match RE/COTR's sample for each type of concrete required.
 - 1. Limit use of fly ash and granulated blast-furnace slag to 20 percent replacement of Portland cement by weight; metakaolin and silica fume to 10 percent of Portland cement by weight.

- B. Design mixes shall be prepared by a qualified independent testing agency or by qualified precast plant personnel at fabricator's option.
- C. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested in accordance with ASTM C1218/C1218M.
- D. Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 34.5 MPa (5000 psi).
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 3. Release Strength at Transfer of Prestress: 24.1 MPa (3500 psi).
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- G. When included in design mixes, add other admixtures to concrete mixes according to manufacturer's written instructions.

2.7 MOLD FABRICATION

- A. Molds: Accurately construct and maintain molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement and temperature changes.
 - 1. Form joints are not permitted on faces exposed to view in the finished work.
 - 2. Edge and Corner Treatment: As indicated
 - 3. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during placing of concrete.
 - 4. Coat contact surfaces of molds with release agent.

2.8 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in units as indicated.

- D. Cast-in openings larger than 250 mm (10 inches) in any dimension.
- E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabrication, placing, and supporting reinforcement.
 - 1. Place reinforcing steel and prestressing strand to maintain at least 19 mm (3/4 inch) minimum concrete cover. Increase cover requirements for reinforcing steel to 38 mm (1-1/2 inches) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete.
 - 2. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
 - 3. Built-In Items: Provide slots, holes, and other accessories in units to receive dowels and other similar work as indicated.
 - 4. Anchorages: Provide loose dowels and other miscellaneous steel shapes not provided by other trades, necessary for securing precast units to supporting and adjacent members.
- F. Pre-stress tendons for units by pre-tensioning methods. Comply with PCI MNL 117.
- G. Mix concrete according to PCI MNL 117 and requirements in this Section. After concrete batching, no additional water may be added.
- H. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in PCI MNL 117 for measuring, mixing, transporting and placing concrete.
- I. Identify pickup points of units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each unit on a surface that will not show in finished structure.
- J. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or radiant heat and moisture.
- K. Repair damaged units to meet acceptability requirements of PCI MNL 117 and the RE/COTR.

2.9 FABRICATION TOLERANCES

- A. Fabricate units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.
 - 1. Additional Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.
 - a. Weld Plates: Plus or Minus 25 mm (1 inch).

- b. Inserts: Plus or Minus 13 mm (1/2 inch).
 - c. Handling Devices: Plus or Minus 75 mm (3 inch).
 - d. reinforcing Steel or Wire Fabric in a structural location: Plus or Minus 6 mm (1/4 inch).
 - e. reinforcing Steel or Wire Fabric in a non-structural location: Plus or Minus 13 mm (1/2 inch).
 - f. reinforcing Steel extending out of a member: Plus or Minus 13 mm (1/2 inch).
 - g. Openings: Plus or Minus 6 mm (1/4 inch).
 - h. Flashing Reglets: Plus or Minus 6 mm (1/4 inch).
 - i. Rotation of Plate, Electrical Boxes or Channel Inserts: Plus or Minus 6 mm (1/4 inch) or 2 degrees.
- B. In addition to tolerances of individual elements required by American Concrete Institute Publication 533.3R, erection tolerances shall be as follows:
- 1. Variation of anchors and fasteners from dimensions specified.....1/8-inch
 - 2. Variation in overall dimensions of precast element (height and width).....1/8-inch
 - 3. Maximum differential between adjacent units in erected position.....1/4-inch
 - 4. Variation in thickness of precast panels and elements.....1/8-inch
 - 5. Maximum vertical differential between adjacent columbarium units in installed position.....1/8-inch
- C. Fabricate architectural trim units such as sills, lintels, coping, cornices, quoins, medallions, bollards, benches, planters, and pavers, with tolerances meeting PCI MNL 135.

2.10 FINISHES

- A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight and sharp. Finish exposed-face surfaces of units to match approved mockups and as follows:
- 1. Exposed to View:
 - a. All surfaces with exposure shall have a light sandblast finish.
 - b. Smooth, As-Cast Finish: Where panel face is smooth, cast panel to produce a surface free of pockets, sand streaks, and honeycombs. Produce a surface appearance of uniform color and texture.

2.11 SOURCE QUALITY CONTROL

- A. Quality-Control Testing:

1. Test and inspect precast concrete according to Section 01 45 29, TESTING LABORATORY SERVICES and PCI MNL 117 requirements respectively.
 2. If using self-consolidating concrete also test and inspect according to PCI TR-6.
 3. Strength of precast panels must meet the requirements of ACI 318.
- B. Testing: If there is evidence that the concrete strength of precast concrete units may be deficient, Precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to PCI MNL 117:
1. Test results will be made in writing on the same day that tests are performed, with copies to RE/COTR, Contractor, and precast concrete fabricator. Test reports will include the information required in Section TESTING LABORATORY SERVICES and the following:
 - a. Identification mark and type of precast concrete units represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- C. Defective or Damaged Work: Units that do not comply with acceptability requirements, including concrete strength, manufacturing tolerances, and color and texture range are unacceptable. Chipped, spalled or cored units may be repaired, if repaired units match the visual mock-up. The RE/COTR reserves the right to reject any unit if it does not match the accepted samples and visual mock-up. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to installation of any of the work in this section, Contractor shall inspect the planned installation locations to insure that conditions are not significantly different from those indicated on the contract drawings. All materials shall be inspected prior to installation to insure compliance with the contract documents and to insure there is no damage. Should conditions be different from those indicated on the contract documents, contractor shall immediately notify the RE/COTR.
- B. All Material must be checked upon receipt at the job site prior to installation to check for any damage that may have occurred during transport.
- C. Deliver anchorage devices that are embedded in or attached to the building structural frame or foundation before start of such work.

Provide locations, setting diagrams, and templates for the proper installation of each anchorage device.

- D. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Do not install units until supporting structure is structurally ready to receive loads from precast.

3.2 ERECTION

- A. Erect level, plumb and square within the specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and use sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast concrete surfaces when recess is exposed.
 - 4. Unless otherwise shown provide for uniform joint widths of 13mm (1/2 inch).
- B. Connect units in position by bolting, welding, grouting, or as otherwise indicated on approved Erection Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and/or grouting are completed.
 - 1. Welding: Comply with applicable requirements for welding.
 - a. Protect units and bearing pads from damage by field welding or cutting operations and provide noncombustible shields as required.
 - b. Welds not specified shall be continuous fillet welds, using not less than the minimum fillet as specified by AWS.
 - c. Clean weld affected metal surfaces and apply a minimum 100 µm (0.004 inch) thick coat of galvanized repair paint to galvanized surfaces in conformance with ASTM A780.
 - d. Visually inspect all welds critical to precast connections. Visually check all welds for completion and remove, reweld or repair all defective welds.
 - 2. At bolted connections, use lock washers, tack welding, or other acceptable means to prevent loosening of nuts after final adjustment.

- a. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connection apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.
3. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
- C. Attachments: Upon approval of RE/COTR, precast pre-stressed products may be drilled or "shot" for fasteners or small openings. Provided reinforcing or pre-stressing steel is not damaged or cut.
 1. Should spalling occur, repair according to this specification section.
- D. Setting: Where shown, fill joints with cement mortar specified in Section 04 05 13, MASONRY MORTARING unless indicated otherwise.
 1. Clean surfaces forming beds and other joints for precast concrete panels of dust, dirt, and other foreign matter, and wet thoroughly to prevent suction before precast concrete, elements are set.
 2. Set precast element level and true to line with uniform joints filled completely with mortar.

Rake out joints 25 mm (1-inch) deep for pointing or sealants.

For joints required to have only sealant: Kept free of mortar for full depth.
 3. Keep exposed faces of precast concrete elements free of mortar.
 4. Remove wedges, spacers, or other appliances which are likely to cause staining from joints.
 5. Where parging is shown, parge back of elements solid with mortar. Apply parging without skips or holidays.
- E. Pointing: Wash and brush clean, leaving joints free from loose mortar, dust and other foreign material.
 1. Carefully point with a slightly concave joint.
 2. Mortar for pointing as specified in Section 04 05 13, MASONRY MORTARING. Use same material and color sand used in fabrication of precast concrete elements.
- F. Sealing of Joints: Where shown and where required to make work watertight: clean, dry and seal joints between precast concrete elements and between precast elements and adjoining materials as specified in Section 07 92 00, JOINT SEALANTS.

3.3 ERECTION TOLERANCES

Erect units level, plumb, square, true, and in alignment without exceeding the erection tolerances of PCI MNL 117, Appendix I.

3.4 FIELD QUALITY CONTROL

- A. Refer to Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Testing agency will report test results promptly and in writing to Contractor and RE/COTR.
- C. Repair or remove and replace work that does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS

- A. Repairs will be permitted provided structural adequacy of units and appearance are not impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 3 m (10 feet).
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780.
- D. Remove and replace damaged units when repairs do not meet requirements.

3.6 CLEANING

- A. Clean all surfaces of precast concrete to be exposed to view, as necessary, prior to shipping.
- B. Clean mortar, plaster, sealants, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

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SECTION 03 48 24
PRECAST CONCRETE COLUMBARIUM UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers the manufacture and installation of precast concrete columbarium units, as shown on the drawings and specified herein, including but not limited to: the steel reinforcement, steel embedment plates, required sleeves, finished exposed surfaces, preparation of setting surface, adhesive, columbarium fasteners, and niche cover anchor clip assemblies.
- B. Acceptable designs of the columbarium units' components are provided as shown on the Drawings. The Contractor may use this design for this Work or may propose alternate designs of the corresponding components as follows:
 - 1. Design for alternate columbarium units shall comply with the design criteria as per Articles 1.3.F and shall comply with the functional tests as per Article 1.3.G of this Specification.
 - 2. Unless indicated otherwise, all provisions of this Specification shall apply to the Contractor proposed design.
- C. The Government may accept or reject part or all of any design proposed by the Contractor.
- D. This section covers acceptance and installation of the Government-provided niche covers, one for each niche of the new columbarium units.

1.2 RELATED DOCUMENTS

- A. Section 31 20 11, EARTH MOVING (SHORT FORM).
- B. Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM) for Cast-in-place concrete work.
- C. Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE for furnishing and installing columbarium wall caps.
- D. Section 04 20 00, UNIT MASONRY for stone or brick work.
- E. Section 04 43 00, NATURAL STONE VENEER, stone veneer.
- F. Section 07 92 00, JOINT SEALANTS, Materials and Workmanship for sealant application.
- G. Section 04 73 01, COLUMBARIUM NICHE COVERS-MARBLE, for niche covers.
- H. Section 07 92 00, JOINT SEALANTS, Materials and Workmanship for sealant application.
- I. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 QUALITY ASSURANCE

- A. Manufacturer's and Installer's Qualifications: Prior to commencement of work, Contractor shall submit documentation regarding the experience of his precast concrete supplier and his precast concrete installer in the design, manufacture and installation of Precast Concrete structures and custom units.
- B. Precast concrete manufacturer's qualified Registered Professional Structural Engineer to certify that precast reinforced concrete conforms to specified requirements.
- C. Codes and regulations of the Federal, State and County authorities shall apply.
- D. Fabricate to dimensions shown or approved. Replace or correct Columbarium Units that do not comply with the individual dimensions and tolerances.
- E. Before starting production of Precast Concrete Columbarium Units, furnish at the site, two complete Precast Concrete Columbarium Units, to demonstrate quality of construction. Commence production of columbarium units only after written approval has been obtained from the Resident Engineer/COR.
- F. Design Criteria:
 - 1. The Columbarium Units shall be of the following type, style, and size:
 - a. Type: Precast concrete, reinforced.
 - b. Size: Interior and exterior dimensions as indicated on plans.
 - 2. Columbarium top shall be capable of structurally supporting imposed service live load of no less than 240 Kgs./Square Meter (50 lb./ft²), and dead loads based on cap (coping) thickness and heights, including material composition and element section properties, mortar and grout, and dead loads based on concrete top element sectional properties.
 - 3. The Contractor shall submit to the Resident Engineer/Contracting Officer's Technical Representative (COTR) for review and approval 5 sets of design documentation showing structural design of the complete Columbarium. This documentation shall include dimensions, methods of construction, and calculations. All design calculations and drawings shall be signed and sealed by qualified Professional Structural Engineer.

G. Functional Load Tests: If required by the Resident Engineer/COTR, a functional load test will be made at the Contractor's expense to insure that the columbarium proposed by the Contractor, as furnished, will be capable of supporting loads stated in Article 1.3.F.2. The functional test will consist of the following loading conditions:

1. Unconfined Loading: The columbarium will be placed on a flat surface with no support against the sides. The entire top of the columbarium will be subjected to a simulated uniform load of live load of 240 Kgs./Square Meter (50 lb./ft²) and required dead load simulating cap, mortar, and grout as they will be installed. The load will be maintained for no less than 72 hours. At end of the loading period, the maximum deflection of the Columbarium top elements shall be no more than 3 mm (1/8"). Upon removal of the load from the unit the residual deflection shall be no more than 1.5 mm (1/16") and concrete elements shall be free of all structural distress.

1.4 MANUFACTURER AND INSTALLER QUALIFICATIONS

- A. Precast concrete columbarium units shall be product of manufacturer who has a minimum of 3 years experience in fabrication of the precast concrete columbarium units similar in material, design, and quantity to that indicated on the drawings and specified herein.
- B. Precast concrete columbarium units installer shall have been regularly engaged for at least three years in installation of precast concrete similar to this project.
- C. Supply and Installation of fastener system shall be by product manufacturers and installers, both whom have had a minimum of 3 years experience in installation of similar design to that indicated on the drawing.
- D. Installation of niche covers will be performed by those companies who have demonstrated previous experience in installation of similar design as indicated in the drawings and specified herein.

1.5 ALLOWABLE TOLERANCES

- A. In addition to tolerances of individual elements required by American Concrete Institute Publication 533.3R, erection tolerances shall be as follows:
 1. Variation of anchors and fasteners from dimensions specified..... 3 mm.(1/8")

2. Variation in overall dimensions of precast element (height and width)..... 3 mm.(1/8")
3. Maximum differential between adjacent units in erected position..... 3 mm.(1/8")
4. Variation in thickness of precast panels and elements..... 3 mm.(1/8")
5. Maximum vertical differential between adjacent columbarium units in installed position..... 3mm.(1/8")

1.6 SUBMITTALS

- A. In accordance with Division 1 Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:
 1. Samples of all fastening systems, mounting hardware and exposed surface finishes including, but not limited to, the following:
 - a. Stainless Steel Angle
 - b. Stainless Steel Bolt, Nut and Washers
 - c. Tamper Proof Stainless Steel Bolt
 - d. Stainless Steel Rosette
 - e. Stainless Steel Expansion Anchors, Bolts and pins
 - f. Stainless Steel Ferrule loop insert.
 - g. Shims
 2. Samples of two complete Precast Concrete Columbarium Units, to demonstrate quality of construction, delivered to the site to be approved prior to production...
 3. Samples of adhesives and grouts.
 4. Shop Drawings: Complete shop and erection drawings of all precast concrete columbarium units, showing all dimensions and details of construction, installation and relation to adjoining work, reinforcements, anchorage, attachments, inserts, location of all pre-drilled sleeves and other items to be installed in the work of other trades, joint treatment, joint alignment coordinated with cap stone joints, and other work required for a complete installation. Provide evidence that the Contractor to be installing the cast in place concrete foundations for the columbarium and pier units has been contacted prior to any work relating to the footings for the columbarium construction, and that the construction of the concrete support (foundations) work has been coordinated with the precast columbarium unit manufacturer and installer.

5. Production Drawings:
 - a. Elevation view of each structural element.
 - b. Planametric view of unit.
 - c. Sections and details to show quantities and position of reinforcing steel, anchors, inserts, and essential embedded and non-embedded hardware for fabrication, handling, transportation and installation.
 - d. Lifting and erection inserts.
 - e. Dimensions and finishes.
 - f. Method of transportation.
 - g. Method of erection and handling.
6. Manufacturer's Literature and Data:
 - a. Each type of Concrete Fastener, including adhesive and anchor devices.
 - b. Instructions for final cleaning
 - c. Concrete stain/coating, including color charts of manufacturers standard color palette (If applicable for this project.)
7. Certificates: Manufacturer's qualifications specifying precast concrete columbarium units meet the requirements of ACI 533.3R and as specified.
8. Certificates: Installer's qualifications documenting the quality and quantity of experience of the precast concrete installer in the installation of Precast Concrete structures and custom units.
9. Arizona State registered structural engineer stamped columbarium and load calculation drawings.
10. Mock-ups: Provide complete full scale columbarium wall mock-ups. Mock-ups shall be constructed on-site where directed by the Resident Engineer/COTR and may not be constructed as part of the project.
 - a. One double columbarium wall: 2 precast concrete columbarium units back to back (two- five high, 40 niche units), stem wall, embedment plates, welds, full scale cap stones, connecting pins/bolts include end wall CMU/Stone veneer wall system. Also include a 10' by 10.5' complete shade canopy section with two columns fastened to cap; 20 niche covers and hardware (10 for each side of wall); gravel flower strip; and wall/row/column identification markers.
 - b. Five High (40 niche unit) single precast columbarium wall, stem wall, masonry ledge and masonry embedment plates, welds, full

scale cap stones, connecting pins/bolts include end wall and masonry ledge CMU/Stone veneer wall system. Also include 10 niche covers and hardware; gravel flower strip; and wall/row/column identification markers.

- c. Construction of columbarium walls may not commence until product samples and mock-up have been approved by the Resident Engineer/COTR.

1.7 DELIVERY, STORAGE

Ship precast concrete columbarium units to site with adequate protection to prevent chipping, breaking and other damage. Materials shall be marked giving proper identifications and location. Store materials in protected areas to prevent damage including vandalism, injurious effects of weather and inclusion of foreign matter.

1.8 COORDINATION

Coordinate the manufacture and erection of precast concrete columbarium units with related work of other sections of the Specifications. Provide templates for inserts and other devices for anchoring precast concrete columbarium units to the work of other trades, in sufficient time to be built into adjoining construction. Perform cutting, fitting and other related work in connection with erection of precast concrete columbarium unit work. See Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES for details regarding the coordination of work.

1.9 GUARANTEE

Guarantee precast concrete columbarium unit work, including anchorage, joint treatment and related components to be free from all defects in materials and workmanship, including cracking and spalling, and after erection, completed work will be subject to terms of "Guarantee" article in Division 1 Specification Sections except that guarantee period is one year.

1.10 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. Federal Specifications (Fed. Spec.):
 - QQ-S-766C (5).....Steel Plates, Sheets, and Strip-Corrosion Resisting
 - QQ-W-423B.....Wire, Steel, Corrosive-Resisting

TT-S-00227E (3).....Sealing Compound Elastomeric Type, Multi-
Component (For Caulking, Sealing, And Glazing
In Building And Other Structures)

TT-S-00230C (2).....Sealing Compound: Elastomeric Type, Single
Component (For Caulking, Sealing and Glazing In
Building and Other Structures)

C. American Concrete Institute (ACI) Publications:

ACI 533.3R-70.....Fabrication, Handling And Erection of Precast
Concrete.

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

A36/A36M-08Structural Steel

A82/A82M-07Steel Wire, Plain, for Concrete Reinforcement

A185/A185M-07Welded Steel Wire Fabric for Concrete
Reinforcement.

ASTM A276-10Stainless Steel Bars and Shapes

A615/A615M-08b.....Deformed and Plain Billet-Steel Bars for
Concrete Reinforcement.

C33-08.....Concrete Aggregates

C150-07Portland Cement

E. American Welding Society (AWS) Publications:

AWS D1.1-90.....Structural Welding Code

AWS D1.4-80.....Welding Reinforcing Steel

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Manufacturers that have previously completed at least one successful
NCA columbarium project are deemed to be acceptable for processing
their units through the procedures according to these specifications
and the drawings.

B. Manufacturers that do not have previous successful experience for a NCA
columbarium project may be selected by the Contractor for the project.
Contractor is hereby notified that the submittal process for a
manufacturer with no previous NCA experience with a successful
columbarium project, typically takes longer to process.

2.2 COARSE AGGREGATE

Hard durable aggregate carefully graded from coarse to fine in
proportions required to match approved samples of precast concrete
columbarium units.

2.3 AGGREGATE FOR BACK-UP MIX (FINE AND COARSE AGGREGATE LIGHTWEIGHT):

ASTM C33. Limit gradation as required to produce the specified appearance and quality of concrete.

2.4 PORTLAND CEMENT

ASTM C150, Type I and Type II; Color as required.

2.5 STRUCTURAL STEEL

ASTM A36.

2.6 STEEL FABRIC REINFORCEMENT

ASTM A185, galvanized.

2.7 STEEL WIRE REINFORCEMENT

ASTM A82, cold drawn.

2.8 REINFORCING STEEL

ASTM A615, deformed, Grade 60.

2.9 MISCELLANEOUS GALVANIZED STEEL ITEMS

Bolts, nuts, washers, anchors, inserts, and the like for handling, erection, or use by trades.

2.10 MARBLE NICHE COVERS

Marble niche covers shall be furnished by the Government and delivered to the site on pallets and shall be of size, type, finish and quantities required for this project. Contractor and Government representatives shall inspect the niche covers upon delivery to the site. The general quantity and condition shall be observed and an adequate count to cover all the installed columbarium units, plus required spares shall be verified. Once the niche covers are accepted at the site, they shall become the Contractors responsibility until installed and the installation is accepted by the Resident Engineer/COTR.

2.11 NICHE COVER ATTACHMENT HARDWARE (ROSETTES)

A. VA National Cemetery Administration, standard stainless steel rosette, mounting brackets, and bolts for complete attachment of the niche covers to the precast columbarium units as shown on drawings:

1. ASTM Type 316 stainless steel sheet goods, 0.100 inch thick
2. Die stamp, producing an eight-petal flower pattern as shown on drawings, one-inch diameter with slight convex; center hole of 0.218", concentric to outer edge, with shoulder recess of 0.400" in diameter and 0.035" in depth.
3. Luster finish.

4. ASTM Type 316 stainless steel tamper-resistant bolts, nuts, washers, anchors, mounting brackets, inserts and the like.

2.12 BACK-UP MATERIAL

Closed cell neoprene, butyl, polyurethane, vinyl or polyethylene foam rod, diameter approximately 1-1/3 times the joint width.

2.13 BOND BREAKERS IF USED

Type and material recommended by sealant manufacturer.

2.14 SEALING COMPOUND IF USED

Fed. Spec. TT-S-00230 C, Type II, Class A, or ASTM C 920-87, Type S, Grade NS, Class 25.

2.15 FABRICATION

- A. Precast concrete columbarium units shall NOT be: fabricated, delivered or incorporated in the work until samples and mock-up have been approved. Precast concrete shall comply with ACI 533.3R, except as modified herein.
 1. Concrete for precast columbarium units shall have minimum compressive strength of 34.5 MPa (5,000 psi) at 28 days.
 2. Provide additional steel reinforcing as required for casting, handling and erection loads.
 3. Back-up Mix: Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics.
 4. Columbarium units shall be cast in steel forms designed to suit shape and finish required and to withstand high frequency vibration. Concrete shall be deposited in oiled forms. Form oil shall be non-staining type. Vibrations, where required, shall be continuous during process of casting to attain through compaction, complete embedment of reinforcement and to assure concrete of uniform and maximum density without segregation of mix and full thickness of precast element is attained.
 - a. Anchors, lifting devices, provisions for cutouts and openings, dovetail slots, notches, reglets, inserts and similar items required for the work of other trades shall be accurately positioned in forms before casting elements.
 - b. All fastener location holes, including those for anchoring of units and attachment of niche covers, shall be cast into units. Drilling to precast concrete columbarium units, after fabrication, shall not be acceptable.

5. Cement, aggregate and water shall be obtained from single sources for facing mix of precast concrete work in order to assure regularity of appearance and uniformity of color.
6. Finish: Exposed faces shall have smooth natural concrete finish, unless otherwise noted. The face of the units shall be processed by the manufacturer, following removal from the forms to insure that the discoloration and blemishes on the niche faces are removed before shipping to the site.
 - a. Back side of single columbarium units, with back exposed to view shall have a stone veneer surface finish as indicated on the drawings.
7. Curing: Precast concrete shall be cured as required to develop specified structural characteristics and shall be stored in a manner that will permit all surfaces to cure equally and minimize warping, without staining the exposed faces.

PART 3 - EXECUTION

3.1 HANDLING AND INSTALLATION

- A. Before beginning installation, inspect work of other trades in-so-far as it affects the work of this Section. Install units by competent installation crews meeting the requirements of paragraph 1.4 B. Commencing installation of precast concrete columbarium units will be construed as acceptance, as suitable, of such work of other trades. Concrete base for the columbarium units shall be inspected and modified as required, grinding off high spots, to become an acceptable base upon which to install the units. Columbarium units shall be handled in a nearly vertical plane at all times and stacked vertically on wood supports of adequate strength, until erected. Cover and protect precast concrete columbarium units against staining and other damage. Reinstall, realign and otherwise correct improperly installed units.
 1. Accurately place and securely anchor precast concrete columbarium units to adjoining construction in accordance with approved shop and erection drawings.

3.2 SETTING

- A. Each precast element shall be set level and true to line with uniform joints. Joints required to have sealants shall be kept free of dirt and other contaminants for their full depth. Precautions shall be taken to protect precast concrete work from being damaged and soiled

during and after installation. Wedges, spacers or other appliances which are likely to cause staining shall be removed from joints.

- B. Where shown, joints shall be filled with sealant. Surfaces and other joints for precast concrete columbarium units shall be cleaned of all dust, dirt and other foreign matter.

3.3 SEALING OF JOINTS

- A. Where shown and/or wherever required to make the work watertight, joints between precast concrete columbarium units and between other precast elements and adjoining masonry, concrete and other materials shall be filled with back-up material for depth extending as required to form joint of depth as shown or recommended by sealant manufacturer. Provide bond breakers, at base of sealant where space for back-up does not exist and to prevent sealant from bonding to material at base of joint.

1. Workmanship shall be in accordance with Division 1 Specification Sections and Section 07 92 00, JOINT SEALANTS.

3.4 CLEANING

After erection is complete, clean precast columbarium units using materials, equipment and methods recommended by manufacturer.

3.5 REPLACEMENT AND REPAIR

Precast concrete columbarium units which are damaged, cracked, stained, improperly fabricated or otherwise defective shall be removed and be replaced. Precast units having minor defects not affecting serviceability or appearance may be repaired when approved by the Resident Engineer. Repaired work shall be sound, permanent, flush with adjacent surfaces and of color and texture matching similar adjoining surfaces and shall show no line of demarcation between original and patched surfaces. Replacement and repairs shall be done at no additional cost to the Government.

3.6 INSTALLATION OF NICHE COVERS

Install niche covers plumb and level as shown so that exposed faces of niche covers lie in the same plane and that rows of niche covers align both horizontally and vertically. Tighten fasteners to achieve snug fit but do not over tighten to the point where they may crack or break niche covers. Coordinate the installation procedures with the Resident Engineer/COTR and establish the critical visual line for which the best alignment is to be established.

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SECTION 03 48 26
CONCRETE MEMORIAL WALLS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.

1.2 DESCRIPTION

This section covers the installation of concrete memorial walls, as shown on the plans and specified herein, including the steel reinforcement and fasteners.

1.3 RELATED WORK

- A. Cast-in-place concrete work: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).
- B. Workmanship for sealant application- Section 07 92 00, JOINT SEALANTS.
- C. Memorial Wall Cap - Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE.
- D. Decorative stone- Section 32 95 16, STONE TOPDRESS.
- E. Installation of memorial markers: Section 04 73 11, MEMORIAL MARKERS-MARBLE.

1.4 MANUFACTURER / INSTALLER QUALIFICATIONS

Concrete memorial wall marker fasteners shall be product of manufacturer/ installer who has a minimum of 3 years experience in fabrication and installation of fasteners similar in material and design to the extent indicated on the drawings and specified herein.

1.5 ALLOWABLE TOLERANCES

- A. Manufacturing and installation tolerances shall be as follows:
 - 1. Variation of anchors and fasteners for memorial markers from dimensions specified-- 1/64-inch

1.6 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
 - 1. Samples: Submit sample of all fastening systems and mounting hardware including, but not limited to, the following:
 - a. Stainless Steel Angle (rosette plates of varying sizes depending on position of marble marker on memorial wall- see drawings).
 - b. Stainless Steel Bolt and Washers
 - c. Stainless Steel Spring Plate
 - d. Tamperproof Stainless Steel Bolt

- e. Stainless Steel Rosette
- f. Stainless Steel Expansion Anchors and Bolts
- 2. Shop Drawings: Complete shop and installation drawings of concrete memorial wall, showing all dimensions, sizes of units, and details of construction, installation and relation to adjoining work, joint locations and details, reinforcements, anchorage, attachments, inserts and other trades, joint treatment, finishes, and other work required for a complete installation.
- 3. Manufacturer's Literature and Data:
 - a. Each type of fastener or anchorage
 - b. Instructions for final cleaning
 - c. Coating
- 4. Job mock-up: provide full scale memorial wall mock-up
 - a. Build mock-up at site where directed by the Resident Engineer/Contracting Officer's Technical Representative (COTR).
 - b. Construct a full height, 4-foot long end segment of the memorial wall. Include precast architectural concrete cap, color coating on cast-in-place concrete, marble markers and hardware, stone veneer as shown on drawings with wall/row/column identification markers, and gravel flower strip.
 - c. Construction of memorial wall may not commence until product samples and mock-up have been approved by the Resident Engineer/COTR.

1.7 DELIVERY, STORAGE

Materials shall be marked giving proper identification and location. Store materials in protected areas to prevent damage, injurious effects of weather and inclusion of foreign matter.

1.8 COORDINATION

Coordinate the manufacture and installation of concrete memorial walls with related work of other sections of the Specifications. Provide templates for fastener and marker installation.

1.9 GUARANTEE

Guarantee concrete memorial wall fasteners and related components to be free from all defects in materials and workmanship for a period of not less than one year.

1.10 APPLICABLE PUBLICATIONS

- A. The publications listed below from a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed.Spec.):
- QQ-S-766C (5).....Steel Plates, Sheets, and Strip-Corrosion Resisting
- QQ-W-423B.....Wire, Steel, Corrosive-Resisting
- TT-S-00227E (3).....Sealing Compound Elastomeric Type, Multi-Component (For Caulking, Sealing, And Glazing In Building And Other Structures)
- TT-S-00230C (2).....Sealing Compound: Elastomeric Type, Single Component (For Caulking, Sealing and Glazing In Building and Other Structures)
- C. American Concrete Institute (ACI) Publications:
- ACI 533.3R-70.....Fabrication, Handling And Erection of Precast Concrete.
- D. American Society for Testing Materials (ASTM) Standards:
- A36/A36M-08.....Structural steel.
- A83/A82M-07.....Steel Wire, Plain, for Concrete Reinforcement
- A186/A185M-07.....Welded Steel Wire Fabric for Concrete Reinforcement.
- A615/A615M-08b.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- C33-08.....Concrete aggregates.
- C 150-87.....Portland Cement.
- E. American Welding Society (AWS) Publications:
- AWS D 1. 1-90.....Structural Welding Code
- AWS D1.4-80.....Welding Reinforcing Steel

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT

ASTM C150, Type I and Type III; Color as required to match existing.

2.2 WATER

Water shall be clean, fresh and potable.

2.3 STEEL WIRE REINFORCEMENT

ASTM A82, cold drawn.

2.4 REINFORCING STEEL

ASTM A615, deformed, Grade 60.

2.5 BACK-UP MATERIAL

Closed cell neoprene, butyl, polyurethane, vinyl or polyethylene foam rod, diameter approximately 1- 1/3 times the Joint width.

2.6 BOND BREAKERS

Type and material recommended by sealant manufacturer.

2.7 SEALING COMPOUND

Fed. Spec. TT-S-00230 C, Type 11, Class A, or ASTM C 920-87, Type S, Grade NS, Class 25.

2.8 ROSETTES

- A. Hardware for attachment shall be specifically designed for attaching markers. The hardware shall be designed to be hidden, except for the rosettes at the corners of the plaques. The hardware shall allow for the removal of an individual plaque for engraving, without having to remove multiple plaques. The material for the attachment hardware shall be stainless steel, compatible with rosettes and rosette attachment screws, without adverse reactions. The hardware shall not cause staining on the plaques. The attachment hardware should only be visible when looking in the crack between the plaques, and shall be recessed from the face of the plaques. The hardware shall be suitable for installation in precast or cast-in-place memorial wall installations and shall be coordinated with the wall design and shall be submitted for review and approval as part of the submittal for the entire memorial wall assembly. The attachment hardware shall be suitable for a permanent installation, out of doors, suitable for the indicated loads, and shall produce the finish installation as indicated on the contract drawings.
- B. VA National Cemetery Administration, standard stainless steel rosette, mounting brackets, and bolts for complete attachment of the memorial wall markers to the cast-in-place concrete wall as shown on drawings:
1. ASTM Type 316 stainless steel sheet goods, 0.100 inch thick
 2. Die stamp, producing an eight-petal flower pattern as shown on drawings, one-inch diameter with slight convex; center hole of 0.218", concentric to outer edge, with shoulder recess of 0.400" in diameter and 0.035" in depth.
 3. Luster finish.
 4. ASTM Type 316 stainless steel tamper-resistant bolts, nuts, washers, anchors, mounting brackets, inserts and the like.

2.9 PRECAST ARCHITECTURAL CONCRETE CAPS

Wall caps shall meet the requirements of Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE.

2.10 DECORATIVE GRAVEL

See Section 32 95 16, STONE TOPDRESS

2.11 CONCRETE FOOTINGS AND WALL

See Section 03 30 53, CAST-IN-PLACE-CONCRETE (SHORT FORM).

2.12 FABRICATION

- A. Memorial wall shall be of size and form as indicated on the plans.
- B. All fastener location holes, including those for anchoring of units and attachment of memorial markers, shall be field drilled for anchor bolts.
- C. Cement, aggregate, and water shall be obtained from single sources for concrete work in order to assure regularity of appearance and uniformity of color.
- D. Architectural Finish: Exposed faces shall have smooth-rubbed finish. Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

PART 3 - EXECUTION

3.1 CONCRETE FOOTINGS

Place concrete footings per lines and grades indicated on the drawings and in accordance with Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM). Concrete footings (pads) for memorial walls shall be constructed to meet all structural requirements to meet local soil and climate conditions and the weight and dimensions of the memorial wall.

3.2 CONCRETE WALL

- A. Place concrete wall per lines and grades indicated on the drawings and in accordance with Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).
- B. Joints shall be filled with sealant. Surfaces and other joints for concrete memorial walls shall be cleaned of all dust, dirt and other foreign matter. Joints required to have sealant shall be kept free of dirt and other contaminants for their full depth. Precautions shall be taken to protect precast concrete work from being damaged and soiled during and after installation. Wedges, spacers or other appliances that are likely to cause staining shall be removed from joints.

- C. Precast concrete caps shall be installed on top of the memorial wall as shown on the drawings.
- D. Place decorative stone to the line and grade as indicated on the drawings. See Section 32 95 16, STONE TOPDRESS.

3.3 SEALING OF JOINTS

- A. Where shown and where required to make the work watertight, joints between concrete memorial wall and adjoining masonry, concrete and other materials shall be filled with back-up material for depth extending as required to form joint of depth recommended by sealant manufacturer. Provide bond breakers, at base of sealant where space for back-up does not exist and to prevent sealant from bonding to material at base of joint.
- B. Workmanship shall be in accordance with Section 07 92 00, JOINT SEALANTS.

3.4 CLEANING

After installation is complete, clean precast memorial wall units using materials, equipment and methods recommended by manufacturer.

3.5 REPAIR

Concrete memorial walls that are damaged, cracked, stained, improperly constructed or otherwise defective shall be removed and be replaced. Repaired work shall be sound, permanent, and flush with adjacent surfaces and of color and texture matching similar adjoining surfaces and shall show no line of demarcation between original and patched surfaces. Replacement and repairs shall be done at no additional cost to the Government.

- - - END - - -

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 03 45 00, PRECAST ARCHITECTURAL CONCRETE.
2. Section 04 05 16, MASONRY GROUTING.
3. Section 04 20 00, UNIT MASONRY.
4. Section 04 43 00, NATURAL STONE VENEER

1.3 TESTING LABORATORY-CONTRACTOR RETAINED

- A. Engage a commercial testing laboratory approved by Resident Engineer (RE)/ Contracting Officer's Technical Representative (COTR) to perform tests specified below.
- B. Submit information regarding testing laboratory's facilities and qualifications of technical personnel to RE/COTR .

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:
 - a. Type M: Minimum 17230 kPa (2500 psi) at 28 days.
 - b. 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. Testing laboratory's facilities and qualifications of its technical personnel.

2. Indicating that following items meet specifications:

- a. Portland cement.
- b. Portland cement-lime mix
- 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.
5. Portland Cement-Lime Mix

E. Pointing Mortar color samples:

1. Provide a minimum of five color samples to match the following:
 - a. Approved precast architectural concrete sample
 - b. Approved natural stone veneer
2. RE/COTR to review and select pointing mortar color from submitted samples. The RE/COTR reserves the right to request additional samples if those submitted are not deemed a satisfactory match.
3. Final pointing mortar color selections to be used in job mock-ups.

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):
 - C40-04.....Organic Impurities in Fine Aggregates for
Concrete
 - C91-05.....Masonry Cement
 - C109-07.....Compressive Strength of Hydraulic Cement Mortars
(Using 2-in. or 50-MM Cube Specimens)
 - C144-04.....Aggregate for Masonry Mortar
 - C150-05.....Portland Cement

C207-06.....Hydrated Lime for Masonry Purposes
C270-07.....Mortar for Unit Masonry
C595-08.....Blended Hydraulic Cement
C780-07.....Preconstruction and Construction Evaluation of
Mortars for Plain and Reinforced Unit Masonry
C979-05.....Pigments for Integrally Colored Concrete
C1329-05.....Mortar Cement

PART 2 - PRODUCTS

2.1 HYDRATED LIME

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. Sand meeting sieve analysis for mortar joints for pointing. Sand to be the same in composition and color as that used in fabrication of precast architectural concrete elements, See Section 03 45 00.

B. Test sand for color value in accordance with ASTM C40. Sand producing color darker than specified standard is unacceptable.

2.3 MASONRY CEMENT

ASTM C91. Type N, S, or M.

2.4 MORTAR CEMENT

ASTM C1329, Type N, S or M.

2.5 PORTLAND CEMENT

ASTM C150, Type I.

2.6 PORTLAND CEMENT-LIME MIX

A. ASTM C150 and ASTM C207

B. Utilize in mortar for adhering natural thin stone veneer.

2.7 LIQUID ACRYLIC RESIN

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

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

2.9 POINTING MORTAR

A. For Precast Architectural Concrete or Natural Stone Veneer joints:
Proportion by volume; One part white Portland cement, two parts white sand, and 1/5 part hydrated lime.

B. Color Admixtures:

1. Proportion as specified by manufacturer.

C. Color:

1. For joints in Precast Architectural Concrete Caps: As selected and approved during submittals phase and mock-up approval.
2. For joints in Natural Stone Veneer: As selected and approved during submittals phase and mock-up approval.

2.10 MASONRY MORTAR

A. Conform to ASTM C270.

B. Admixtures:

1. Do not use mortar admixtures, except color admixtures as approved by RE/COTR.
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 or mock-up.
3. Color of mortar for exposed work: See pointing mortar.

D. Color Admixtures:

1. Proportion as specified by manufacturer.
2. Color to match approved samples as determined by approved job mock-ups.

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 caps that support metal shade canopy columns.
- B. Use Type N mortar for other masonry work, except as otherwise specified.
- C. Use Portland Cement-Lime in bedding mortar for Natural Stone Veneer.
- D. 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 03 45 00, PRECAST ARCHITECTURAL CONCRETE.
2. Section 04 20 00, UNIT MASONRY.
3. Section 04 05 13, MASONRY MORTARING

1.3 TESTS:

- A. Test grout and materials specified.
- B. Certified test reports.
- C. Identify materials by type, brand name and manufacturer or by origin.
- D. Do not use materials until laboratory test reports are approved by Resident Engineer.
- E. After tests have been made and materials approved, do not change without additional test and approval of Resident Engineer.
- F. Testing:
 1. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:
 2. Grout:
 - a. Test for compressive strength; ASTM C1019.
 - b. Grout compressive strength of 13790 kPa (2000 psi) at 28 days.
 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. Grout.
 - c. Hydrated lime.
 - d. Fine aggregate (sand).
 - e. Coarse aggregate for grout.
- 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):
 - C40-04.....Organic Impurities in Fine Aggregates for
Concrete
 - C150-07.....Portland Cement
 - C207-06.....Hydrated Lime for Masonry Purposes
 - C404-07.....Aggregate for Masonry Grout
 - C476-08.....Grout for Masonry
 - C595-08.....Blended Hydraulic Cement
 - C1019-09.....Sampling and Testing Grout

PART 2 - PRODUCTS

2.1 HYDRATED LIME:

ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY GROUT:

ASTM C404, Size 8.

2.3 BLENDED HYDRAULIC CEMENT:

ASTM C595, Type IS, IP.

2.4 MASONRY CEMENT:

See Section 04 05 13, MASONRY MORTARING.

2.5 PORTLAND CEMENT:

ASTM C150, Type I.

2.6 LIQUID ACRYLIC RESIN:

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:

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 (NOT USED)

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. Measure by the use of a container of known capacity.
- 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.
- D. Cells of unit masonry shall be grouted solid, unless noted otherwise

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SECTION 04 20 00
UNIT MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

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. Flashing: Section 07 60 00, FLASHING AND SHEET METAL.
- C. Sealants and sealant installation: Section 07 92 00, JOINT SEALANTS.
- D. Stone Veneer: Section 04 43 00, NATURAL STONE VENEER
- E. Columbarium job mock-up: Section 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples:
 - 1. Anchors, and ties, one each and joint reinforcing 305 mm (12 inches) long.
- C. Shop Drawings:
 - 1. Special masonry shapes.
 - 2. Drawings, showing reinforcement.
 - 3. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of reinforcing bars. Comply with ACI 315.
- D. Certificates:
 - 1. Certificates signed by manufacturer, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies.
 - 2. Indicating that the following items meet specification requirements:
 - a. Solid and load-bearing concrete masonry units.
 - 3. 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.

1.4 SAMPLE PANEL

- A. Before starting masonry, lay up a sample panel in accordance with Masonry Standards Joint Committee (MSJC) and Brick Industry Association (BIA).
 - 1. Use masonry units from random cubes of units delivered on site.
 - 2. Include reinforcing, ties, and anchors.
- B. Use sample panel approved by Resident Engineer/Contracting Officer's Technical Representative(COTR) for standard of workmanship of new masonry work.
- C. Sample panel may be erected for approval as part of single columbarium wall mock-up. See Section 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS and Section 04 43 00, NATURAL STONE VENEER.

1.5 WARRANTY

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

1.6 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 Society for Testing and Materials (ASTM):
 - A615/A615M-09.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - A675/A675M-09.....Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
 - A951-06.....Steel Wire for Masonry Joint Reinforcement.
 - C67-08.....Sampling and Testing Brick and Structural Clay Tile
 - C90-08.....Load-Bearing Concrete Masonry Units
 - C216-07a.....Facing Brick (Solid Masonry Units Made From Clay or Shale)
 - C476-08.....Standard Specification for Grout for Masonry
 - C612-04e1.....Mineral Fiber Block and Board Thermal Insulation
 - C744-08.....Prefaced Concrete and Calcium Silicate Masonry Units.
 - D1056-07.....Flexible Cellular Materials - Sponge or Expanded Rubber
 - D3574-08.....Flexible Cellular Materials-Slab, Bonded, and Molded Urethane Foams
 - F1667-05.....Fasteners: Nails, Spikes and Staples

C. Masonry Industry Council:

Hot and Cold Weather Masonry Construction Manual, 1999.

D. American Welding Society (AWS):

D1.4-05.....Structural Welding Code - Reinforcing Steel.

E. Masonry Standards Joint Committee; Specifications for Masonry Structures

(ACI 530.1-08/ASCE 6-05/TMS 602-05) (MSJC).

F. American Concrete Institute (ACI)

ACI 315-99.....Details and Detailing of Concrete Reinforcement

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.

1. Unit Weight: Normal weight.

2. Sizes: Modular.

3. Finishes: Standard

2.2 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.

9. Ladder Design:

a. Longitudinal wires deformed 4 mm (0.16 inch) diameter wire.

b. Cross wires 4 mm (0.16 inch) diameter.

10. Trussed Design:

a. Longitudinal and cross wires not less than 4 mm (0.16 inch nominal) diameter.

b. Longitudinal wires deformed.

2.3 ANCHORS, TIES, AND REINFORCEMENT

A. Steel Reinforcing Bars: ASTM A615M, deformed bars, grade as shown.

B. Joint Reinforcement:

1. Form from wire complying with ASTM A951.

2. Galvanized after fabrication.
3. Width of joint reinforcement 40 mm (0.16 inches) less than nominal width of masonry wall or partition.
4. Cross wires welded to longitudinal wires.
5. Joint reinforcement at least 3000 mm (10 feet) in length.
6. Joint reinforcement in rolls is not acceptable.
7. Joint reinforcement that is crimped to form drip is not acceptable.
8. Maximum spacing of cross wires 400 mm (16 inch) to longitudinal wires.
9. Ladder Design:
 - a. Longitudinal wires deformed 4 mm (0.16 inch) diameter wire.
 - b. Cross wires 4 mm (0.16 inch) diameter.
10. Trussed Design:
 - a. Longitudinal and cross wires not less than 4 mm (0.16 inch nominal) diameter.
 - b. Longitudinal wires deformed.
- C. 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 2mm (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.
- D. 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.

2.4 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, B2F1.

C. Non-Combustible Type: ASTM C612, Class 5, 1800 degrees F.

2.5 ACCESSORIES

- A. Weep Hole Wicks: Glass fiber ropes, 10 mm (3/8 inch) minimum diameter, 300 mm (12 inches) long.
- B. Cavity Drain Material: Shall be a recycled polyester/polyethylene mesh trapezoidal shaped to maintain cavity air flow and drainage while suspending mortar droppings at unequal heights.
- C. Masonry Cleaner:
 - 1. Detergent type cleaner selected for each type masonry used.
 - 2. Acid cleaners are not acceptable.
 - 3. Use soapless 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 nonstaining 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. 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.
- D. Before connecting new masonry with previously laid, remove loosened masonry or mortar, and clean and wet work in place as specified under wetting.
- E. When new masonry partitions start on existing floors, machine cut existing floor finish material down to concrete surface.
- F. 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 in lieu of individual ties for anchoring brick facing to CMU backup in exterior masonry walls.
 3. 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 STONE WORK

A. Joints:

1. Joint widths: 3/8", unless shown otherwise.
2. Rake joints for pointing with colored mortar when colored mortar is not full depth.

B. Weep Holes:

1. Install weep tubes in bottom of vertical joints of natural stone veneer.

3.7 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 spacings noted.
12. Grout cells of concrete masonry units, containing the reinforcing bars, solid as specified under grouting.

3.8 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:
 - a. 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.

3.9 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/COTR. 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.

3.10 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. 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

This section specifies requirements for installation of natural stone veneer. This section also includes inscribing Columbarium and Memorial Wall identification characters and row letters.

1.2 RELATED WORK

- A. Mortars : Section 04 05 13, MASONRY MORTARING
- B. Concrete Masonry back-up wall: Section 04 20 00, UNIT MASONRY
- C. Cast-in-place concrete: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM) .
- D. Caps for columbarium walls, memorial wall, and seat walls: Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE.
- E. Columbarium wall job mock-ups: Section 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS.
- F. Flashing: Section 07 60 00, FLASHING AND SHEET METAL.
- G. 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, proposed mortar joints, and inscribed row letters and wall identification characters as detailed in the drawings.
 - 2. Anchors, and ties, one each and joint reinforcing 1200 mm (48 inches) long.
- C. Certificates:
 - 1. Certificates signed by manufacturer, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies.
 - 2. Indicating that the following items meet specification requirements:
 - a. Stone veneer.
- D. Manufacturer's Literature and Data:
 - 1. Anchors, ties, and reinforcement.
 - 2. Reinforcing bars.
- E. Shop Drawings: Complete drawings of stone veneer pieces depicting face sizes, including incising of addressing characters, mortar joints, expansion joints, and showing all dimensions for:

1. Typical columbarium end walls face and end - single and double walls
2. Back side of each single columbarium walls
3. Typical seat wall
4. Memorial Wall - all sides
5. Ossuary and ossuary screen wall
6. Bridge planter walls

1.4 SAMPLE PANEL

See Part 1.5.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of listed standards unless otherwise indicated.
- B. Obtain stone from single quarry with consistent color range and texture throughout work.
- C. Subcontract fabrication of stone to firm which has successfully fabricated stone similar to quality specified for period of not less than 5 years and is equipped to provide quantity and sizes shown.
- D. Job mock-up: Prior to installation of stonework, erect veneer sample as in the columbarium wall mock-ups showing proposed range of color and texture, using materials, erection methods, jointing, and workmanship required for final work.
 1. Build mock-up at site where directed and as described in Section 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS and Section 03 48 26, CONCRETE MEMORIAL WALL.
 2. Obtain Senior Resident Engineer's acceptance of visual qualities of mock-up before start of stone work.

1.6 WARRANTY

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

1.7 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 Society for Testing and Materials (ASTM):
 - A82/A82M-07.....Standard Specification for Steel Wire, for
Concrete Reinforcement
 - A153/A153M-09.....Standard Specification for Zinc Coating (Hot-
Dip) on Iron and Steel Hardware
 - C97/C97M.....Test Method for Absorption and Bulk Specific
Gravity of Dimension Stone
 - C99/99M.....Test Method for Modulus of Rupture of Dimension
Stone

- C119-08.....Standard Terminology Relating to Dimension Stone
C170/C170M.....Test method for Compressive Strength of
Dimension Stone
C568-08a.....Standard Specifications for Limestone Dimension
Stone
C616-08Standard Specification for Quartz-Based
Dimension Stone
C1242-05..... Standard Guide for Selection, Design, and
Installation of Dimension Stone Anchoring
Systems
C1515-01.....Standard Guide to Cleaning of Exterior Dimension
Stone, Vertical and Horizontal Surfaces, New or
Existing
C1528-09.....Standard Guide for Selection of Dimension Stone
for Exterior Use
D1056-07.....Standard Specification for Flexible Cellular
Materials - Sponge Expanded Rubber
D5017-07.....Standard Practice for Preparatory Surface
Cleaning of Architectural Sandstone
- C. Masonry Industry Council:
All Weather Masonry Construction Manual, 2000.
- D. Federal Specifications (FS):
FF-S-107C-00.....Screws, Tapping and Drive
- E. International Masonry Industry All Weather Council (IMIAC): Recommended
Practices and Guide Specification for Cold Weather Masonry Construction

PART 2 - PRODUCTS

2.1 ACCEPTABLE STONE PRODUCTS

- A. Quartz Based Stone: Comply with ASTM C 616,
Classification II Quartzitic Sandstone.
1. Face Size: As indicated
 2. Natural Stone Veneer: 1-1/2" thick
 3. Natural Stone Veneer Border (at Memorial Wall): 3/4" thick
 4. Color range shall be light to medium pink snap cut stone to match
color and finish of existing columbarium wall veneer.
 5. Thin veneer stone to be Arizona Sandstone, color Rosa, as supplied by
AZ Flagstone Supply, or approved equal.
AZ Flagstone Supply
100 Sierra Rd.
Sedona, Arizona 86336
928 848-0083

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. 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. Weep Holes: Weep tubes in vertical joints of stone veneer at bottom of walls.
- C. Mortar: Refer to Section 04 05 13.
- D. Expansion Joint Fillers: ASTM D1056 Class RE-11.

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. Surface Preparation: Precast concrete and concrete block must be cleaned and in its original untreated condition. If it has been treated, light sandblasting or waterblasting can be used to restore the surface wall. Remove all form-release agents, dust, etc. that may inhibit the mortar bond.
- C. Establish lines, levels, and coursing. Protect from disturbance.
- D. Provide temporary bracing during erection of masonry work. Maintain in place until building structure provides permanent bracing.
- E. 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 shall be sufficiently substantial to support workmen, and necessary materials and equipment. Provide adequate guard rails for protection of property, workmen, and passerby.

3.3 COURSING

- A. Place masonry to lines and level indicated.
- B. Arrange and trim stones for adequate fit in a stacked bond pattern as indicated with course heights as indicated, lengths indicated, uniform joint widths with no 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. Rake excess mortar from joints for installation of pointing mortar. See Section 04 05 13, MASONRY MORTARING for joint finishing.
- 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 10 vertical feet non-cumulative.
- 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 (1/2 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 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.

3.8 WEEPS AND VENTS

Install weep holes in veneer at every vertical joint at bottom of walls.

3.9 CONTROL/EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcing across control joints.
- B. Size control joints in accordance with Section 07 92 00 for sealant performance, but in no case larger than adjacent mortar joints in exposed face brick.
- C. Provide expansion joints as indicated.

3.10 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 stone or adjacent materials. Consult masonry stone 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. ASTM C1515 and D7089.

3.11 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 73 01
COLUMBARIUM NICHE COVERS (MARBLE)

PART 1 - General

1.1 GENERAL PROVISIONS

Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.

1.2 DESCRIPTION

This section covers installation only of pre-drilled niche covers fabricated to the size indicated on the drawings. Niche covers will be furnished by VA to the Contractor. No incising is required.

1.3 RELATED WORK

All fittings, mounting brackets, rosettes: Section 03455 PRECAST CONCRETE COLUMBARIUM UNITS.

1.4 SUBMITTALS

Certification of installer's qualifications as specified in Section 03455 PRECAST CONCRETE COLUMBARIUM UNITS.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

Finished marble shall be carefully handled using all reasonable and customary precautions against damage.

Coordinate delivery of the niche covers with the Resident Engineer. All marble shall be received and unloaded at the site with care in handling to avoid damaging or soiling. Unload, inspect, store, and protect niche covers after delivery to the job site and prior to erection.

Site Storage: Store marble niche covers off ground with adequate protection to prevent chipping, breaking, and other damage. No material which may cause staining or discoloration shall be used for blocking in storage. If marble is stored outside it shall be covered with nonstaining waterproof paper, clean canvas or polyethylene.

PART 2 - Products NOT USED

PART 3 - Execution

3.1 INSTALLATION

Install niche covers plumb and level as shown so that exposed faces of niche covers lie in the same plane and that rows of niche covers align

both horizontally and vertically. All stone veining shall be vertical. Tighten fasteners to achieve snug fit but do not over-tighten to the point where they may crack or break niche covers.

Contractor shall furnish to the Resident Engineer two (2) tools for removing and installing tamperproof, stainless steel bolts, which go through the rosettes to fasten the niche covers.

3.2 CLEANING AND PROTECTION

Marble shall be shop cleaned at time of fabrication. After installation, carefully clean the marble, removing all dirt stains, and all other incident defacements.

Stiff bristle fiber brushes may be used, but the use of wire brushes or of acid-type cleaning agents and other solutions which may cause discoloration is expressly prohibited. Fabricator should be contacted before cleaners other than neutral detergents are used.

Protection of Finished Work: All marble work in progress shall be protected at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.

End of Section 04 73 01

SECTION 04 73 11
MEMORIAL MARKER-MARBLE

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.

1.2 DESCRIPTION

- A. Work Included: Provide labor and materials necessary to complete the work of this Section, including but not limited to the following:
1. Installation of memorial wall markers furnished by the Department of Veterans Affairs (VA), National Cemetery Administration (NCA).

1.3 DELIVERY

Contractor shall coordinate the submittal review, ordering, and delivery of the memorial markers to arrive sufficiently in advance to allow the inspection for compliance with the allowable tolerances and obtain additional approved units to replace any not deemed acceptable and complete the full installation within the allowable project work schedule. The complete installation shall be before the date of the final inspection. The Government shall have the covers delivered F.O.B. to the Contractor selected location 30 days prior to the commencement of memorial marker installation per the Contractor's Network Analysis Schedule approved by the VA to:

National Memorial Cemetery of Arizona
23029 North Cave Creek Road
Phoenix, AZ 85024
(408) 513-3600

1.4 RELATED WORK

- A. The following items are not included in this Section and will be performed under the designated Sections:
1. Section 03 48 26: CONCRETE MEMORIAL WALLS (SEE MEMORIAL MARKER ATTACHMENT HARDWARE AND INSTALLATION)
 2. Section 09 91 00: PAINTING, Memorial Wall Marker attachment plate hardware

1.5 SUBMITTALS

See Section 03 48 26: CONCRETE MEMORIAL WALLS for hardware submittal

1.6 REFERENCE STANDARDS

- A. The publications listed below form a part of this specification and the work shall comply with pertinent standards of the latest editions as specified below or by industry standards unless designated otherwise

herein. The publications are referenced in the text by basic designation only.

1. Munsell Neutral Value Scale, Matte (31 - step scale)
617 Little Britain Road, New Windsor, NY 12553 - 6148
2. American Society for Testing Materials (ASTM) Standards:
C97/C97M-09 Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone
C99/C99M-09.....Standard Test Method for Modulus of Rupture of Dimension Stone
C119-08Standard Terminology Relating to Dimension Stone
C170/C170M-09Standard Test Method for Compressive Strength of Dimension Stone
C241/C241M-09Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic
C880/C880M-09Standard Test Method for Flexural Strength of Dimension Stone
3. Dimension Stones of the World, Volume II
Marble Institute of America, Inc.
28901 Clemens Road, Suite 100, Cleveland, OH 44145
4. Drawings, Memorial Marker Layout (Marble/Granite) following the end of this section.

1.7 QUALITY ASSURANCE

A. Marble Testing

1. The marble supplied under this contract shall conform to the following specifications and physical requirements. Stone shall be tested, for the tests listed below, by an approved testing laboratory and test results shall be submitted to the Memorial Programs Service, Program Support Unit for approval prior to the production of the sample memorial markers. Testing is required only once and shall be from a representative sample of the quarry.
2. Abrasion Resistance, Hardness:
 - a. Marble shall have an abrasive hardness value (Ha) of 10.0 minimum, when tested as specified in ASTM C241.
3. Absorption:
 - a. Marble absorption shall be 0.15 of moisture by weight when tested for a 48 hour period as specified in ASTM C97.
4. Compressive strength:
 - a. Marble shall have a minimum compressive strength of 5.27 kg/mm² (7,500 psi), when tested as specified in ASTM C170.
5. Modulus of rupture:

- a. Marble shall have a minimum modulus of rupture of 0.70kg/mm² (1000 psi) when tested as specified in ASTM C99.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Memorial Marker Attachment Hardware: See Section 03 48 26, CONCRETE MEMORIAL WALLS, 2.8 ROSETTES
- B. Memorial Marker Hardware Tools
 1. Provide two (2) tools for installation/removal of tamper-resistant screws.
 2. Provide twelve (12) 3/4 round rosettes for removing and installing markers.

PART 3 - EXECUTION

3.1 INSPECTION

All materials shall be inspected prior to installation to insure compliance with the contract documents and to insure there is no damage. Should conditions be different from those indicated on the contract documents, contractor should immediately notify the Resident Engineer/COTR.

3.2 INSTALLATION

- A. Prime exposed face of memorial marker attachment plate hardware with High Performance Exterior Epoxy Primer and finish with High Build Epoxy Coating, low gloss.
- B. Install markers plumb and level as shown so that exposed faces of markers lie in the same plane and that rows of markers align both horizontally and vertically. Tighten fasteners to achieve snug fit but do not over tighten to the point where they may crack or break markers. Coordinate the installation procedures with the Resident Engineer/COTR and establish the critical visual line for which the best alignment is to be established.
- C. Deliver two (2) tamper-resistant screw installation/removal tools and 3/4 round rosettes to the Resident Engineer/COTR.

3.3 CLEAN UP

Clean up area of excess material and debris. Clean visible portions of all markers.

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SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 DESCRIPTION

This section specifies structural steel shown and classified by Section 2, Code of Standard Practice for Steel Buildings and Bridges.

1.2 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Painting: Section 09 91 00, PAINTING.

1.3 QUALITY ASSURANCE

- A. Fabricator and erector shall maintain a program of quality assurance in conformance with Section 8, Code of Standard Practice for Steel Buildings and Bridges. Work shall be fabricated in an AISC certified Category Conventional Steel Structures fabrication plant.
- B. Before authorizing the commencement of steel erection, the controlling contractor shall ensure that the steel erector is provided with the written notification required by 29 CFR 1926.752. Provide copy of this notification to the Resident Engineer (RE)/Contracting Officer's Technical Representative (COTR).

1.4 TOLERANCES

- A. Fabrication tolerances for structural steel shall be held within limits established by ASTM A6, by Section 7, Code of Standard Practice for Buildings and Bridges, and by Standard Mill Practice - General Information (AISC ASD Manual, Ninth Edition, Page 1-145, except as follows:
 - 1. Elevation tolerance for top surface of steel beams and girders at connections to columns at time floor is erected is 13 mm (1/2 inch).
 - 2. Elevation tolerance for closure plates at the building perimeter and at slab openings prior to concrete placement is 6 mm (1/4 inch).

1.5 REGULATORY REQUIREMENTS

- A. AISC: Specification for Structural Steel Buildings - Allowable Stress Design.
- B. AISC: Code of Standard Practice for Steel Buildings and Bridges.

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop and Erection Drawings: Complete
- C. Certificates:
 - 1. Structural steel.
 - 2. Steel for all connections.
 - 3. Welding materials.
 - 4. Shop coat primer paint.
- D. Test Reports:
 - 1. Welders' qualifying tests.
- E. Design Calculations and Drawings:
 - 1. Connection calculations, if required.
- F. Record Surveys.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Institute of Steel Construction (AISC):
 - 1. Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design (Ninth Edition, 1989)
 - 2. Load and Resistance Factor Design Specification for Structural Steel Buildings (Second Edition, 1995)
 - 3. Code of Standard Practice for Steel Buildings and Bridges (March 2000).
- C. American National Standards Institute (ANSI):
 - B18.22.1-03.....Plain Washers
 - B18.22M-05.....Metric Plain Washers
- D. American Society for Testing and Materials (ASTM):
 - A6/A6M-08a.....Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
 - A36/A36M-08.....Standard Specification for Carbon Structural Steel
 - A53/A53M-07.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

A123/A123M-08Standard Specification for Zinc (Hot-Dip
Galvanized) Coatings on Iron and Steel Products

A242/A242M-04e1Standard Specification for High-Strength Low-
Alloy Structural Steel

A283/A283M-07Standard Specification for Low and Intermediate
Tensile Strength Carbon Steel Plates

A307-07bStandard Specification for Carbon Steel Bolts
and Studs, 60,000 psi Tensile Strength

A325-07aStandard Specification for Structural Bolts,
Steel, Heat Treated, 120/105 ksi Minimum
Tensile Strength

A490-08aStandard Specification for Heat-Treated Steel
Structural Bolts 150 ksi Minimum Tensile
Strength

A500-07Standard Specification for Cold Formed Welded
and Seamless Carbon Steel Structural Tubing in
Rounds and Shapes

A501-07Standard Specification for Hot-Formed Welded
and Seamless Carbon Steel Structural Tubing

A572/A572M-07Standard Specification for High-Strength
Low-Alloy Columbium-Vanadium Structural Steel

A992/A992M-06aStandard Specification for Structural Steel
Shapes

E. American Welding Society (AWS):

D1.1-08Structural Welding Code-Steel

F. Research Council on Structural Connections (RCSC) of The Engineering
Foundation:

G. Specification for Structural Joints Using ASTM A325 or A490 Bolts
(2000)

- H. Military Specifications (Mil. Spec.):
MIL-P-21035.....Paint, High Zinc Dust Content, Galvanizing,
Repair (2003)

- H. Occupational Safety and Health Administration (OSHA):
29 CFR Part 1926-2006..Safety Standards for Steel Erection

PART 2 PRODUCTS

2.1 MATERIALS

- A. Structural Steel: ASTM A36, A242, and A283, Grade A992.
- B. Structural Tubing: ASTM A500, Grade B.
- C. Structural Tubing: ASTM A501.
- D. Steel Pipe: ASTM A53, Grade B.
- E. Bolts, Nuts and Washers:
 - 1. High-strength bolts, including nuts and washers: ASTM A325 and A490, as required.
 - 2. Bolts and nuts, other than high-strength: ASTM A307, Grade A.
 - 3. Plain washers, other than those in contact with high-strength bolt heads and nuts: ANSI Standard B18.22.1.
- F. Zinc Coating: ASTM A123.
- G. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035.

PART 3 EXECUTION

3.1 CONNECTIONS (Shop and Field)

- A. Welding: Welding in accordance with AWS D1.1. Welds shall be made only by welders and welding operators who have been previously qualified by tests as prescribed in AWS D1.1 to perform type of work required.
- B. High-Strength Bolts: High-strength bolts tightened to a bolt tension not less than proof load given in Specification for Structural Joints Using ASTM A325 or A490 Bolts. Tightening done with properly calibrated wrenches, by turn-of-nut method or by use of direct tension indicators (bolts or washers). Tighten bolts in connections identified as slip-critical using Direct Tension Indicators or the turn-of-the-nut method. Twist-off torque bolts are not an acceptable alternate fastener for slip critical connections.

3.2 FABRICATION

- A. Fabrication in accordance with Chapter M, Specification for Steel Buildings - Load and Resistance Factor Design.

3.3 SHOP PAINTING

- A. General: Shop paint steel with primer in accordance with Section 6, Code of Standard Practice for Steel Buildings and Bridges.
- B. Shop paint for steel surfaces is specified in Section 09 91 00, PAINTING.
- C. Do not apply paint to following:
 - 1. Surfaces within 50 mm (2 inches) of joints to be welded in field.
 - 2. Surfaces which will be encased in concrete.
- D. Zinc Coated (Hot Dip Galvanized) per ASTM A123 (after fabrication):
Touch-up after erection: Clean and wire brush any abraded and other spots worn through zinc coating, including threaded portions of bolts and welds and touch-up with galvanizing repair paint.

3.4 ERECTION

- A. General: Erection in accordance with Section 7, Code of Standard Practice for Steel Buildings and Bridges.
- B. Temporary Supports: Temporary support of structural steel frames during erection in accordance with Section 7, Code of Standard Practice for Steel Buildings and Bridges.

3.5 FIELD PAINTING

- A. After erection, touch-up steel surfaces specified to be shop painted. After welding is completed, clean and prime areas not painted due to field welding.
- B. Finish painting of steel surfaces is specified in Section 09 91 00, PAINTING.

3.6 SURVEY

- A. Upon completion of finish bolting or welding on any part of the work, and prior to start of work by other trades that may be supported, attached, or applied to the structural steel work, submit a certified report of survey to RE/COTR for approval. Reports shall be prepared by Registered Land Surveyor or Registered Civil Engineer as specified in Section 01 00 00, GENERAL REQUIREMENTS. Report shall specify that location of structural steel is acceptable for plumbness, level and alignment within specified tolerances specified in the AISC Manual.

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SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Metal fabrications, including items fabricated from aluminum, iron and steel shapes, plate, bars, strips, tubes, pipes, panels and casting, which are not a part of structural steel of other metal systems in other Sections of these Specifications. Types of metal items include, but are not limited to the following:

1. Miscellaneous steel framing and supports.
2. Shelf angles.
3. Loose bearing and leveling plates.
4. Steel weld plates and angles.
5. Miscellaneous steel trim.
6. Loose steel lintels.
7. Fabricated steel accents and ornamentation.
8. Aluminum panels.
9. Other items as indicated

1.2 SUBMITTALS

- A. Shop Drawings: Submit Drawings for the fabrication and erection of assemblies of items which are not completely shown by the Manufacturer's data sheets.
1. Include plans and elevations at not less than 1 inch to 1'-0" scale, and include details of sections and connections at not less the 3 inches to 1'-0" scale.
 2. Show anchorage and accessory items.

1.3 QUALITY ASSURANCE

- A. Standards: Comply with the following, except as otherwise shown and specified:
1. AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings."
 2. AISI "Specifications for the Design of Cold-Formed Steel Structural Members."
 3. AWS "Structural Welding Code-Steel."
 4. ASTM A6 "General Requirements for Rolled Steel Plates Shapes, Sheet Piping and Bars for Structural Use."
- B. Qualifications: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure."

1.4 DELIVERY, STORAGE AND HANDLING

- A. Exercise care during unloading, storage and erection to avoid damage. Dumping on the ground is not permitted.
- B. Support material stored at the site completely free of the ground, and cover to avoid damage from the elements.

1.5 PROJECT / SITE CONDITIONS

Field Measurements: Take field measurements prior to preparation of Shop Drawings and fabrication, where possible, to ensure proper fitting of the Work. Allow for trimming and fitting wherever the taking of field measurements before fabrication might delay the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Wide Flange Steel Sections: ASTM A572 or A992.
- B. Steel Shapes, Plates, Rod, Bars and Bar-size Shapes: ASTM A36.
- C. Steel Tubing (Cold-formed Welded and Seamless): ASTM A500, Grade b.
- D. Steel Tubing (Hot-formed Welded and Seamless): ASTM A501.
- E. Cold-Finished Carbon Steel Sheets: ASTM A611.
- F. Hot-Rolled Carbon Steel Sheets and Strips: ASTM A568 and ASTM A569.
- G. Cold-Finished Carbon Steel Bars: ASTM A108, Grade as selected by fabricator.
- H. Aluminum Panels: ASTM B209-04
- I. Stainless Steel Fasteners
- J. Neoprene Washers: ASTM D-2000 BC
- K. Hot-rolled Carbon Steel Sheets and Strips: ASTM A568 and ASTM A569, pickled and oiled.
- L. Cold-rolled Carbon Steel Sheets: ASTM A611.
- M. Cold-drawn Steel Tubing: ASTM A512, sunk drawn, butt welded, cold-finished and stress-relieved.
- N. Steel Pipe: ASTM A53, type as selected; Grade A. Black finish unless galvanizing is required. Standard weight, Schedule 40, unless otherwise shown or specified.
- O. Anchors:
 - 1. Masonry Anchorage Devices: Expansion shield, FS FF-S-325.
 - 2. Toggle bolts: Tumble-wing type, FS FF-B-588; type class and style as required.
 - 3. Chemical Type Anchors: 2-component chemically curing anchors for concrete or masonry construction, capsule or injection type, designed to accept manufacturer's galvanized anchor rod.

- P. Fasteners: Provide zinc-coated fasteners with galvanizing complying with ASTM A153 for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required for the installation of miscellaneous metal items.
1. Bolts and nuts: ASTM A307, Grade A, regular hexagon head.
 2. Bolts, hexagon and square: ANSI B-18.2.1.
 3. Bolts, round head: ANSI B-18.5.
 4. Lag Bolts: Square head type.
 5. Wood Screws: ANSI B-18.6.1, flat head carbon steel.
 6. Plain Washers: ASTM F844 helical spring type carbon steel.
 7. Neoprene Washers: ASTM D-2000 BC
- Q. Metal Primer: installation of miscellaneous metal items.
1. High performance exterior primer: Epoxy, anti-corrosive for metal, MPI 101.
- R. Metal Paint:
1. Exterior High Performance Polyurethane (AESS), two-component pigmented, Gloss (Level 6), MPI #72, premium grade (includes intermediate coat).

2.2 ACCESSORIES

Inserts and Anchorages: Furnish inserts and anchorage devices to be set in concrete or built into masonry for installation of Miscellaneous Metal Work. Provide setting Drawings, templates, instructions and directions for installation of anchorage devices.

2.3 FABRICATION

- A. General: For fabrication of Miscellaneous Metal Work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, roller trade names and roughness. Remove such blemishes by grinding or by welding and grinding prior to cleaning, treating and application of surface finishes, including zinc coatings.
- B. Shop Assembly: Preassemble items in shop, when possible, to minimize field splicing and assembly of units at the site. Disassemble units only to extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Workmanship:
1. Use materials of the size and thickness shown, or if not shown, of the required size and thickness to produce adequate strength and durability of the finished product for the intended use. Work to

the dimensions of fabrication and support. Use type of materials shown or specified for various components of Work.

2. Form exposed Work true to line and level with accurate angles, surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise shown. Form bent-metal corners to the smallest radius possible without causing grain separation of otherwise impairing the Work.
 3. Weld corners and seam continuously and in accordance with the recommendations of AWS. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.
 4. Form exposed connections with hairline joints which are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type shown, or if not shown, use Phillips flat-head (countersunk) screws or bolts.
 5. Provide for anchorage of type shown, coordinate with supporting structure and the progress schedule. Fabricate as required to provide adequate support for the intended use of the Work.
 6. Cut, reinforce, drill and tap Miscellaneous Metal Work as may be required to receive finish hardware and similar items of Work.
 7. Use hot-rolled steel bars for Work fabricated from bar stock, unless Work is indicated to be fabricated from cold-rolled, or cold-finished stock.
 8. Remove all machine oil and/or lubricant from metal products through the use of detergent or chemical process prior to galvanization or application of exterior finishes.
- D. Miscellaneous Framing and Supports: Provide steel framing and supports not specified in other Sections as needed to complete the Work. Fabricate units from steel shapes, plates, and bars of welded construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.
- E. Miscellaneous Framing and Supports:
1. Provide steel framing and supports which are not a part of the structural steel framework, as required to complete the Work.
 2. Fabricate miscellaneous units to sizes, shapes and profiles shown, or if not shown, of the dimensions required to receive adjacent grating, plates, doors, or other Work to be retained by the framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars of all welded construction using mitered

- corners, welded brackets and splice plates, and a minimum number of joints for field connection. Cut, drill and tap units to receive hardware and similar items to be anchored to the Work.
3. Equip units with integrally welded anchor straps for casting into concrete or building into masonry wherever possible. Furnish inserts if units must be installed after concrete poured. Except as otherwise shown, space anchors 24 inches o.c., and provide minimum anchor units of 1-1/4 inch x 1/3 inch x 8 inch steel straps.
- F. Exterior Canopies, Awning, Accents and Ornamentation: Fabricate to sizes, configurations and shapes indicated using steel tubing, shapes, plate, and rod as detailed. Continuously weld all joints and grind smooth. Provide exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, roller trade names, and roughness, except where these features are a design feature of the ornamental item.
1. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.
- G. Miscellaneous Steel Trim: Provide shapes and sizes as required for the profiles shown. Except as otherwise noted, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other Work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine subsurfaces to receive Work and report detrimental conditions in writing to Architect. Commencement of Work will be construed as acceptance of subsurfaces.
- B. Coordination: Coordinate with other Work which affects, connects with, or will be concealed by this Work.

3.2 PREPARATION

- A. Supply items required to be cast into concrete or embedded in masonry with setting templates to appropriate Trades.
- B. Set sleeves in concrete with tops flush with finish surface elevations. Protect sleeves from water and concrete entry.

- C. Remove all machine oil and/ or lubricant from metal products through the use of detergent or chemical process prior to galvanization or application of exterior finishes.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components indicated on Shop Drawings.
- D. Perform field welding in accordance with AWS D1.1.
- E. Obtain Architect approval prior to site cutting or making adjustments not scheduled.

3.4 ERECTION TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset from True Alignment: 1/4 inch

3.5 CLEANING

During the course of the Work and on completion, remove and dispose of excess materials, equipment and debris away from premises.

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SECTION 07 60 00
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 DESCRIPTION

Formed sheet metal work for flashing and insulated expansion joint covers are specified in this section.

1.2 RELATED WORK

Sealant compound and 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. Shop Drawings:
 - 1. Flashings
 - 2. Copings
 - 3. Expansion joints
- C. Manufacturer's Literature and Data:
 - 1. Thru wall flashing
 - 2. Expansion joint cover, each type
 - 3. Non-reinforced, elastomeric sheeting

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below for a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - A167-99-09.....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - A653/A653M-08.....Steel Sheet Zinc-Coated (Galvanized) or Zinc Alloy Coated (Galvanized) by the Hot- Dip Process
 - B32-08.....Solder Metal
 - B209-07.....Aluminum and Aluminum-Alloy Sheet and Plate
 - B370-09.....Copper Sheet and Strip for Building Construction
 - D173-03.....Bitumen-Saturated Cotton Fabrics Used in Roofing and Waterproofing
 - D412-06.....Vulcanized Rubber and Thermoplastic Elastomers-Tension

- D1187-97 (R2002).....Asphalt Base Emulsions for Use as Protective
Coatings for Metal
- D1784-08.....Rigid Poly (Vinyl Chloride) (PVC) Compounds and
Chlorinated Poly (Vinyl Chloride) (CPVC)
Compounds
- D3656-07.....Insect Screening and Louver Cloth Woven from
Vinyl-Coated Glass Yarns
- D4586-07.....Asphalt Roof Cement, Asbestos Free
- C. American National Standards Institute/Single Ply Roofing Institute
(ANSI/SPRI):
- ES-1-2003.....Wind Design Standard for Edge Systems Used with
Low Slope Roofing Systems
- D. Sheet Metal and Air Conditioning Contractors National Association
(SMACNA): Architectural Sheet Metal Manual (2003 Edition).
- E. National Association of Architectural Metal Manufacturers (NAAMM):
AMP 500-06.....Metal Finishes Manual
- F. American Architectural Manufacturers Association (AAMA):
605-98.....Voluntary Specification for High Performance
Organic Coatings on Architectural Extrusions
Panels
- G. Federal Specification (Fed. Spec):
- A-A-1925A.....Shield, Expansion; (Nail Anchors)
- UU-B-790A.....Building Paper, Vegetable Fiber
- H. International Building Code (IBC):
2009 Edition

PART 2 - PRODUCTS

2.1 MATERIALS

Non-reinforced, Elastomeric Sheetting: ASTM D412J.

2.2 THROUGH-WALL AND COPING FLASHINGS

- A. Flexible flashing not exposed to exterior
1. Elastomeric Thermoplastic Flashing; Composite flashing product
consisting of polyester-reinforced ethylene interpolymer alloy as
follows:
- a. Self Adhesive Sheet: Elastomeric thermal flashing 0.635 mm
(0.025 inch) thick with 0.40 mm (0.015 inch) thick coating of
rubberized asphalt adhesive.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Apply Sealant as specified in Section 07 92 00, JOINT SEALANTS.
2. Apply flashing material to surfaces which are smooth, sound, clean, dry and free from defects that might affect the application.
3. Remove projections which would puncture the materials and fill holes and depressions with material compatible with the substrate.
4. Install flashings in conjunction with other trades so that flashings are inserted in other materials and joined together to provide a water tight installation.

3.2 THROUGH-WALL FLASHING

A. General:

1. Install continuous through-wall flashing between top of concrete foundation walls and back of precast concrete columbarium niche units and under concrete copings and elsewhere as shown.
2. Terminate exterior edge beyond face of wall approximately 6 mm (1/4 inch) with drip edge.
3. Under copings terminate both edges one half inch from face of wall.
4. Where dowels, reinforcing bars and fastening devices penetrate flashing, seal penetration with sealing compound. Sealing compound is specified in Section 07 92 00, JOINT SEALANTS.
5. Turn flashing up not less than 200 mm (8 inch) between masonry or behind exterior veneer.

B. Flashing at Veneer Walls:

1. Install where shown.
2. Turn up against concrete.

C. Flashing at Precast Concrete Copings:

1. Form penetration openings to fit tight against dowel or other item with edge turned up. Seal penetrations with sealant.

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SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION:

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

1.2 RELATED WORK:

- A. Sealing of site work concrete paving: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- B. Wall caps and mock ups: Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE
- C. Precast Concrete Columbarium Units and mock-ups: Section 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS
- D. Masonry control and expansion joint: Section 04 20 00, UNIT MASONRY.
- E. Stone veneer and mock-ups: Section 04 43 00, NATURAL STONE VENEER
- F. Flashing: Section 07 60 00, FLASHING AND SHEET METAL

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 other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
- D. VOC: Acrylic latex and Silicon sealants shall have less than 50g/l VOC content.

E. Samples

1. Provide at least 3 samples to match each of the applications listed below
 - a. Colors of approved pointing mortar
 - b. Color of approved recast concrete columbarium unit sample
 - c. Color of cast-in-place concrete Memorial Wall from mock-up
2. If the samples provided are not a sufficient match following review by the RE/COTR, custom color sealants will be required.

- F. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution:
1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this section.

1.4 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. Primers
 2. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

1.5 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:
 1. 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:

1. Do not proceed with installation of joint sealants until
contaminants capable of interfering with adhesion are removed from
joint substrates.

1.6 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).

1.7 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.

1.8 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 shall be extended to two years.
- B. General Warranty: Special warranty specified in this Article shall not
deprive Government of other rights Government may have under other
provisions of Contract Documents and shall be in addition to, and run
concurrent with, other warranties made by Contractor under requirements
of Contract Documents.

1.9 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to extent
referenced. Publications are referenced in text by basic designation
only.
- B. American Society for Testing and Materials (ASTM):
C509-06.....Elastomeric Cellular Preformed Gasket and
Sealing Material.
C612-04.....Mineral Fiber Block and Board Thermal
Insulation.
C717-09.....Standard Terminology of Building Seals and
Sealants.
C834-05.....Latex Sealants.
C919-08.....Use of Sealants in Acoustical Applications.
C920-08.....Elastomeric Joint Sealants.

C1021-08.....Laboratories Engaged in Testing of Building
Sealants.

C1193-09.....Standard Guide for Use of Joint Sealants.

C1330-02 (R2007).....Cylindrical Sealant Backing for Use with Cold
Liquid Applied Sealants.

D1056-07.....Specification for Flexible Cellular Materials—
Sponge or Expanded Rubber.

E84-09.....Surface Burning Characteristics of Building
Materials.

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

PART 2 - PRODUCTS

2.1 SEALANTS:

A. S-1:

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

B. S-2:

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

C. S-3:

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

E. S-5:

1. ASTM C920, polyurethane or polysulfide.
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.
6. Minimum elongation of 1200 percent.

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 COLOR:

- A. Sealants used with exposed stone veneer masonry shall match color of mortar joints.
- B. Sealants used with unpainted concrete shall match color of adjacent concrete.
- C. Color of sealants for other locations shall be light gray or aluminum, unless specified otherwise.

2.3 JOINT SEALANT BACKING:

- A. General: Provide sealant backings of material and type that are nonstaining; 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.

2.4 FILLER:

- A. Mineral fiber board: ASTM C612, Class 1.
- B. Thickness same as joint width.
- C. Depth to fill void completely behind back-up rod.

2.5 PRIMER:

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

2.6 CLEANERS-NON POUROUS SURFACES:

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 SWRI.
- 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. Natural Stone Veneer.

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.
- 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.

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 LOCATIONS:

A. Exterior Building Joints, Horizontal and Vertical:

1. Metal to Metal: Type S-1, S-2
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. Masonry Expansion and Control Joints: Type S-6

B. Metal Reglets and Flashings:

1. Flashings to Wall: Type S-6
2. Metal to Metal: Type S-6

C. Horizontal Traffic Joints:

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

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PAINTING
SECTION 09 91 00

PART 1-GENERAL

1.1 DESCRIPTION

- A. Section specifies prime coats which may be applied in shop under other sections.
- B. Painting includes shellacs, stains, varnishes, coatings specified, and striping or markers and identity markings.

1.2 RELATED WORK

Shop prime painting of steel and ferrous metals: Division 05 - METALS, Division 08 - OPENINGS, Division 10 - SPECIALTIES, Division 11 - EQUIPMENT, Division 12 - FURNISHINGS, Division 13 - SPECIAL CONSTRUCTION, Division 21 - FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 - HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 - ELECTRONIC SAFETY AND SECURITY sections.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
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).
- D. Manufacturers' Certificates indicating compliance with specified requirements:
 - 1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.

- #### 1.4 DELIVERY AND STORAGE

- ## 1.5 APPLICABLE PUBLICATIONS

- PAINTING
09 91 00 - 2

No. 9-07.....Exterior Alkyd Enamel MPI Gloss Level 6 (EO)
No. 10-07.....Exterior Latex, Flat (AE)
No. 11-07.....Exterior Latex, Semi-Gloss (AE)
No. 26-03.....Cementitious Galvanized Metal Primer
No. 27-07.....Exterior / Interior Alkyd Floor Enamel, Gloss
(FE)
No. 43-06.....Interior Satin Latex, MPI Gloss Level 4
No. 44-08.....Interior Low Sheen Latex, MPI Gloss Level 2
No. 45-02.....Interior Primer Sealer
No. 46-04.....Interior Enamel Undercoat
No. 47-02.....Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
(AK)
No. 48-05.....Interior Alkyd, Gloss, MPI Gloss Level 6 (AK)
No. 49-02.....Interior Alkyd, Flat, MPI Gloss Level 1 (AK)
No. 50-08.....Interior Latex Primer Sealer
No. 51-02.....Interior Alkyd, Eggshell, MPI Gloss Level 3
No. 52-06.....Interior Latex, MPI Gloss Level 3 (LE)
No. 53-06.....Interior Latex, Flat, MPI Gloss Level 1 (LE)
No. 54-06.....Interior Latex, Semi-Gloss, MPI Gloss Level 5
(LE)
No. 59-07.....Interior/Exterior Alkyd Porch & Floor Enamel,
Low Gloss (FE)
No. 60-07.....Interior/Exterior Latex Porch & Floor Paint, Low
Gloss
No. 68-07.....Interior/ Exterior Latex Porch & Floor Paint,
Gloss
No. 77-08.....Epoxy Cold Cured, Gloss (EC)
No. 79-08.....Marine Alkyd Metal Primer
No. 94-07.....Exterior Alkyd, Semi-Gloss (EO)
No. 95-03.....Fast Drying Metal Primer
No. 101-08.....Epoxy Anti-Corrosive Metal Primer
No. 108-08.....High Build Epoxy Coating, Low Gloss (EC)
No. 114-06.....Interior Latex, Gloss (LE) and (LG)
No. 119-07.....Exterior Latex, High Gloss (acrylic) (AE)
No. 134-06.....Primer, Galvanized, Water Based
No. 135-06.....Non-Cementitious Galvanized Primer
No. 138-06.....Interior High Performance Latex, MPI Gloss Level
2 (LF)
No. 139-06.....Interior High Performance Latex, MPI Gloss Level
3 (LL)

No. 140-06.....Interior High Performance Latex, MPI Gloss Level

4

No. 141-06.....Interior High Performance Latex (SG) MPI Gloss
Level 5

G. 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. High Performance Exterior Primer: Epoxy, anti-corrosive for metal, MPI 101.

B. Exterior High Performance Polyurethane (AESS), two-component pigmented, Flat (Gloss Level 1), MPI #72, premium grade (includes intermediate coat).

C. High Build Epoxy Coating, Low Gloss: MPI #108

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/QUALITY ASSURANCE

A. Paint materials shall conform to the restrictions of the local Environmental and Toxic Control jurisdiction.

1. Volatile Organic Compounds (VOC): VOC content of paint materials shall not exceed 10g/l for interior latex paints/primers and 50g/l for exterior latex paints and primers.

2. Lead-Base Paint:

a. Lead based paint is not permitted to be used.

3. Asbestos: Materials shall not contain asbestos.

4. Chromate, Cadmium, Mercury, and Silica: Materials shall not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.

5. Human Carcinogens: Materials shall not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.

6. Use high performance acrylic paints in place of alkyd paints, where possible.

7. VOC content for solvent-based paints shall not exceed 250g/l and shall not be formulated with more than one percent aromatic hydrocarbons 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. Under no circumstances shall application conditions exceed manufacturer recommendations.
 2. Maintain interior temperatures until paint dries hard.
 3. Do no exterior painting when it is windy and dusty.
 4. Do not paint in direct sunlight or on surfaces that the sun will soon warm.
 5. 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.

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 prefinished 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. Zinc-Coated (Galvanized) Metal:

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) or MPI 135 (Non-Cementitious Galvanized Primer) depending on finish coat compatibility.

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/COTR.

- E. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, 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/COTR, 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. Apply prime coat as recommended by the manufacturer.
- B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- 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. Metals:
 - 1. Steel and iron: MPI 101 (Cold Curing Epoxy Primer).

3.6 EXTERIOR FINISHES

- A. Apply following finish coats for Steel and Ferrous Metal:
 - 1. Exterior High Performance Polyurethane, two-component pigmented, Flat (Gloss Level 1), MPI 72, premium grade (includes intermediate coat). Apply intermediate and finish coat as recommended by the manufacturer.
 - 2. For Memorial Wall Marker attachment hardware coating: High Build Epoxy Coating, Low Gloss, MPI 108

3.7 PAINT COLOR

- A. Color is Matthews Paint MP 07458 Cast Bronze Matte for all exposed shade canopy components.
- B. Color is Matthews Paint MP 25849 Durango Grey Matte for Memorial Wall Marker attachment plate hardware.

C. 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.

3.8 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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SECTION 10 14 00
EXTERIOR SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the work required to furnish and install the indicated and specified exterior cemetery site signage systems, including posts where indicated on the drawings. The signage systems to be provided include all those shown on the drawings including: identification signs, directional signs, traffic regulatory signs, directory, and warning/informational signs like "DO NOT DRINK" and cast bronze ossuary cover.
- B. Signs shall be products of manufacturers regularly engaged in manufacturing signs of types specified.
- C. Signs included are as follows:
 - 1. Single post & panel signs to match existing.
 - 2. Single post traffic regulatory signs.
 - 3. Single post directional signs.
 - 4. Directory signs.

1.2 RELATED WORK

- A. Post Setting Excavation, Material, Backfill, Section 31 20 11, EARTH MOVING (SHORT FORM).
- B. Concrete Bases for posts: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM)
- C. Precast Architectural Concrete Posts: Section 03 45 00 PRECAST ARCHITECTURAL CONCRETE.
- D. Columbarium Wall Identification, Columbarium wall row markers, and Memorial Wall row markers: Section 04 43 00, NATURAL STONE VENEER.
- E. Columbarium wall and Memorial Wall column identification: Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE

1.3 MANUFACTURER'S QUALIFICATIONS.

- 1. Sign manufacturer shall regularly and presently manufacture signs similar to those specified as one of their principal products. Sign manufacturer shall submit qualifications demonstrating a minimum of three years of experience manufacturing the qualifying signs.

1.3 SUBMITTALS

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

- B. Samples: Submit 3 sets. One set to the Contractor, one set to the Resident Engineer (RE) or Contracting Officer's Technical Representative (COTR) and one set to the A/E Designer.
1. Panel and frame sign mock-up, not less than 12" by 12", shall be constructed and submitted, showing typical colors, finishes, texture and fonts shown on Contract Drawings. Mock-up shall show typical fabrication methods, including panel to post(s) connection. Mock-ups of all other sign systems for post mounted signs shall be capable of demonstrating how the sign panels are to be removed and replaced from the posts, or mounting support system attached to the posts, without moving the posts. Top surface of the sign panel shall not contain screws or metal joints that could trap or allow water to enter the sign assembly.
 2. Precast architectural concrete post, showing typical color and finish.
 3. Aluminum samples showing full range of finish colors available selected to match the existing site signage colors: Federal Standard 595 Colors FS 30091 (red brown) for panel and FS 37178 (natural metal) for frame.
 4. Color samples of each color, 150 mm x 150 mm (6 inches x 6 inches). Show anticipated range of color and texture.
 5. Sample of typeface, arrows and symbols in a typical full size layout.
 6. Directory panels and frames, with letters and symbols, each type.
- C. Shop Drawings: All signs showing material, finish, colors, size of members, details of construction, letter spacing, size and type, numbers, symbols or image details, and mounting details. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes.
- D. Full size layout in full color of the Sign Panels.
- E. Manufacturer's Literature and Data (Mark literature to indicate items proposed to be furnished): Signs, each type. Manufacturer's printed specifications, anchorage details, installation and maintenance instructions. Manufacturer's recommendations for mounting the Sign Panels shall be provided.
- F. Manufacturer's Certificates: Provide certification from the coating installer, that they prepared the aluminum and applied the coating(s) to the specified thickness(es).

- G. Sample sign of sufficient size to show the full scaled features of each of the sign types, including frame, mounting, panels, panel mounting, and sign mounting facilities. All aluminum signs shall have full exterior Powder Coated finish, with color and quality to match existing Federal Standard 595 Colors FS 30091 (red brown) and FS 37178 (natural metal).
- H. Provide shop drawings, clay proofs, photographs, and associated products to clearly define and illustrate the 3-dimensional bas-relief (high relief) bronze ossuary cover.

1.4 DELIVERY AND STORAGE

- A. Package to prevent damage or deterioration during shipment, handling, storage and installation. Maintain protective covering in place and in good repair until removal is necessary.
- B. Deliver signs only when the site, mounting materials, and equipment are ready for installation work to proceed.
- C. Store products in dry condition inside enclosed facilities.

1.5 WARRANTY

Sign Manufacturer shall guarantee text and symbols application to aluminum for an extended warranty period of five years.

1.6 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. Americans with Disabilities Act - 1990
- C. Federal Highway Administration
Manuals on Uniform Traffic Control Devices for Street and Highways. Single Post Traffic Regulatory Signs:
- D. American Society for Testing and Materials (ASTM):
 - B209-07.....Aluminum and Aluminum-Alloy Sheet and Plate
 - B221-07.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
 - B449-93(2004).....Standard Specification for Chromates on Aluminum
- E. American Architectural Manufacturer's Association (AAMA):
 - AAMA 2604.....Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum extrusions and Panels.
- F. Federal Specifications (Fed. Spec.):

MIL-P-8184E Plastic Sheet, Acrylic, Modified.

MIL-P-46144C Plastic Sheet, Polycarbonate

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum, Extruded: Fed. Spec. QQA-200-9, alloy 6063-T5, applicable as material.
- B. Aluminum, Sheet and Plate: ASTM B209
- C. Aluminum, Extrusions and Tubing: ASTM B221
- D. Zinc Chromate Primer: Fed. Spec. TT-P-645.
- E. Bronze Castings: ASTM B 584, Alloy UNS No. C86500 (No. 1 manganese bronze).
- F. Bronze Plate: ASTM B 36/B 36/M

2.2 GENERAL

- A. Signs shall be of type, size and design shown on the drawings and as specified.
- B. Signs shall be complete with lettering, framing, and related components for a complete sign installation.
- C. Provide graphics items as completed units produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.
- D. Do not scale drawings for dimensions. Contractor to verify and be responsible for all dimensions and conditions shown by these drawings. Contractor to verify dimensions of existing sign panel and frame replacements. RE/COTR to be notified of any discrepancy in drawing, in field directions or conditions, and/or of any changes required for all such construction details.
- E. The Sign Contractor, by commencing work of this section, assumes overall responsibility, as part of his warranty of work, to assure that assemblies, components and parts shown or required within the work of the section, comply with the Contract Documents. The Contractor shall further warrant: That all components, specified or required to satisfactorily complete the installation are compatible with each other and with conditions of installations.
- F. All aluminum sign panels shall match existing Federal Standard 595 Colors FS 30091 (red brown) and FS 37178 (natural metal).

2.3 SIGN STANDARDS

A. Typography:

1. Type Style: Times New Roman Bold. Initial caps or and lower case as indicated in Site Signage Plan, unless otherwise indicated.
2. Arrow: See graphic standards in drawings.
3. Letter spacing: See graphic standards on drawings.
4. All text, arrows, and symbols to be provided in size, colors, typefaces and letter spacing shown. Text shall be a true, clean, accurate reproduction of typeface(s) shown. Text shown in drawings are for layout purposes only; final text for signs shall be as approved in the shop drawings.

B. Sign Colors and Finishes: As specified and approved in the Shop Drawing & Submittal process.

2.4 SIGNS TYPES

A. Signs to match existing cemetery sign types.

B. General: The exterior sign system shall be comprised of sign type families that are identified by a letter and number which identify a particular group of signs. An additional number identifies a specific type of sign within that family, as indicated below:

1. Type A - Traffic Regulatory Signs, both non-traffic code type as shown on the drawing details.
2. Type B - Directional Signs, shall be as shown on the drawing details and shall be coated aluminum signs with integral mounting frame and letters, numbers and arrows as indicated.
3. Type C - Identification Signs, shall be as shown on the drawing details and shall be coated aluminum signs with integral mounting frame and letters and symbols as indicated in the detail drawings.
4. 'DO NOT DRINK' sign panels shall be coated aluminum signs with lettering and/or graphic symbol as shown on the drawing details.

C. Text and Graphics:

1. Types A, B, C, and 'DO NOT DRINK' signs:
 - a. Surface applied reflective white opaque vinyl letters, numbers and graphics shall be of a quality and life expectancy equal to or exceeding that for Engineering Grade 3M Scotchlite, unless otherwise noted. Color shall match existing. Font Type Style shall be Times New Roman Bold, unless otherwise approved during design review for the specific project.

D. Post and Panel Signs:

1. Sign shall be constructed of aluminum tubing system utilizing 25 mm x 25 mm x 3mm (1-inch by 1-inch by 1/8") tubular aluminum frame system and 3 mm (1/8 - inch) aluminum panels anchored to the tubing, with all corners mitered and welded and ground smooth. Mounting holes for attaching the sign panel and frame to the posts shall be pre-drilled before the coating system is applied. The entire sign panel and frame system shall be coated with the indicated powder coating, as indicated on the drawings.
2. Insulating sleeves, gaskets, bolts and concrete anchors shall be provided and signs anchored to sign posts as indicated on the drawings and approved shop drawings.
3. Signs to be installed with direct burial precast architectural concrete shall be installed and mounted at the locations as indicated on the drawings.

E. Panel and Frame Replacements

1. Where only panel and frame replacement is indicated in drawing, the existing precast architectural concrete post shall remain in place and the new panel mounted in the same location as the removed panel.

2.5 FABRICATION

- A. Design components to allow for expansion and contraction for a minimum material temperature range of 56 °C (100 °F), without causing buckling, excessive opening of joints or over stressing of adhesives, welds and fasteners.
- B. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary rebates, lugs and brackets for assembly of units. Use concealed fasteners whenever and wherever possible.
- C. Shop fabricate so far as practicable. Joints fastened flush to conceal reinforcement, or welded where thickness or section permits.
- D. Contact surfaces of connected members be true. Assembled so joints will be tight and practically unnoticeable, without use of filling compound.
- E. Signs shall have fine, even texture and be flat and sound. Lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern. Plane surfaces be smooth flat and without oil-canning, free of rack and twist. Maximum variation from plane of surface plus or minus 0.3 mm (0.015 inches). Restore texture to filed or cut areas.
- F. Level or straighten wrought work. Members shall have sharp lines and angles and smooth sulrfaces.

- G. Extruded members to be free from extrusion marks. Square turns and corners sharp, curves true.
- H. Drill holes for bolts and screws. Conceal fastenings where possible. Exposed ends and edges mill smooth, with corners slightly rounded. Form joints exposed to weather to exclude water.
- I. All painted surfaces properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Finished surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter and other imperfections.
- J. Movable parts, including hardware, are to be cleaned and adjusted to operate as designed without binding or deformation of members. Doors and covers centered in opening or frame. All contact surfaces fit tight and even without forcing or warping components.
- K. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.
- L. Aluminum plate recesses and all exposed surfaces shall receive the acid etch finish. Aluminum plates installed in post recesses shall be installed prior to delivery to the site. Protect all surfaces from damage.
- M. No signs are to be manufactured until final sign message schedule and location review has been completed by the RE/COTR & forwarded to contractor.

2.6 PROTECTION OF ALUMINUM

- A. Isolate aluminum in contact with or fastened to dissimilar metals other than stainless steel, white bronze or other metals compatible with aluminum by one of the following:
 - 1. Painting the dissimilar metal with a prime coat of zinc-chromate or other suitable primer, followed by two coats of aluminum paint.
 - 2. Placing an approved caulking compound, or a non-absorptive tape, or gasket between the aluminum and the dissimilar metal.
- B. Paint aluminum in contact with or built into mortar, concrete, or other masonry materials with bituminous paint or zinc chromate primer.

2.7 SINGLE-POST TRAFFIC REGULATORY SIGNS

- A. Signs shall be constructed of square tubular galvanized steel post with an aluminum plate sign panel.

- B. Sign panel shall be a 2 mm (0.080") aluminum plate with surface applied reflective vinyl traffic regulatory decals. Panel, text & graphics shall comply with the Department of Transportation, Manual for Uniform Traffic Control Devices in color, text and symbols. Shape and proportions to match existing as detailed in the drawings. Panel shall mechanically fasten to support post with tamper resistant fasteners.
- C. Posts shall be re-used precast architectural concrete as specified and shown in the details.

2.8 BRONZE OSSUARY COVER

- A. Furnish and install the Ossuary Cover, in Bronze as indicated on the contract drawings.
- B. The Ossuary Cover shall be of the sculpted BAS relief style. The cover shall be sculpted in a full range of high relief using a range of projected sculpted relief elements to create a three dimensional illustration of the components of the graphics and eagle depicted on the drawings. The sculpted bas-relief seal shall include a variety of raised portions, background areas, and sculpted elements at a variety of elevations. A single raised and/or flat relief cover is unacceptable. Shop drawings of the cover showing color, texture, relief, and border shall be submitted for approval prior to fabrication. Contractor to provide the shop drawings, clay proofs, and photographs for review and approval. Multiple review cycles if necessary shall be provided by the contractor at no additional cost to VA.
- C. The Ossuary Bronze Cover shall be of the sculpted BAS relief style with the size and graphics as approved during the submittal review and approval process. The size, location and attachment for the bronze cover shall be as agreed to during the design review process, incorporating adequate security concerns to reduce or deter theft.
- D. Coordinate construction and cover details with locking mechanism and mounting hardware.
- E. Finish cover with one coat of clear protective exterior metal lacquer.
- F. Castings shall be of uniform quality and condition, free from injurious blowholes and porosity, cracks and other defects and not warped or distorted, well finished, free from burrs, sharp edges, scratches and defects that may affect appearance or serviceability. Castings shall not be repaired, plugged, welded, or burned.

- G. Fasteners shall be corrosion resisting metal compatible with material of the bronze casting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set work accurately, in alignment and where shown. Signs shall be plumb, level, free of rack and twist and set parallel or perpendicular as required to line and plane the surface.
- B. Signs shall be installed with direct burial of post into concrete as shown on Contract Drawings.
- C. Protect aluminum in contact with dissimilar metals or mortar as specified in Paragraph 2.5.
- D. Furnish setting drawings and instructions for installation of anchors and for the positioning of items having anchors or sleeves to be built into construction. Provide temporary bracing for such items until permanent anchors are set.
- E. Provide anchoring devices and fasteners as shown and as necessary for securing signs to construction as specified.
- F. Contractor will be responsible for verifying that behind each sign location there are no utility lines that will be affected by installation of signs. Any damage during installation of signs to utilities will be the sole responsibility of the Contractor to correct and repair.
- G. Furnish inserts and anchoring devices which must be set in concrete or other material for installation of signs. Provide setting drawings, templates, instructions and directions for installation of anchorage devices which may involve other trades.

3.2 CLEANING

After installation, all items shall be cleaned as recommended by the manufacturer and protected from damage until completion of the project.

3.3 PROTECTION

Protect finished surfaces from damage during fabrication, erection and after completion of the work.

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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 75 mm (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 (RE)/Contracting Officer's Technical Representative's (COTR) approval.

B. Earthwork: Earthwork operations required within the new construction area. It also includes earthwork required for auxiliary structures 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 standard Proctor compaction test, ASTM D698.

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

1.3 RELATED WORK

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Safety Requirements : Section 01 00 00, GENERAL REQUIREMENTS, Article, ACCIDENT PREVENTION.

C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.

D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

1.4 CLASSIFICATION OF EXCAVATION

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.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Furnish to RE/COTR, soil samples, suitable for laboratory tests, of proposed off site or on site fill material.

1.6 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 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop
T180-01 (2004).....Moisture-Density Relations of Soils Using a 4.54-kg [10 lb] Rammer and a 457 mm (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 (Insert name of local state) State Department of Transportation, latest revision.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General Fill: On-site soils may be suitable for fill provided that they meet the characteristics herein. Fill material shall consist of natural soils that have a maximum Liquid Limit of 45 and a plasticity index of not more than 20. It should be free from organic matter, debris or other deleterious materials. In general, the material should have an upper particle size diameter of 2 inches.

- B. Granular Fill/Engineered Fill: Granular fill should be used in confined areas such as trenches, backfill around foundations and shall meet the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
6 inch	100
3 inch	95-100
Loss by Wash	0-15

- C. Sand-Gravel Fill: Sand-gravel fill should be used for underfloor fill and shall meet the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
2 inch	100
1/2 inch	45-85
No. 4	20-85
No. 30	5-30
Loss by Wash	0-5

- D. Crushed Stone Fill (Aggregate Base): Crushed stone fill shall meet the following gradations:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 1/2 inch	100
1 inch	85-100
1/2 inch	50-75
No. 8	20-45
Loss by Wash	0-10

- E. Bedding: Bedding for utilities shall be crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No. 4).

- F. Drainage Aggregate: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 37.5 mm (1 1/2 inch) sieve and 0 to 5 percent passing a 2.36 mm (No. 8) sieve.

PART 3 - EXECUTION

3.1 SITE PREPARATION

- A. Clearing: Clearing within the limits of earthwork operations as described or designated by the RE/COTR. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, decomposed granite, debris, trash and any other obstructions. Remove materials from the Cemetery Property.
- B. Grubbing: Remove stumps and roots 75 mm (3 inches) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inches) diameter, and nonperishable solid objects which will be a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left. Cemetery Projects: do

not leave material within the burial profile up to 2400 mm (8 feet) below finished grade.

- C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from the areas within 4500 mm (15 feet) of new construction and 2250 mm (7'-6") of utility lines if such removal is approved in advance by the RE/COTR. 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. 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.
 2. If the bearing of any foundation is disturbed by excavating, improper shoring or removal of shoring, placing of backfill, and similar operations, provide a concrete fill support under disturbed foundations, as directed by RE/COTR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by RE/COTR.

B. Excavation Drainage: Operate pumping equipment as required, to keep excavations free of water and subgrades dry, firm, and undisturbed until approval of permanent work has been received from RE/COTR. Approval by the RE/COTR 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.

C. Structures 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 25 MPa (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 RE/COTR.
2. Storm sewer trenches:
 - a. Trench width below a point 150 mm (6 inches) above top of the pipe shall be 600 mm (24 inches) for up to and including 300 mm (12 inches) diameter and four-thirds diameter of pipe plus 200 mm (8 inches) for pipe larger than 300 mm (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 300 mm (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 75 mm (3 inches) plus one-sixth of pipe diameter below the pipe of 300

- mm (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 RE/COTR 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 RE/COTR, 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 base course as applicable.
 - 2. Planting and Lawn Areas - 100 mm (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 RE/COTR.
- 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 uniform horizontal layers not exceeding 200 mm (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 3000 mm (10 feet) of new or existing building walls without the prior approval of the RE/COTR. 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 ASTM D698.

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 1800 mm (6 feet).
- D. The finished grade shall be 150 mm (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 150 mm (6 inches), unless otherwise indicated.
- F. Finish subgrade in a condition acceptable to the RE/COTR at least one day 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 +/- 6 mm (0.25 inches) of indicated grades.

3.5 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 RE/COTR 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.

3.6 CLEAN-UP

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 DESCRIPTION

- A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown. Construction shall include the following:
- B. Pedestrian Pavement: flower/water station pads

1.2 RELATED WORK

- A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Section 31 20 11, EARTH MOVING-SHORT FORM.
- C. Concrete Materials, Quality, Mixing, Design and Other Requirements: Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.
- D. Joint Sealants: Section 07 92 00, JOINT SEALANTS

1.3 DESIGN REQUIREMENTS

Design all elements with the latest published version of applicable codes.

1.4 WEATHER LIMITATIONS

Placement of concrete shall be as specified under Article 3.4 E., for Cold Weather Placement and Article 3.4 D., for Cold Weather Placement of Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
 - 1. Expansion joint filler
 - 2. Hot poured sealing compound
 - 3. Reinforcement
 - 4. Curing materials
- C. Data and Test Reports: Select subbase material.
 - 1. Job-mix formula.
 - 2. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

1.6 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. Refer to the latest edition of all referenced Standards and codes.

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

- M31-07.....Deformed and Plain Billet Steel Bars for
Concrete Reinforcement (ASTM A615/A615M-96A)
- M55M/55M-09.....Welded Steel Wire Fabric for Concrete
Reinforcement (ASTM A185)
- M147-04.....Materials for Aggregate and Soil-Aggregate
Subbase, Base and Surface Courses (R 1996)
- M148-05.....Liquid Membrane-Forming Compounds for Curing
Concrete (ASTM C309A)
- M171-05.....Sheet Materials for Curing Concrete (ASTM C171)
- M182-05.....Burlap Cloth Made from Jute or Kenaf
- M213-05.....Preformed Expansion Joint Fillers for Concrete
Paving and Structural Construction
(Non-extruding and Resilient Bituminous Type)
(ASTM D1751)
- T99-09.....Moisture-Density Relations of Soils Using a 2.5
kg. (5.5 lb) Rammer and a 305 mm (12 in.) Drop
- T180-09.....Moisture-Density Relations of Soils Using a 4.54
kg (10 lb.) Rammer and a 457 mm (18 in.) Drop

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

- C94/C94M-09.....Ready-Mixed Concrete
- C143/C143M-08.....Slump of Hydraulic Cement Concrete
- C1116/C1116M-08.....Fiber Reinforced Concrete
- C979-05.....Pigments for Integrally Colored Concrete

PART 2 - PRODUCTS

2.1 GENERAL

Concrete shall be Type C, air-entrained as specified in Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE, with the following exceptions:

TYPE	MAXIMUM SLUMP*
Curb & Gutter	75 mm (3")
Pedestrian Pavement	75 mm (3")
Vehicular Pavement	50 mm (2") (Machine Finished) 100 mm (4") (Hand Finished)
Equipment Pad	75 to 100 mm (3" to 4")
* For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94.	

2.2 REINFORCEMENT

- A. The type, amount, and locations of steel reinforcement shall be as shown on the drawings and in the specifications.
- B. Welded wire-fabric shall conform to AASHTO M55.
- C. Dowels shall be plain steel bars conforming to AASHTO M31 or M42. Tie bars shall be deformed steel bars conforming to AASHTO M31 or M42.

2.3 SELECT SUBBASE (WHERE REQUIRED)

- A. Subbase material shall consist of select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials conforming to AASHTO M147, Grading E or F.
- B. Materials meeting other gradations than that noted will be acceptable whenever the gradations are within a tolerance of three to five percent, plus or minus, of the single gradation established by the job-mix formula.
- C. Subbase material shall produce a compacted, dense-graded course, meeting the density requirement specified herein.

2.4 FORMS

- A. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.
- B. Do not use forms if they vary from a straight line more than 3 mm (1/8 inch) in any 3000 mm (ten foot) long section, in either a horizontal or vertical direction.
- C. Wood forms should be at least 50 mm (2 inches) thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

2.5 CONCRETE CURING MATERIALS

- A. Concrete curing materials shall conform to one of the following:
 - 1. Burlap conforming to AASHTO M182 having a weight of 233 grams (seven ounces) or more per square meter (yard) when dry.
 - 2. Impervious Sheeting conforming to AASHTO M171.
 - 3. Liquid Membrane Curing Compound conforming to AASHTO M148 (ASTM C309), Type 1 and shall be free of paraffin or petroleum.

2.6 EXPANSION JOINT FILLERS

Material shall conform to AASHTO M213.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 11, EARTH MOVING-SHORT FORM.

- B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.2 SETTING FORMS

A. Base Support:

1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.

B. Form Setting:

1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.
2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.
3. Forms shall conform to line and grade with an allowable tolerance of 3 mm (1/8 inch) when checked with a straightedge and shall not deviate from true line by more than 6 mm (1/4 inch) at any point.
4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
5. Clean and oil forms each time they are used.

3.3 EQUIPMENT

- A. The Resident Engineer (RE)/Contracting Officer's Technical Representative (COTR) shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.
- B. Maintain equipment and tools in satisfactory working condition at all times.

3.4 PLACING REINFORCEMENT

- A. Reinforcement shall be free from dirt, oil, rust, scale or other substances that prevent the bonding of the concrete to the reinforcement.
- B. Before the concrete is placed, the RE/COTR shall approve the reinforcement, which shall be accurately and securely fastened in place with suitable supports and ties. The type, amount, and position of the reinforcement shall be as shown.

3.5 PLACING CONCRETE - GENERAL

- A. Obtain approval of the RE/COTR before placing concrete.

- B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the RE/COTR before placing concrete.
- C. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.
- D. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.
- E. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets. Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.
- F. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.
- G. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.

3.6 PLACING CONCRETE FOR PEDESTRIAN PAVEMENTS

- A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.
- B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.
- C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.
- D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish the surface to grade with a wood or metal float.
- F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

3.7 CONCRETE FINISHING - GENERAL

- A. The sequence of operations, unless otherwise indicated, shall be as follows:
 - 1. Consolidating, floating, straight-edging, troweling, texturing, and edging of joints.
 - 2. Maintain finishing equipment and tools in a clean and approved condition.

3.8 CONCRETE FINISHING PEDESTRIAN PAVEMENT

- A. flower/water station pads:

1. Finish the surfaces to grade and cross section with a metal float, trowled smooth and finished with a broom moistened with clear water.
2. Brooming shall be transverse to the line of traffic.
3. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown on the Drawings.
4. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 2 mm (1/16 inch) in depth.
5. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. The finished surface of the pavement shall not vary more than 5 mm (3/16 inch) when tested with a 3000 mm (10 foot) straightedge.
6. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).
7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.

3.9 JOINTS - GENERAL

- A. Place joints, where shown, conforming to the details as shown, and perpendicular to the finished grade of the concrete surface.
- B. Joints shall be straight and continuous from edge to edge of the pavement.

3.10 EXPANSION JOINTS

- A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.
- B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.
- C. Anchor with approved devices to prevent displacing during placing and finishing operations.
- D. Round the edges of joints with an edging tool.
- E. Form expansion joints as follows:
 1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.
 2. Using joint filler of the type, thickness, and width as shown.
 3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

3.11 FORM REMOVAL

- A. Forms shall remain in place at least 12 hours after the concrete has been placed. Remove forms without injuring the concrete.

- B. Do not use bars or heavy tools against the concrete in removing the forms. Promptly repair any concrete found defective after form removal.

3.12 CURING OF CONCRETE

- A. Cure concrete by one of the following methods appropriate to the weather conditions and local construction practices, against loss of moisture, and rapid temperature changes for at least seven days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. Provide protection as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, remove and replace the damaged pavement and employ another method of curing as directed by the RE/COTR.
- B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 150 mm (6 inches).
- C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at least 0.1 mm (4 mils) in thickness. Wet the entire exposed concrete surface with a fine spray of water and then cover with the sheeting material. Sheets shall overlap each other at least 300 mm (12 inches). Securely anchor sheeting.
- D. Liquid Membrane Curing:
 - 1. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 5 m²/L (200 square feet per gallon) for both coats.
 - 2. Apply compound in even applications with no drips or drops.
 - 3. Do not allow the concrete to dry before the application of the membrane.
 - 4. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.
 - 5. Immediately re-spray any area covered with curing compound and damaged during the curing period.

3.13 CLEANING

- A. After completion of the curing period:
 - 1. Remove the curing material (other than liquid membrane).
 - 2. Sweep the concrete clean.

3. After removal of all foreign matter from the joints, seal joints as specified in 07 92 00, JOINT SEALANTS.
4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.14 PROTECTION

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the RE/COTR, and at no additional cost to the Government. Exclude traffic from vehicular pavement until the concrete is at least seven days old, or for a longer period of time if so directed by the RE/COTR.

3.15 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the Station.

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SECTION 32 14 13
PRECAST CONCRETE UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY

Section Includes: Aggregate base, setting bed, geotextile and precast concrete unit pavers.

1.2 RELATED WORK

- A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation and aggregate base: Section 31 20 11, EARTH MOVING-SHORT FORM.

1.3 REFERENCES

- A. ASTM International, as referenced herein as ASTM.
- B. Arizona Department of Transportation, Standard Specifications for Construction, latest edition, as referenced herein as ADOT.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's technical data for each manufactured product, including certification that each product complies with specified requirements.
- B. Source Quality Control:
 - 1. Submit 2 samples made up of actual unit pavers for each type, color and texture required. Include in each set of samples the full range of exposed color and texture to be expected in the completed Work.
 - 2. Submit testing certification showing capability of pavers proposed to comply with the specified strength requirement.
- C. Field Quality Control:
 - 1. During construction, submit field test reports in accordance with Article 3.8.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Engage an installer who has successfully completed within the past 3 years at least three unit paver applications similar in type and size to that of this Project and who will assign installers from these earlier applications to this Project, of which one will serve as lead installer.
- B. Mock-Up:
 - 1. Construct a mock-up sample, 10 feet square minimum, of the paving system, including the materials, pattern and joint treatment

required in actual construction. Make mock-up samples as required until acceptance by the Resident Engineer. Consider the accepted mock-up as a minimum standard of workmanship to be matched or bettered throughout the Project. The sample may be constructed as part of the Project and, if approved, will be accepted as part of the Work. Remove samples which fail to meet the Architect's approval.

- C. Engage an independent Testing and Inspection Agency to perform sampling and testing of aggregate base materials proposed for use in the Work as follows: Perform laboratory moisture density test: ASTM D1557.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging, Shipping, Handling and Unloading:

1. Deliver materials to the Project site in their original, unopened containers bearing label clearly identifying manufacturer's name and brand. Store materials under cover, clear of the ground and protected from the weather.
2. Protect unit pavers and aggregate during storage and construction against wetting by rain, snow or groundwater, and against soilage or intermixture with earth or other types of materials.
3. Handle pavers to prevent chipping, breakage, soiling or other damage. Do not use pinch or wrecking bars without protecting edges of pavers with wood or other rigid materials. Lift with wide-belt type slings wherever possible; do not use wire rope or ropes containing tar or other substances which might cause staining. If required, use wood rollers and provide cushion at end of wood slide.
4. Store pavers on wood skids or pallets. Place and stock skids and pavers to distribute weight evenly and to prevent breakage or cracking. Protect stored pavers from weather with waterproof non-staining covers or enclosures, but allow air to circulate around pavers.

1.7 WARRANTY

Warrant the finished area to be free of bumps and depressions, evenly graded to levels shown, and free of defects in materials and workmanship for a period of 1 year after substantial completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate Base:

1. Aggregate: Natural or slag aggregate, MDOT Grade 21AA.

B. Sand Setting Bed:

1. Sand: ASTM C33, well graded, washed sharp sand meeting the following sieve analysis gradations:

<u>Sieve</u>	<u>Percent Passing</u>
0.375 inch	100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	20 - 30
No. 200	0 - 5

2. Use of masonry sand will not be permitted.

C. Concrete Pavers:

1. Single layer hydraulic pressed concrete.
2. Colors
 - a. Color 1: Tierra Norte Blend as supplied by Phoenix Paver Mfg. LLC, Phoenix, AZ, (www.phoenixpaver.com), or approved equal.
 - b. Color 2: Antique Pewter as supplied by Acker-Stone Industries, Chandler, AZ, (www.ackerstone.com), or approved equal.
3. Cementitious Materials:
 - a. Portland cements: ASTM C150.
 - b. Blended hydraulic cements: ASTM C595.
 - c. Hydrated lime: ASTM C207, Type S.
 - d. Pozzolans: ASTM C618 for fly ash and raw or calcined natural pozzolans for use in Portland cement concrete.
4. Aggregates:
 - a. ASTM C33 for normal weight concrete aggregate.
5. Other Constituents:
 - a. Air-entraining agents, coloring pigments, integral water repellents, finely ground silica, and other additives: previously established as suitable for use in concrete and either conforming to ASTM standards where applicable, or shown by test or experience not to be detrimental to the durability of the concrete.
6. Compressive Strength:
 - a. Average not less than 8,000 psi with no individual unit less than 7,200 psi, as tested per ASTM C140.
7. Absorption:
 - a. Under freeze/thaw conditions, average no greater than 5%, with no individual unit greater than 7%, as tested per ASTM C936.

8. Proven Field Performance:

- a. Satisfactory field performance is indicated when units similar in composition and made with the same manufacturing process as those to be provided for the Work do not exhibit objectionable deterioration after at least 3 years.
- b. The units used as the basis for proven field performance have been exposed to the same general type of environment, temperature range and traffic volume as is contemplated for the units to be provided for the Work.

9. Freeze-Thaw:

- a. No breakage and no greater than 1.0% loss in dry weight of any individual unit when subjected to 50 freeze-thaw cycles, as tested per ASTM C67.

10. Visual Inspection:

- a. Provide units which are sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. Cracks or chipping resulting from handling in shipment, delivery and installation are deemed grounds for rejection.

11. Size:

- a. As indicated with a maximum tolerance 0.0625 inch in depth, width or length.

D. Jointing Sand:

1. ASTM C144, clean, fine, sharp, free of organics and soluble salts or other contaminants likely to cause efflorescence, with the following grading limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 8	95 - 100
No. 16	70 - 100
No. 30	40 - 75
No. 50	10 - 35

2. "Unicare Polymeric Sand Max," as manufactured by Unilock, 1-800-864-5625, or approved equal. Polymeric sand shall be in original, unopened packaging. On-site mixing is not permitted. Install per manufacturers recommendations.

E. Geotextile Fabric:

1. Filter Fabric:

- a. Synthetic, non-woven, needle-punched fabric that is resistant to chemicals and mildew, stable under freeze-thaw cycles, does not

shrink or expand under wet conditions, does not unravel during use and meets the following criteria:

<u>Property</u>	<u>Test Method</u>	<u>Results</u>
Weight	ASTM D3776	4 oz./sq. yd. min.
Grab Tensile Strength	ASTM D4632	100 lbs. min.
Mullen Burst	ASTM D3786	210 psi min.
Puncture Resistance	ASTM D4833	65 lbs. min.
Trapezoidal Tear	ASTM D4533	40 lbs. min.
Coefficient of Permeability	ASTM D4491	0.15 cm/sec. min.

2. Stabilization Fabric:

- a. Synthetic, woven fabric that is resistant to chemicals and mildew, stable under freeze-thaw cycles, does not shrink or expand under wet conditions, does not unravel or become clogged during use and meets the following criteria:

<u>Property</u>	<u>Test Method</u>	<u>Results</u>
Weight	ASTM D3776	4.5 oz./sq. yd. min.
Grab Tensile Strength	ASTM D4632	150 lbs. min.
Grab Elongation	ASTM D4632	25% max.
Mullen Burst	ASTM D3786	300 psi min.
Puncture Resistance	ASTM D4833	95 lbs. min.
Trapezoidal Tear	ASTM D4533	65 lbs. min.
Coefficient of Permeability	ASTM D4491	0.01 cm/sec.

F. Edge Restraint:

1. ASTM-A-569, hot-rolled, standard flexible carbon steel edge restraint fabricated in sections with stake pockets stamped, punched, or welded to face of sections approximately thirty (30") apart to receive stakes. Edge restraint (header) shall be double staked at overlap joints and designed to receive tapered steel stakes.
2. Size: 3/16" thick, 4" wide, by 16 ft. length, with 6 stakes.
3. Finish: Painted finish to be powder coat paint electrostatically-applied and oven baked. Minimum thickness to be 1.5 mils. Color shall be Brown.
4. Steel edge restraint stakes: Steel, tapered, 16" minimum length, and finished to match steel edge restraint finish. Stakes designed specifically to anchor steel edge restraint (header) in place, and shall be made by the manufacturer of the steel edge restraint (header) for which they will be used.
5. Accessories: Standard start/end sections, 90 degree corners, custom angle corners, and splicers as required.

6. Acceptable Manufacturer: 'DURAEDGE' as manufactured by J.D. Russell Co., Tucson, AZ, Phone: 1-800-888-7425, or approved equal as reviewed and approved by the Resident Engineer/COTR.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection:

1. Protect the work and adjacent construction against damage during progress of the Work.
2. Do not use construction equipment which will damage existing or new pavement.

3.2 AGGREGATE BASE COURSES

A. Sub-grade Preparation:

1. Examine sub-grade surfaces for line, grade, and compaction.
2. Bring sub-grade surface found to be unsuitable up to grade and recondition as specified under Section 31 20 00 Site Earthwork, including the necessary fine grading, to ensure that the minimum specified depth of paving will bring the surface to the indicated elevations. If the Resident Engineer finds the sub-grade surface unsuitable, such surface shall be struck off with approved graders, scarified and wetted, and finally rolled with the addition of sufficient moisture to prevent drying out prior to the placing of the aggregate material.

B. Equipment:

1. Equipment for construction of aggregate base courses is subject to approval by the Resident Engineer and shall be maintained in satisfactory working condition at all times.
2. Place the aggregate base courses by means of a moving vehicle equipped with spreader box, mechanical spreader, or other approved equipment capable of laying the courses so that the finished layer will be of the proper gradation and thickness.
3. Use compaction equipment consisting of self-propelled tamper or pneumatic-tired rollers or vibrating compactors, and three-wheeled or tandem rollers weighing from 6 to 10 tons and having a weight of between 200 lbs. and 325 lbs. per inch-width of roller. Use equipment which is capable of obtaining the required density throughout the entire depth of the layer being compacted.

C. Placing Aggregate:

1. Place aggregate on the sub-grade, using approved placing equipment, in a uniform layer to the required contour and shape and in layers not more than 4 inches (compacted) in thickness. Total thickness after compaction: minimum as indicated. Segregation of large or fine particles will not be acceptable; remove pockets of segregated material and replace with a satisfactory mixture, or remix as directed and approved by the Resident Engineer.

D. Compaction:

1. After placing, compact the material by approved means. Begin rolling at edges of the area to be compacted and proceed towards the center. Compact areas not accessible to rollers by mechanical tampers.
2. Compact material to at least 95% of maximum unit weight. Maintain the moisture content within a tolerance of plus or minus 3% of optimum until the prescribed unit weight is obtained, as determined by ASTM D1557.
3. Compact each layer until the maximum unit weight is attained before placing the succeeding layer.

E. Density:

1. During the construction of aggregate base courses, field density tests will be made as specified under Section 31 20 00 Site Earthwork.
2. If density tests indicate that the base course does not comply with specified density requirements, additional wetting, if necessary, and rolling will be required until the specified density is obtained. Add moisture to the material during compaction only when it is necessary to increase the percentage of moisture to obtain the specified density.

F. Condition of Finished Surfaces:

1. Smooth, even and true to the lines, grades and cross sections indicated. Maximum deviation of finished surface when tested with a 10 foot straight-edge parallel to the center line of the surfaced area: 0.25 inch in 10 feet.

3.3 EDGE RESTRAINT

- A. General: Edge restraint must be used anywhere pavers are not otherwise permanently restrained from any horizontal movement as well as the edges of decomposed granite pathways.

1. Contractor may install restraint after pavers are laid but prior to compaction.
2. Install restraint on aggregate base extended 6" beyond edge of pavers. Restraint must be installed directly on compacted aggregate base, not sand setting bed.
3. Install edge restraint per Contract Drawings and manufacturer's recommendations.
4. Place restraint all along exposed edges of the pavers in full pieces wherever possible. Make sure the snap together feature is used to firmly join one piece to the next. Avoid using pieces that don't connect into at least one neighboring piece.
5. Backfilling: Once construction is complete, it is important to cover the edge restraint with stone topdress as indicated in drawings.

3.4 SAND SETTING BED

A. Moisture Content:

1. In the range of 4 to 8% when installed and uniform when screeded. Protect sand against rain when stockpiled on site prior to screeding.

B. Spreading:

1. Spread the bedding sand loose in a uniform layer to give a depth after compaction of the paving units of a minimum of 0.75 inch thickness and as required to achieve designed grades.

C. Screeding:

1. Carefully maintain the spread sand in a loose condition and protect against pre-compaction by traffic or rain both prior to and following screeding. Lightly screed sand in a loose condition to predetermined depth. Do not screed the sand in advance of the laying face to an extent to which paving will not be completed on that day. Bring screeded sand which is pre-compacted prior to laying of paving unit back to profile in a loose condition. Do not permit pedestrian or vehicular traffic on the screeded sand.
2. Screed the bedding sand using either an approved mechanical spreader or by the use of screed guides and boards.

3.5 SETTING PAVERS

A. General:

1. Do not install pavers with chips, cracks, voids, discolorations or other defects.

B. Pattern:

1. Lay the pavers in the pattern as indicated or as shown on approved Shop Drawings.

C. Color Blending:

1. Install paving units from a minimum of 3 bundles, simultaneously drawing the paver vertically rather than horizontally.

D. Joints:

1. Maintain a consistent joint spacing of approximately 0.125 inch, unless otherwise indicated. Provide this spacing also for the first row abutting the edge restraint. Where pavers have 0.125 inch setting nodes, set nodes tight to adjacent pavers.

E. Alignment:

1. Use string lines or chalk lines on bedding sand to hold pattern lines true.

F. Cutting:

1. Cut paving units only under the written approval of the Resident Engineer. Where cutting is approved, fill the gaps at the edge of the paving surface with manufactured edge pavers or with pavers cut to fit. Accomplish cutting to leave a clean edge to the traffic surface using a mechanical hydraulic, or guillotine cutter or masonry saw.
2. The use of infill concrete or discontinuities in patterns will not be permitted. Lay out pavers in all areas so as to eliminate slivers at edges.

G. Sweeping Clean:

1. Upon completion of cutting, sweep the area clean of debris to facilitate inspection and to ensure pavers are not damaged during compaction.

H. Inspection of Installed Pavers:

1. After sweeping and prior to compaction, inspect the paved area to ensure satisfactory color blending. Move pavers as necessary to achieve good color distribution.

I. Compaction:

1. After inspection of the paving unit installation, compact pavers to achieve consolidation of the sand bedding and achieve design levels and profiles by not less than 3 passes of a suitable plate compactor.

2. Accomplish compaction by the use of a plate compactor capable of a 5,000 pound compaction force.
3. Proceed with initial compaction as closely as possible following installation of the paving units and prior to acceptance of any traffic or application of sweeping sand.
4. Do not attempt compaction within 3 feet of the laying edge.

J. Paver Replacement:

1. Immediately remove and replace units which are structurally damaged during compaction.

K. Jointing Sand:

1. Spread the jointing sand over the pavement as soon as is practical after initial compaction and prior to the termination of Work on that day. Do not use wet sand.
2. Broom the jointing sand to fill the joints. Remove excess sand from the pavement surface and compact the pavers again to settle the jointing sand.

L. Final Compaction of Pavers:

1. After jointing sand has been installed and the pavement surface swept clean, accomplish final compaction by not less than two passes of the plate compactor.
2. Proceed with final compaction as closely as possible following installation of jointing sand and prior to the acceptance of any traffic.
3. Inspection by the Resident Engineer/COTR will determine whether a second application or partial application of jointing sand is required.

3.6 PROOF ROLL

- A. Proof roll the completed installation with pneumatic tire equipment which replicates anticipated service traffic. Subject each individual paver to at least one passage of load.
- B. Proof roll plaza areas with the equivalent of a 2,000 pound wheel load with a tire pressure of 50 psi.
- C. Proof roll road areas with the equivalent of a 5,000 pound wheel load with a tire pressure of 100 psi.
- D. Equipment and procedures are subject to approval by the Resident Engineer. Notify the Resident Engineer when proof rolling will be conducted.

- E. Remove and replace units which are cracked or otherwise damaged by proof rolling. Inspect and repair setting bed.
- F. ALLOWABLE TOLERANCE
- G. Finished surface: smooth, even, and true to the lines, grades and cross section indicated.
- H. Maximum deviation of finished surface when tested with a 10 foot straight-edge parallel to the centerline of the surfaced area: 0.5 inch in 10 feet.
- I. Maximum offset from flush from paver surface to paver surface or from paver surface to a fixed flush edge: 0.0625 inch.

3.7 REPAIR/RESTORATION

- A. Remove and replace pavers which are chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment to eliminate evidence of replacement.
- B. Clean concrete pavers after setting is complete; use procedures recommended by producer for types of application indicated.

3.8 FIELD QUALITY CONTROL

- A. Testing:
 - 1. Engage and independent Testing and Inspection Agency to perform field testing for quality control during construction as follows:
 - a. Field gradation analysis for setting bed and joint sand: ASTM D422.
 - b. Field density-in-place tests for aggregate base course. Make at least 4 tests in accordance with ASTM D2167 or other method approved by the Resident Engineer. Testing Agency report shall indicate location of each test.

3.9 CLEANING

- A. Sweep clean paved areas of excess sand and dirt.
- B. Pick up and remove from the site surplus materials, equipment and debris resulting from the work of this Section.

3.10 PROTECTION

Provide final protection and maintain conditions which ensure paver work being without damage or deterioration at time of substantial completion.

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SECTION 32 30 00
SITE FURNISHINGS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.

1.2 DESCRIPTION

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Furnish and install the Flower-watering stations, including trash receptacles, water spigot, and flower vase container and complete any required work necessary to make the water supply equipment operate using the water supply source indicated.

1.3 RELATED WORK

- A. The following items are not included in this Section and will be performed under the designated Sections:
1. Section 03 30 53: CAST-IN-PLACE-CONCRETE (SHORT FORM)

1.4 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:
1. General: For each item specified in description of work or Part 2 - Products, provide information showing complete detail, location in the project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors. Mark items requiring field assembly for erection identification and furnish erection drawings and instruction.
 2. Provide templates and rough-in measurements as required.
 3. Provide samples of full range of colors and finishes available for review and approval, prior to ordering.

1.5 REFERENCE STANDARDS

- A. The publications listed below form a part of this specification and the work shall comply with pertinent standards of the latest editions as specified below or by industry standards unless designated otherwise herein.
- B. American Society for Testing and Materials (ASTM):
- B221-08Aluminum and Aluminum-Alloy Extruded Bars, Rods,
Wire, Shapes, and Tubes
- C. American Welding Society (AWS):

D1.2-97..... Structural Welding Code Aluminum

D. National Association of Architectural Metal Manufacturers (NAAMM)

PART 2 - PRODUCTS

2.1 FLOWER WATERING STATIONS: GENERAL

Flower watering station materials, finishes and colors shall match existing or be deemed as approved equal.

2.2 TRASH RECEPTACLE

A. Trash receptacles shall completely meet the specifications and Contract Drawings or be approved as an equal. To achieve approval as an equal, submittal of a point by point comparison of the proposed equal product to the specifications and Contract Drawings is required by the Contractor during the submittal process. If the product being submitted for approval as an equal has any features that are different than the specifications and Contract Drawings, they must be identified in the submittal. If the differences result in a product that is deemed less than that specified and shown in the Contract Drawings, then the process for attempting approval as an equal shall NOT be performed during submittals. The product should be submitted with a variance request along with explanation of the differences, why they should be accepted and any cost or project completion factors shall be included.

B. Materials

1. Main body construction shall be 9.53mm x 25.4mm (3/8" x 1") vertical solid steel bar; 6.35mm x 63.5mm (1/4" x 2-1/2") horizontal solid steel bands; 9.53mm x 76.2mm (3/8" x 3") steel support bars; 15.88mm (5/8") solid steel top ring; leveling feet with a 9.53mm (3/8") diameter threaded steel shaft. All trash receptacles shall be signed to read "TRASH" as indicated on the details in the Contract Drawings. Sign material, finish, color, font and font size shall be as shown on the Contract Drawings. Mounting of signs shall be as shown on approved Shop Drawings. All joints of steel components shall be fully welded and ground smooth throughout.
2. Unit shall contain one 136 liter (36-gallon) capacity high density plastic inner liner with its weight not to exceed 2.72 kg (6 lbs.). The unit manufacturer shall provide the black plastic inner liners which shall be molded on tooling designed for and owned by the unit manufacturer. The inner liner shall offer maximum capacity and strength with lightweight construction using critical molded ribs, integral handholds, and high strength materials. This style of inner liner shall minimize handling difficulty and facilitate easy emptying and storage while affording long service life.

C. Required Options

1. Lids: Units shall be shipped with manufacturer's standard tapered formed lid with formed dome and with self-closing door. The lids shall be made of the manufacturer's standard high strength plastic material designed to match the selected manufacturer's standard color. Each lid shall be provided with a stainless steel aircraft cable and attachments to secure the lid to the unit.
2. Color shall match existing- Federal Standard 595 color FS 10140 "Brown Special"
3. Mounting plate: Standard (1) anchor bolt hole.

D. Finishes

1. All fabricated metal components are steel shotblasted, etched, phosphatized, preheated, and electrostatically powder-coated with TGIC polyester powder coatings. Products are fully cleaned and pretreated, preheated and coated while hot to fill crevices and build coating film. Coated parts are then fully cured to coating manufacturer's specifications.
2. The thickness of the resulting finish averages 8-10 mils (200-250 microns).

2.3 FLOWER VASE RECEPTACLE

- A. Flower vase receptacles shall completely meet the specifications and Contract Drawings or be approved as an equal. To achieve approval as an equal, submittal of a point by point comparison of the proposed equal product to the specifications and Contract Drawings is required by the Contractor during the submittal process. If the product being submitted for approval as an equal has any features that are different than the specifications and Contract Drawings, they must be identified in the submittal. If the differences result in a product that is deemed less than that specified and shown in the Contract Drawings, then the process for attempting approval as an equal shall NOT be performed during submittals. The product should be submitted for consideration as part of a variance request along with explanation of the differences, why they should be accepted and any cost or project completion factors shall be included.

B. Materials:

1. Flower vase receptacles shall be regularly produced by the manufacturer for use at VA Cemeteries, with a special light weight hinged lid designed for the VA Cemeteries. Flower vase receptacles shall be of the size indicated on the Contract Drawings, and shall be of the same construction, finish and indicated color as the trash receptacles.

2. Unit shall contain one high density plastic inner liner with its weight not to exceed 2.72 kg (6 lbs.). The unit manufacturer shall provide the black plastic inner liners which shall be molded on tooling designed for and owned by the unit manufacturer. The inner liner shall offer maximum capacity and strength with lightweight construction using critical molded ribs, integral handholds, and high strength materials. This style of inner liner shall minimize handling difficulty and facilitate easy emptying and storage while affording long service life. Four holes (4) shall be provided on a 6-inch radius equally spaced and six holes (6) on a 15-inch radius equally spaced for drainage.
3. All flower vase receptacles shall be signed to read "FLOWER VASES" as indicated on the details in the Contract Drawings.
4. The "Floral Regulations" decal shall be as indicated on the Contract Drawings and be factory applied to the top of the receptacle lid. Decal shall be pressure sensitive vinyl designed for outdoor use. The content of the decal, lettering color and background color of decal shall be as approved during the shop drawing process. The materials for the decal shall be regularly used by the manufacturer for flower vase receptacles at VA National Cemeteries.

2.4 WATER SPIGOT ASSEMBLIES

Water spigots shall match existing or be approved equal. Water spigot fountain shall be from a manufacturer with at least 5 years of experience producing similar products. The water spigot fountain assembly shall operate with an inlet water pressure of 275 kPa (40 psi) and shall include a pressure regulator installed on the supply line to the spigot prior to the connection to the spigot as well as an isolation valve, both of which shall be installed in a valve box as indicated on the drawings. The spigot shall be of cast aluminum with a long lasting paint coating system, applied to a sand blasted aluminum, with a primer coat and finish coat that matches the Victor Stanley Bronze. The water spigot shall operate with a handle, be self-closing, and operate with 2 Kg (5 lbs). of force or less when the water pressure to the spigot is provided at 275 kPa (40 psi) or less. The outlet for the spigot shall be plain end, with no threads (preferred configuration) or shall include a vacuum breaker on the outlet if the end is threaded. The final approved configuration, including the mounting method, shall be as approved during the submittal process.

PART 3 - EXECUTION

3.1 INSPECTION

Prior to installation of any of the work in this section, contractor shall inspect the planned installation locations to insure that conditions are not significantly different from those indicated on the contract drawings. All materials shall be inspected prior to installation to insure compliance with the contract documents and to insure there is no damage. Should conditions be different from those indicated on the contract documents, contractor should immediately notify the Resident Engineer (RE)/Contracting Officer's Technical Representative (COTR).

3.2 PREPARATION

- A. Stake alignment and locations for all site furnishings for review and approval by RE/COTR. Verify that all elements in this section "fit" within location provided.
- B. Install items rigid, plumb and true to lines and levels shown.
- C. Assemble (if required) and install items as per manufacturer's printed instructions, or approved shop drawings, unless otherwise specified or shown.

3.3 INSTALLATION

- A. Flower Watering Stations:
 - 1. Stake location of flower watering stations and obtain approval from Owner's Representative prior to forming concrete pad. Install concrete pad in accordance with 03 30 53 - CAST-IN-PLACE CONCRETE.
 - 2. Anchor trash receptacle and flower vase containers as shown on the Contract Drawings and following the manufacturer's recommended installation instructions.
 - 3. Install water spigot assemblies according to manufacturer's recommendations, including pipe, isolation valve, fittings, pressure reducing valve and valve boxes. Coordinate all work with other trades.

3.4 CLEAN UP

Clean up area of excess material and debris. Clean above ground portions of all receptacles and other site improvements.

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SECTION 32 84 00
PLANTING IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Contractor is responsible for providing a system with full and complete coverage. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the irrigation system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

1. Procurement of all applicable licenses, permits, and payment of required fees.
2. Coordination of Utility Locates with Contracting Officer's Technical Representative.
3. Maintenance period.
4. Sleeving for irrigation pipe and wire.

1.2 RELATED WORK

- A. Section 32 90 00, PLANTING
- B. Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM): spigot post

1.3 QUALITY ASSURANCE

A. Contractor:

1. Irrigation Contractor must have demonstrated, using persons directly employed by the Contractor, experience with the installation of at least five (5) irrigation systems having large diameter gasketed pipe (6-inch and larger), electrically operated remote control valves, and irrigation central control.

B. Equipment Manufacturer:

1. Manufacturer regularly and presently manufactures the item as one of their principal products.

C. System Requirements:

1. Full and complete coverage is required. Contractor shall, at no additional cost to the Government, make necessary adjustments to layout required to achieve full coverage of irrigated areas.
2. Layout work as closely as possible to drawings. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown.

1.4 SUBMITTALS

- A. Make submittal and provide number of copies per Specification Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Unless otherwise noted,

provide four (4) copies of irrigation information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled for valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings and all other irrigation equipment shown or described on the drawings and within these specifications. Highlight items being supplied on the catalog cut sheets. Submittal package must be complete prior to being reviewed by the Contracting Officer's Technical Representative. Incomplete submittals will be returned without review.

- B. Materials List: Include all materials and products that are part of the irrigation system including, but not limited to: pipe, fittings, valves, mainline components, water emission components, and control system components. Quantities of materials need not be included.
- C. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on the materials list.
- D. Shop Drawings: Submit shop drawings called for in the installation details. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to the installation detail.
- E. Testing: Submit a proof of testing report following completion of each test listed in Part 1 of these specifications. Unless otherwise noted, include name of test, date of test, name of the individual completing the test, name of the company completing the test and a summary of the test results. If system fails test, document any and all retests until system passes test.
- F. Maintenance and Operation Instructions: Submit information listed in Part 3 of these specifications.
- G. As-built Drawings: Submit information listed in Part 3 of these specifications.

1.5 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. Federal Specifications (Fed. Spec.): RR-F-621E Frames, Covers, Gratings, Steps, Sump And Catch Basin, Manhole
- C. American National Standard Institute (ANSI):
 - 1. A21.4-Cement-Mortar Lining/Cast and Ductile Iron Pipe and Fittings
 - 2. B40.1-91Gauges-Pressure Indicating Dial Type Elastic Element
- D. American Society of Agricultural Engineers (ASAE):
 - 1. S398 Sprinkler Testing and Performance Reporting.
- E. American Society for Testing and Materials (ASTM):

1. B61-93 Steam or Valve Bronze Castings
2. B62-93 Composition Bronze or Ounce Metal Castings
3. C857 Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
4. C858 Specification for Underground Precast Concrete Utility Structures
5. C891 Practice for Installation of Underground Precast Concrete Utility Structures
6. D1785-91 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120
7. D2241-89 Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
8. D2287-81 Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
9. D2464-91 Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
10. D2466-90 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
11. D2564-94 Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe And Fittings
12. D2855-90 Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
13. F477-90 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
14. F656-08 Primers for Use In Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

F. American Water Works Association (AWWA):

1. C104 Cement-Mortar Lining/Cast and Ductile Iron Pipe and Fittings
2. C110-93 Ductile-Iron and Gray-Iron Fittings, 3-Inch Through 48-Inch for Water and Other Liquids
3. C111-90 Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe Fittings.
4. C115-94 Flanged and Ductile Iron and Gray Iron Pipe with Threaded Flanges
5. C151-93 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids
6. C153-94 Ductile-Iron Compact Fittings, 3 Inch Through 12-Inch for Water and Other Liquids.
7. C500-93 Gate Valves for Water and Sewerage Systems
8. C504-87 Rubber Sealed Butterfly Valves
9. C600-93 Installation for Ductile-Iron water Mains and Their Appurtenances

10.C901-02 Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm)
Through 3 In. (76 mm), for Water Service

G. Manufacturers Standardization Society (MSS):

1. SP70-90 Cast Iron gate Valves, Flanged and Thread Ends

H. National Electrical Manufacturers Association (NEMA):

1. 250-85 Enclosures for Electrical Equipment (1000 Volts Maximum);
Revision 1, May 1986

I. National Electric Code: (latest edition)

J. Uniform Plumbing Code: (latest edition)

1.6 RULES AND REGULATIONS

- A. Work and materials will be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only. It is the Contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

1.7 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The government shall make NO utilities available to the Contractor from existing outlets and supplies except as follows. Upon completion of the irrigation system or completion of portions thereof, the contractor through the connection of the new irrigation system to the potable water system, shall be provided water for flushing and testing of the new irrigation system. Once the system is deemed operable and approved, and prior to the final inspection, the contractor may use water at no cost through the irrigation system for establishing turf and maintaining plant material. No other expressed or implied uses of government furnished water exist.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the Resident Engineer/Contracting Officer's Technical Representative (COTR), shall install and maintain all necessary temporary connections and distribution lines, and meters required by the public utilities. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated appurtenances.

1.8 TESTING

- A. Notify the Contracting Officer's Technical Representative five working days in advance of testing.
- B. Subject pipelines jointed with rubber gaskets or threaded connections to a pressure test after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints will be allowed to cure at least 24 hours before testing.
- C. Subsections of mainline pipe may be tested independently, subject to the review of the Contracting Officer's Technical Representative.
- D. Furnish clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests.
- E. Hydrostatic Pressure Test - Solvent Weld Lateral Pipe:
 - 1. Subject lateral pipe to a hydrostatic pressure equal to the anticipated operating pressure for 30 minutes.
 - 2. Cap all risers.
 - 3. Backfill to prevent pipe from moving under pressure. Expose all joints, couplings and fittings.
 - 4. Leakage will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
 - 5. As an alternative to the visual inspection described in Item 4. above, the Contracting Officer's Technical Representative may request that a pressure drop test be performed:
 - a. Purge air from pipe before test. Attach pressure gauge to a riser in the middle of the lateral. Cap all sprinkler risers.
 - b. Pressurize the lateral via the remote control valve then turn down flow control handle on remote control valve to seal off lateral.
 - c. Observe pressure loss on pressure gauge. If pressure loss is greater than 5 PSI, identify reason for pressure loss. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until pressure loss is equal to or less than 5 PSI.
 - 6. Cement or caulking to seal leaks is prohibited.
 - 7. After lateral passes test and prior to operational test, install sprinklers and backfill and compact all pipe, fittings, joints, or appurtenance.
- F. Operational Test - Remote Control Valves, Lateral Piping and Sprinklers:
 - 1. Activate each remote control valve in sequence from each controller. Manual operation of the valves from the bleed valve on the remote control valve is not an acceptable method of activation. The Contracting Officer's Technical Representative will visually observe operation, water application patterns, and leakage.

2. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
3. Replace, adjust, add, or move water emission devices to correct operational or coverage deficiencies.
4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
5. Repeat test(s) until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.

G. Control System Grounding:

1. Test for proper grounding of control system per manufacturer's recommendations. Test results must meet or exceed manufacturer's guidelines for acceptance.
2. Replace defective wire, grounding rod or appurtenances. Repeat the test until the manufacturer's guidelines are met.
3. If the test is acceptable, the individual completing the test must document the results of the grounding test via a written report.
4. A written report of the test data listing controller number or location, date of test, name of the individual completing the test, name of the company completing the test and the ohms resistance to ground for each controller must be submitted to the Contracting Officer's Technical Representative.

H. Acceptance Test Prior to Final Inspection:

1. Upon completion of construction and prior to Final Inspection, an Acceptance Test must be passed.
2. Coordinate start of Acceptance Test with Contracting Officer's Technical Representative.
3. During the Acceptance Test, the irrigation system must be fully operational from the control system. The irrigation system must operate with no faults for 14 consecutive days. If at any time during the 14 day test period, a system fault occurs, the source of the fault must be determined and corrected and the 14 day evaluation period will start again. If a system fault occurs, make repairs within 72 hours of notification from Contracting Officer's Technical Representative. Document any faults in the proof of test report listing date of fault, fault, cause of the fault and the corrective action taken.
4. When the system has operated for 14 days without fault, contact the Contracting Officer's Technical Representative to schedule Final Inspection.

1.9 CONSTRUCTION REVIEWS

- A. The purpose of on-site reviews by the Contracting Officer's Technical Representative is to periodically observe the work in progress, the Contractor's interpretation of the construction documents, and to address questions with regard to the installation.
 - 1. Schedule reviews for irrigation system layout or testing with the Contracting Officer's Technical Representative as required by these specifications.
 - 2. Impromptu reviews may occur at any time during the project.
 - 3. A Final Inspection will occur at the completion of the irrigation Acceptance Test. The intent of the Final Inspection is to verify that all installation; testing; maintenance and operation submittals; and project as-built drawing submittals are completed prior to the start of the Maintenance and Guarantee/Warranty periods.
 - 4. All costs, including travel expenses and site visits by the Veterans Administration representative(s) for additional Inspection(s) that may be required after the Final Inspection due to non-compliance with the Construction Documents are the sole responsibility of the Contractor.

1.10 GUARANTEE/WARRANTY AND REPLACEMENT

- A. The purpose of this guarantee/warranty is to insure that the Government receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.
- B. Guarantee/warranty irrigation materials, equipment, and workmanship against defects for a period of one year from Final Inspection by Contracting Officer's Technical Representative. Fill and repair depressions. Restore landscape, utilities, structures or site features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by construction or a defective item. Make repairs within 72 hours of notification from Contracting Officer's Technical Representative.
- C. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to the contract price.
- D. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

1.11 GENERAL CONSTRUCTION REQUIREMENTS

- A. Coordinate construction of irrigation system with Contracting Officer's Technical Representative and Cemetery Staff. See irrigation plans and installation details for required coordination efforts related to the installation of specific irrigation components.

- B. Control of Excavations: See Section 3.3 for safety and access directions.
- C. Install mainline and wiring sleeving under new roads prior to installation of road base.
- D. Install irrigation components in landscaped areas only.
- E. Construction cannot proceed unless staking of irrigation mainline, remote control valve locations, and sprinkler locations are reviewed and accepted by the Contracting Officer's Technical Representative.

PART 2 - MATERIALS

2.1 QUALITY

Use new materials without flaws or defects.

2.2 SUBSTITUTIONS

- A. Unless noted otherwise, use specified equipment. Contracting Officer's Technical Representative must approve equipment prior to construction. The Contractor through written request prior to purchase or installation may request substitutions to the approved equals listed herein. Changes and associated design costs to accommodate alternative equipment are Contractor's responsibility.
- B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at Contractor's option.

2.3 SLEEVING

- A. Provide sleeve beneath hardscape for irrigation pipe and wiring.
Provide separate sleeve beneath hardscape for wiring.
- B. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
- C. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241 for mainline pipe, lateral pipe and wiring sleeves.
- D. Mainline and lateral pipe sleeves are as shown on the drawings.
- E. Install separate control wiring sleeves. Wiring bundle contained in the sleeve should not exceed 40% of the available area within the sleeve per NEC recommendations.

2.4 PIPE AND FITTINGS

- A. Mainline Pipe and Fittings:
 - 1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.

2. Use Sch 40, conforming to dimensions and tolerances established by ASTM Standard D1785.
3. Use solvent weld pipe for mainline pipe under 3". Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Primer for use with solvent cement to conform to ASTM F656. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

B. Lateral Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end suitable for solvent welding.
2. Use Sch 40, conforming to dimensions and tolerances established by ASTM Standard D1785.
3. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Primer for use with solvent cement to conform to ASTM F656. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

C. Specialized Pipe and Fittings:

1. Joint sealant: Use only teflon-type tape or teflon based paste pipe joint sealant on plastic threads. Use nonhardening, nontoxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

2.5 MAINLINE COMPONENTS

A. Isolation Gate Valve Assembly:

1. As presented in the installation details.
2. Iron body, bronze mounted, double disc with parallel or inclined seats, non-rising stem turning clockwise to close, 200 PSI minimum working pressure. AWWA C509. Acceptable manufacturers are Clow, Kennedy, Mueller, Waterous or approved equal.
3. Valve Box: Use plastic (ABS) 10-inch round valve box with black lid. Acceptable manufacturer is Brooks Products or approved equal.
4. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

B. Quick Coupling Valve Assembly:

1. As presented in the installation details.
2. Brass construction, 1-inch nominal size, operating pressure 5-125 PSI with locking rubber or vinyl cover. Acceptable manufacturer and model is to match existing or approved equal.

3. Swing Joint: Use pre-manufactured triple swing joint. Acceptable manufacturer is Spears, Lasco or approved equal.
 4. Quick Coupler Anchor: Use pre-manufactured bolt on anchor. Acceptable manufacturer is Harco or approved equal.
 5. Valve Box: Use plastic (ABS) 10-inch round valve box with black lid. Acceptable manufacturer is Brooks Products or approved equal.
 6. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.
- C. Flower Water Station Hydrant Connection Assembly:
1. As presented in the installation details.
 2. Yard Hydrant: Self-closing plain end bib faucet with rough brass finish and a special extended lever handle that is locked to valve. Acceptable manufacturer and model is Haws 6252EHLF to match existing.
 3. Curb Stop Valve: Brass body, 300 PSI minimum working pressure. ASTM B-62, female threaded connections, with stop and waste feature. Acceptable manufacturers are Ford, Mueller, A.Y. McDonald or approved equal.
 4. Inline pressure regulator: 40-45 PSI, 1-inch inlet and outlet. Acceptable manufacturers and models are Rain Bird PSI-M40X-100 and Senniger Model PSR-40 or approved equal.
 5. Valve Box: Use F8 concrete curb valve box with cast iron lid sized 8" ID x 12". Valve box must be capable of being face anchored in concrete. Acceptable manufacturer is Christy Concrete Products or approved equal.

2.6 POINT SOURCE DRIP IRRIGATION COMPONENTS

- A. Drip Remote Control Valve Assembly:
1. As presented in the installation details.
 2. Remote Control Valve: Use a normally closed 24 VAC 50/60 cycle solenoid actuated globe pattern design. The valve pressure rating will not be less than 200 PSI. The valve body and bonnet will be constructed of brass and have stainless steel studs and flange nuts. The valve will have both internal and external manual open/close control (internal and external bleed) to manually open and close the valve without electrically energizing the solenoid. The valve's internal bleed will prevent flooding of the valve box. The valve will have a pressure regulation module to regulate outlet pressure as specified. Acceptable manufacture Superior to match existing.
 3. PVC Ball Valve: Use a compact ball rated to 235 PSI. Use valve with safe-t-blocked seal carrier (full rated pressured) safe-t-shear stem, and self adjusting floating seat. Acceptable manufacturer is Spears or approved equal.

4. PVC Union: Use a Schedule 40 threaded union with O-ring seal. Acceptable manufacturer is Spears or approved equal.
 5. Pressure Regulator: Use a normally-open pressure regulating device with preset outlet pressure of approximately 40 PSI. Body is to be constructed of glass filled, UV-resistant polypropylene, with a 120 PSI operating pressure rating. Acceptable manufacturer is Rain Bird or approved equal.
 6. Compact Y filter: Use y-style filter with removable screen. Body is to be constructed of glass filled, UV-resistant polypropylene, with 120 PSI operating pressure rating. Screen is to be 200 mesh constructed of durable polyester fabric attached to propylene frame. Screen is serviceable for cleaning purposes by unscrewing cap from filter body and removing filter element. Acceptable manufacturer is Rain Bird or approved equal.
 7. Valve Boxes: Use plastic (ABS) standard valve boxes with black lid. Acceptable manufacturer is Brooks Products or approved equal.
 8. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.
 9. Install assembly over gravel sump as presented in the installation details.
 10. Wire connectors: Use 3M DBR/Y-6.
 11. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background.
- B. Drip Emission device
1. As presented in the installation details.
 2. Single-outlet emitters: Use ½" treaded inlet emitter. Emitter to be constructed of UV resistant acetyl materials. Self-flushing with consistent flow rate of 0.6 GPH, 1.0 GPH, or 2.0 GPH (depending on model. Acceptable manufacture is Bowsmith to match existing.
 3. Multiple-outlet emitters: Use ½" treaded inlet emitter with 6 barbed outlet ports. Emitter to be constructed of UV resistant acetyl materials. Self-flushing with consistent flow rate of 0.6 GPH, 1.0 GPH, or 2.0 GPH (depending on model. Acceptable manufacture is Bowsmith to match existing.

2.7 CONTROL SYSTEM COMPONENTS

A. Control Units:

1. Description: Pedestal mount, 36 station controller. Acceptable manufacturer is Weathermatic SL Series to match existing.
2. Basic Capabilities:
 - a 100% solid state electrical components with heavy duty electrical surge protection for input and output circuits.

- b 24 VAC transformer.
 - c Built in lightning and surge protection.
 - d Battery backup of at least 14 days.
 - e Manual activation of remote control valves from hand held radio.
 - f Minimum number of stations as shown on the drawings. Maximum number of stations is 48.
 - g Use pedestal mount configuration.
- 3. Electrical conduit: Use PVC Schedule 40 conforming to the dimensions and tolerances established by ASTM Standard D-1785. Fittings for PVC conduit will be Schedule 40, Type 1, PVC solvent weld fittings, ASTM Standards D2466 and D1784.
 - 4. Wire markers: Prenumbered or labeled with indelible nonfading ink, made of permanent, nonfading material.
 - 5. Lightning protection: Provide one ground plate, earth contact enhancement material, one copper clad UL listed grounding rod, approximately 30 feet of #6 AWG bare copper grounding wire, 6-inch plastic round valve box and CADWELD connectors at each control unit per installation detail.
- B. Controller Wire:
- 1. Use American Wire Gauge (AWG) #14-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for individual control wires and spare control wires from the controller assembly to each remote control valve or stub-out location.
 - 2. Use American Wire Gauge (AWG) #12-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for common ground wire and spare common wires from controller assembly to each remote control valve or stub-out location.
 - 3. Color: Wire color must be continuous over its entire length.
 - 4. Splices: Use 3M DBR/Y-6 splices.
 - 5. Valve Box: Use plastic (ABS) standard rectangular valve with black lid. Acceptable manufacturer is Brooks Products or approved equal.
 - 6. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide colored red and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW", in black lettering.

2.8 OTHER COMPONENTS

- A. Tools and Spare Parts: Provide operating keys, servicing tools, spare parts and other items indicated in the General Notes of the drawings.
- B. Other Materials: Provide other materials or equipment shown on the drawings or installation details that are part of the irrigation system,

even though such items may not have been referenced in these specifications.

PART 3 - EXECUTION

3.1 INSPECTIONS AND REVIEWS

A. Site Inspections:

1. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the Contracting Officer's Technical Representative prior to beginning work.
2. Beginning work of this section implies acceptance of existing conditions.

B. Utility Locates ("Call Before You Dig"):

1. Arrange for and coordinate with cemetery maintenance staff the location of all underground utilities.
2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.

C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking has been completed. Notify the Contracting Officer's Technical Representative one week in advance of review. The Contracting Officer's Technical Representative will identify modifications during this review.

3.2 LAYOUT OF WORK

- A. Stake locations of alley and sprinklers in burial sections using a licensed surveyor. Use alleys as identified on the drawings.
- B. Stake out the irrigation system. Items staked include: irrigation mainline pipe, thrust blocks, isolation gate valve assemblies, air/vacuum relief valve assemblies, quick coupling valves, remote control valves, lateral piping, and sprinklers.
- C. If staked irrigation components conflict with utilities or other components or site features, coordinate rerouting of components with Contracting Officer's Technical Representative.

3.3 EXCAVATION, TRENCHING, AND BACKFILLING

- A. Excavate to permit the pipes to be laid at the intended elevations and to permit workspace for installing connections and fittings.
- B. Survey Markers:
 1. Protect markers during construction.
 2. If a survey marker is disturbed during construction, the Contractor is responsible for replacing the marker. The Contractor must hire a licensed surveyor to resurvey the location of the marker and replace it.

C. Minimum cover:

1. 24-inches over irrigation mainline pipe in landscaped areas.
(distance from top of pipe to finish grade)
2. 18-inches over irrigation lateral pipe in landscaped areas (distance from top of pipe to finish grade)
3. 18-inches over control wire conduit when not in common trench with mainline or lateral piping. (distance from top of control wire to finish grade)
4. 10-inches vertical separation between lateral and mainline pipe installed in a common trench.
5. 2-inches minimum horizontal separation between pipes and wiring in a common trench.
6. Install sleeves at depth to maintain specified depth of pipe or wire routed through sleeve.

D. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the Contracting Officer's Technical Representative.

E. All excavations must be backfilled by the end of each workday. Do not leave any open trenches overnight, on weekends or on holidays.

F. If trenching operation restricts access to a burial section, provide plywood and safety fencing across open trench to allow access to burial section. Provide access to the satisfaction of the Contracting Officer's Technical Representative.

G. Excavated material is generally satisfactory for backfill. Backfill will be free from rubbish, vegetable matter, frozen materials, and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe will be free of sharp objects that may damage the pipe.

H. Enclose pipe and wiring beneath roadways, walks, curbs, etc in sleeves. Backfill sleeves in the following manner:

1. Backfill trench using excavated material in 6-inch layers. Minimum compaction of backfill for sleeves shall be a minimum 95% Standard Proctor Density, ASTM D698-78. Backfill to bottom of road base under roads or to finish grade under walks and curbs.

I. Backfill mainline pipe, lateral pipe and wiring in turf areas in the following manner:

1. Backfill the trench by depositing the backfill material equally on both sides of the pipe or wire in 6-inch layers and compacting to the density of surrounding soil.

J. Enclose pipe and wiring beneath roadways, walks, curbs, etc., in sleeves.

- K. Dress backfilled areas to original grade. Remove excess backfill to on-site location as directed by the Contracting Officer's Technical Representative.
- L. Where utilities conflict with irrigation trenching and pipe work, contact the Contracting Officer's Technical Representative for trench depth adjustments.

3.4 SLEEVING AND BORING

- A. Install sleeving at a depth that permits the encased pipe or wiring to remain at the specified burial depth.
- B. Extend sleeve ends a minimum of 12-inches beyond the edge of the paved surface. Cover pipe ends and mark edge of pavement with a chisel or saw.
- C. Verify that sleeve sizing is adequate prior to installation. Note that sleeves required for pipe with restrained casing spacers are larger than twice the diameter of the pipe.

3.5 ASSEMBLING PIPE AND FITTINGS

- A. General:
 - 1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.
 - 2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
 - 3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 20-foot length of mainline and lateral pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

SIZE	RADIUS	OFFSET PER 20' LENGTH
1 ½"	25'	7'-8"
2"	25'	7'8"
2 ½"	100'	1'-11"

- B. Mainline Pipe and Fittings:
 - 1. PVC Solvent Weld Pipe:

- a Use primer and solvent cement. Join pipe in manner recommended by manufacturer and in accordance with accepted industry practices.
 - b Cure for 30 minutes before handling and 24 hours before pressurizing or installing with vibratory plow.
 - c Snake pipe from side to side within trench.
- 2. Fittings: The use of cross type fittings is not permitted.
- C. Lateral Pipe and Fittings:
 - 1. PVC Solvent Weld Pipe:
 - a Use primer and solvent cement. Join pipe in manner recommended by manufacturer and in accordance with accepted industry practices.
 - b Cure for 30 minutes before handling and 24 hours before pressurizing or installing with vibratory plow.
 - c Snake pipe from side to side within trench.
 - 2. Fittings: The use of cross type fittings is not permitted.
- D. Specialized Pipe and Fittings:
 - 1. PVC Threaded Connections:
 - a Use only factory-formed threads. Field-cut threads are not permitted.
 - b Apply thread sealant in manner recommended by component, pipe and sealant manufacturers and in accordance with accepted industry practices.
 - c Use plastic components with male threads and metal components with female threads where connection is plastic-to-metal.

3.6 INSTALLATION OF MAINLINE COMPONENTS

- A. Isolation Gate Valve Assembly:
 - 1. As presented in the installation details, per manufacturer's instructions.
 - 2. Install where indicated in the irrigation plans.
 - 3. Brand "GV" in 2-inch high by 3/16-inch deep letters on valve box lid.
- B. Quick Coupling Valve Assembly:
 - 1. As presented in the installation details, per manufacturer's instructions.
 - 2. Install where indicated in the irrigation plans.
 - 3. Brand "QC" in 2-inch high by 3/16-inch deep letters on valve box lid.
- C. Flower Watering Station Hydrant Connection Assembly:
 - 1. As presented in the installation details, per manufacturer's instructions.
 - 2. Sequence of construction:
 - a Coordinate exact location with Contractor Officer Technical Representative.

- b Components up to and including copper pipe are to be installed before concrete components. After concrete components is finished, complete installation of remaining components. Coordinate installation with concrete contractor.

3.7 INSTALLATION OF POINT SOURCE DRIP IRRIGATION COMPONENTS

A. Remote Control Valve Assembly:

1. Mainline Flushing:

- a. Thoroughly flush mainline before installation of Remote Control Valve Assemblies.
 - b. Identify remote control valve service tee(s) to be used for mainline flushing. Plug service tees not being used for flushing.
 - c. Connect 2-inch pipe to flushing service tee(s). Use pipe to direct water away from trench and into drainage swale, curb section or storm sewer, i.e. to an area that will direct the water away from the work area. Direct water so that it does not disrupt the cemetery operations.
 - d. Use a volume of water such that the velocity in the largest pipe flushing to this point is 3 FPS.
 - e. Multiple points may be flushed simultaneously.
 - f. Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.
 - g. Contracting Officer's Technical Representative will review the flushing operation and clarity of water before stopping the flushing operation.
 - h. Disconnect pipe from service tee(s) and install remote control valve(s).
- 2. Install per manufacturer's recommendations where indicated on the drawings.
 - 3. Use wire connectors and waterproof sealant to connect control and common wire to solenoid wires. Install connectors and sealant per the manufacturer's recommendations.
 - 4. Install only one remote control valve or wye strainer/pressure reducer to a valve box. Locate valve box 5-feet from and align square with nearby edges of paved areas.
 - 5. Attach ID tag with controller station number to control wiring at solenoid.
 - 6. Brand controller and station number in 2-inch high by 3/16-inch deep letters on valve box lid.
 - 7. Install per the installation details at locations shown on the drawings.

B. Point Source Drip Emission Device Assembly:

1. Lateral Flushing:

- a. Thoroughly flush laterals before installation of emitters.
 - b. Utilize specified flush valves and additional open emitter risers as needed to completely purge laterals of debris.
 - c. Use pipe to direct water away from trench and into drainage swale, curb section or storm sewer, i.e. to an area that will direct the water away from the work area. Direct water so that it does not disrupt the cemetery operations.
 - d. Use a volume of water such that the velocity in the largest pipe flushing to this point is 3 FPS.
 - e. Multiple points may be flushed simultaneously.
 - f. Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.
 - g. Contracting Officer's Technical Representative will review the flushing operation and clarity of water before stopping the flushing operation.
2. Install per manufacturer's recommendations where indicated on the drawings.

3.8 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Control Units:

1. Install control unit at location shown in construction documents. Control unit to be installed in pedestal mounted outdoor enclosure per installation detail.
2. Install electrical connections per control system manufacturer's recommendations. Electrical connections are to be completed by control system manufacturer's trained representative.
3. Lightning protection: Install per installation detail. Drive grounding rod into soil its full length. Connect #6 AWG copper grounding wire to rod and plate using CADWELD connections. Connect to control unit dedicated ground terminal.
4. Connect control wire to the corresponding control unit terminals.

B. Control Wire:

1. Provide a 24-inch excess length of wire in an 8-inch diameter loop at each 90 degree change of direction, at both ends of sleeves, and at 100-foot intervals along continuous runs of wiring. Do not tie wiring loop. Coil 24-inch length of wire within each remote control valve box.
2. If a cable must be spliced, use waterproof wire connectors and sealant installed per the manufacturer's instructions. Locate splice in turf areas using a valve box that contains an irrigation valve

assembly, or in a separate valve box. Use same procedure for connection to valves as for in-line splices. If a separate valve box is used for wire splices, brand "WS" in 2-inch high by 3/16-inch deep letters on valve box lid.

3. Unless noted on plans, install wire parallel with and below mainline pipe.
4. Protect wire not installed with PVC mainline pipe with a continuous run of warning tape placed in the backfill 6-inches above the wiring.

3.9 INSTALLATION OF OTHER COMPONENTS

A. Tools and Spare Parts:

1. Prior to the Review at completion of construction, provide operating keys, servicing tools, spare parts, and any other items indicated on the drawings.

B. Other Materials: Install other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

3.10 MAINTENANCE AND OPERATION INSTRUCTIONS

A. Irrigation System Maintenance:

1. Prior to Final Inspection, provide one-day training session to operating personnel on proper operation and maintenance of the irrigation system. Training session should be for a period of not less than 8-hours and cover aspects of maintaining, operating and repairing the new irrigation system components.
2. Unless otherwise noted, provide irrigation operation and maintenance information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled. Provide the following information:
 - a. Catalog cut sheets for control system, valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings, and all other irrigation equipment shown or described on the drawings and within these specifications.
 - b. Manufacturer's Operation and Maintenance manuals.
 - c. Manufacturer's Technical Service Bulletins.
 - d. Manufacturer's Warranty Documentation.
 - e. Recommended routine maintenance inspections for weekly, monthly and annual inspections and recommended actions for the inspections and a recommended method for recording the findings of the inspections.
 - f. Predictive schedule for component replacement.
 - g. Listing of technical support contacts.

3. Operation and maintenance submittal package must be complete prior to being reviewed by the Contracting Officer's Technical Representative. Incomplete submittals will be returned without review.

B. Control System Programming:

1. Contractor to verify or enter historic ET rate data for irrigation season.
2. Contractor responsible to program each controller with a peak season irrigation schedule for the areas being irrigated by the controller.
3. Using the precipitation rate results of the Distribution Uniformity tests calculate the peak season run time for each station.
4. Verify operation of program.
5. Prepare a memorandum documenting the details and assumptions of the programming. Turn over memorandum to Contracting Officer's Technical Representative. Completion of the memorandum is a prerequisite for final inspection and operational testing of the irrigation system.
6. Program must be created by manufacturer's training personnel or an individual with documented experience in programming the control system. Provide documentation of programming experience if requested by the Contracting Officer's Technical Representative.

3.11 Colored Controller Charts:

- A. Draft using a CADD program. Each type of sprinkler to have a unique color. All pipe within a zone, and the control valve for that zone are to be of a single color, distinguished from the colors of adjacent zones.
- B. On this drawing include a table that lists for each zone:
 1. Zone number, coordinated with indication on as-built drawing
 2. Remote control valve size
 3. Sprinkler complement (model, quantity, nozzle)
 4. Regulated discharge pressure of remote control valve
 5. Flow
 6. Precipitation rate, inches per hour
 7. Initial schedule (minutes per cycle, days/week, and application depth per cycle)
- C. Draft of chart to be submitted prior to the request for final inspection. Correct all missing or incorrect information on charts during final inspection. Submit for final approval subsequent to final inspection. Upon approval by Contracting Officer's Technical Representative, deliver laminated chart and PDF of chart to Contracting Officer's Technical Representative for cemetery use.

3.12 PROJECT AS-BUILT DRAWINGS

- A. The Contractor is responsible for documenting installed system and all changes to the design. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.
- B. Record irrigation components, pipe and wiring network alterations. Record work that is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system valve, each controller or control unit, each stub-out for future pipe or wiring connections, and other irrigation components enclosed within a valve box.
- C. Prior to project completion label each sheet of the project drawings (redlines) as "As-built Drawing" and turn over to Resident Engineer/COTR for delivery to A/E. Completion of the As-built Drawings is a prerequisite for Final Inspection.

3.13 MAINTENANCE

Operate and maintain irrigation system for a duration of 30 calendar days from Final Inspection. Make periodic examinations and adjustments to irrigation system components so as to achieve the most desirable application of water.

3.14 CLEANUP

Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish. Restore site to normal or original condition.

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SECTION 32 90 00
PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION AND REQUIREMENTS

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.

1.2 EQUIPMENT

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 01 45 29, TESTING LABORATORY SERVICES, Topsoil Testing.
- B. Section 31 20 11, EARTH MOVING (SHORT FORM), rough grading.
- C. Section 32 84 00, PLANTING IRRIGATION.
- D. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- E. Section 32 30 00, SITE FURNISHINGS
- F. Section 32 95 16, STONE TOPDRESS, Decomposed Granite Mulch and Flower Strip Gravel
- G. Section 32 14 13, PRECAST CONCRETE UNIT PAVING, Steel Edge Restraint

1.4 SUBMITTALS

- A. Samples: Submit the following samples for approval before work is started:
 - 1. Plant Materials: Plant material: Sources and nursery purchase order agreements for each specified plant. Inspection and tagging may be completed by the Resident Engineer/COTR.
 - 2. In addition, plant samples or digital photos of plants may be requested in lieu of inspection. Digital photos must have, included in the image, a visual reference relative to the landscape subject.
 - 3. Decomposed Granite topdress: See Section 32 95 16, STONE TOPDRESS
 - 4. Staking and guying material.

5. For 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 must be submitted.
 6. Topsoil: see paragraph 1.4.E.
- 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/COTR 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). Submit vendor invoice for each plant shipment showing sizes, quantities and root treatment.
 2. Fertilizers.
 3. Lime
 4. Peat
 5. Membranes
- C. Manufacturer's Literature and Data:
1. Antidesiccant
 2. Erosion control materials
- D. Licenses: Licenses of Arborist shall be submitted (one copy), to the Resident Engineer/COTR.
- E. 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. Imported Topsoil for Planting Soil Mixture: 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/COTR. 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 01 45 29, 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 plant growth.
 - f. All tests shall be performed in accordance with the current standards of the Association of Official Agricultural Chemists.
2. Fertilizer: Submit four (4) certificates of analysis for each type of fertilizer.

F. Schedules:

- 1. Upon authorization to proceed with the work, submit a project work schedule indicating the dates of each of the following items:
 - a. Tagging of plants in nurseries
 - b. Delivery of other materials to the site
 - c. Staking of plant locations on the site
 - d. Delivery of plant material to the site
 - e. Planting
 - f. Substantial completion of the work.

G. Maintenance Instructions:

- 1. Prior to the end of the Warranty Period, submit three copies of typewritten instructions for annual maintenance of the landscape including cultivation, irrigation, fertilization, pest and weed control, and pruning.
- 2. Submit Maintenance Report Forms immediately following completion of each maintenance visit for items outlined in Part 3.3 of this Section. The form shall cross-reference the maintenance schedule. Payment for maintenance visits will not be made without submission of report forms.

1.5 QUALITY CONTROL

A. Qualifications

- 1. The Contractor shall be a company specializing in landscape installation, having experience in projects of the scope and scale being specified.

- B. All materials and work shall comply with applicable sections of the following references:

1. American Association of Nurserymen, Inc. (AAN) Standard: American Standard for Nursery Stock (ANSI Z60.1-2004)
2. Hortus Third, Cornell University, 1976
3. Federal Specifications (Fed. Spec.)
 - a. A-A-1909 - Fertilizer.

C. Source Quality Control

1. Certification: All plant materials shall be inspected and certified by authorized governmental agencies and shall comply with regulations prevailing at both the source and the project site.
2. Plant material selection: Tag and request plant material inspection and approval by the RE/COTR at least four weeks prior to digging.
3. Analysis and standards: Products in sealed containers shall be labeled with manufacturer's certified analysis. Bulk materials shall be tested by an approved laboratory in accordance with Association of Official Agricultural Chemists procedures, or as specified by product specifications referenced herein.

D. Substitutions

1. If specified landscape material cannot be located, the Resident Engineer/COTR in coordination with the MSN Agronomist will identify alternate sources or substitutions. Plants of larger size may be used if approved and if root balls meet ANA standards for the increased size. Adjustments will be made at no additional cost to the Government, except if downsized, credits to the Government will be based on comparable industry costs.
2. Container plants may be substituted for those designated "B&B" if approved by the Resident Engineer/COTR.

1.6 DELIVERY AND STORAGE

A. Delivery:

1. Notify the Resident Engineer/COTR 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. Protect trees during transport by tying in the branches and covering all exposed branches.
3. Labels: Prior to shipping, each plant or bundle of like variety and size shall be labeled with legible weatherproof tags indicating the correct name and size of plant.
4. The use of equipment such as "tree spades" is permitted provided the plant balls are sized in accordance with ANSI Z60.1 and tops are protected from damage.

5. If installation of plant material is delayed more than six hours after delivery, store plants in the shade, protect from the weather and mechanical damage, and keep them moist and cool. All plant material should be planted within 24 hours of delivery.
6. 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.
7. Handle plants at all times in accordance with the best horticultural practices. Lift B&B materials from the bottom of the ball only. Plants handled otherwise will be subject to rejection. Balled and burlapped plants which have cracked or broken balls are not acceptable and shall not be planted. Plants with mechanical damage, deformation or breakage will not be accepted and are to be replaced at the Contractor's expense.

B. Storage:

1. Store materials only in locations approved by the Resident Engineer/COTR.
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. Heel in bare root plants.
 - c. Protect plants stored on the project from drying out at all times by covering the balls or roots with moist sawdust, wood chips, shredded bark, peat moss, or other similar mulching material.
 - d. Keep plants, including those in containers, in a moist condition until planted, by watering with fine mist spray.
 - e. Plant within 24 hours of delivery date.

1.7 PLANTING INSTALLATION SEASONS AND CONDITIONS

- A. Perform landscape planting operations within the following dates: From February 15 to May 31 for spring and from September 1 to November 15 for fall, but not before irrigation system installed, tested, and approved.
- B. No work shall be done when the ground is 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/COTR stating the special conditions and proposal variance for approval.

1.8 LANDSCAPE PLANT ESTABLISHMENT PERIOD

A. The Establishment Period for landscape plants shall begin immediately after installation, with the approval of the Resident Engineer/COTR and continue for a period of time during the growing season sufficiently long (optimally a minimum of 3 months) for the landscape plant materials to achieve an establishment condition and appearance satisfactory to the Government. These conditions and appearance are described as follows: 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 during the establishment period. Plants will not be accepted until after completion of an acceptable establishment period. During the Landscape Plant Establishment Period the Contractor shall:

1. Water all plants to maintain a moist soil surface at all times until the plants 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 create any water ponding or runoff from the soil supporting the plants. 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 Resident Engineer/COTR.
2. Prune plants and replace mulch as required.
3. Replace and restore stakes, guy straps, and eroded plant saucers as required.
4. In plant beds and saucers, remove 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/COTR in coordination with the MSN Agronomist.
6. Immediately replace dead, missing or defective plant material during the establishment period and an active growing season. Replace each plant with one of the same size and species.
7. Complete remedial measures directed by the RE/COTR in consultation with the MSN Agronomist to ensure plant survival.
8. Repair damage caused while making plant replacements.

1.9 LANDSCAPE PLANT ACCEPTANCE.

- A. Landscape plant acceptance will occur after completion of the LANDSCAPE PLANT ESTABLISHMENT PERIOD. The Contractor shall have completed, located, and installed all plants according to the plans and specifications. All plants 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. Upon inspection when work is found to not meet the specifications, the PLANT ESTABLISHMENT PERIOD shall be extended at no additional cost to the Government 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. Tree support stakes, guys, and turnbuckles are in good condition.
 3. Total plants on site as required by specifications and required number of replacements have been installed.
 4. Remedial measures directed by the RE/COTR to ensure plant material survival and promote healthy growth have been completed.

1.10 PLANT WARRANTY

- A. All work shall be in accordance with the terms of the Paragraph, "Warranty" of Section 00 72 00, GENERAL CONDITIONS, including the following supplements:
1. A One Year Plant Warranty will begin on the date that the Government accepts the plants after completion of the Landscape Plant Establishment Period.
 2. The Contractor will immediately replace any dead plant material during the warranty period and during an active growing season. A one year warranty for the plants that are replaced will begin on the day the replacement work is accepted.
 3. Replacement of relocated plants, that the Contractor did not supply, is not required unless they die from improper handling and care during transplanting. Loss through Contractor improper handling, care, or negligence requires replacement in kind and size.
 4. The Government will reinspect all replacement plants at the end of the One Year Warranty. The Contractor will replace any dead, missing, or defective plant material 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.

5. The Contractor shall remove stakes, guy straps and any required tree wrappings from plants having been installed for one year, unless otherwise directed by the RE/COTR in consultation with the MSN Agronomist.

1.11 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 basic designation only.
- B. 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
- C. Hortus Third, most current edition. A Concise Dictionary of Plants Cultivated in the U.S. and Canada.
- D. 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
D1557-09.....Test Methods for Laboratory Compaction of Soil
D2103-08.....Polyethylene Film and Sheeting
D5851 (Rev 2006)..... Planning and Implementing a Water
Monitoring Program
- E. U. S. Department of Agriculture Federal Seed Act.
Amended July 2011.....Rules and Regulations

PART 2 - PRODUCTS

2.1 GENERAL

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

2.2 PLANTS

- A. Plants shall be in accordance with ANSI Z60.1, except as otherwise stated in the specifications or shown on the plans. 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 trees, deciduous and evergreen, that are single trunked with a single leader, unless otherwise indicated, display no weak crotches. Provide symmetrically developed deciduous trees and shrubs of uniform habit of

growth, with straight boles or stems and free from objectionable disfigurements, and evergreen trees and shrubs with well developed symmetrical tops with typical spread of branches for each particular species or variety. Provide ground cover and vine plants with the number and length of runners for the size specified, and the proper age for the grade of plants specified. Provide vines and ground cover plants well established in removable containers, integral containers, or formed homogeneous soil sections. 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. Never pick-up or move tree species by grasping the trunk. Trees must be moved by lifting the root ball, box or container.
- E. Balled and burlapped (B&B) plant ball sizes and ratios will conform to ANSI Z60.1, consisting of firm, natural balls of soil wrapped firmly with burlap or strong cloth and tied.
- F. Bare-root (BR) plants shall have the root system substantially intact, but with the earth carefully removed. Cover roots with a thick coating of mud by "puddling" after the plants are dug.
- G. 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/COTR 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.
- I. When existing plants are to be relocated, ball sizes shall conform to requirements for collected plants in ANSI Z60.1, and plants shall be dug, handled, and replanted in accordance with applicable sections of these specifications.

2.3 LABELS

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.

2.4 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. All topsoil shall be imported from off-site sources.
- C. At least 10 days prior to topsoil delivery, notify the Resident Engineer/COTR 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 Part 1.4.E and Section 01 45 29, TESTING LABORATORY SERVICES. Amend topsoil not meeting the pH range specified by the addition of pH adjusters.

2.5 LIME

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%.

2.6 SOIL CONDITIONERS

- A. Peat shall be a milled sphagnum or reed sedge product having at least 95 percent organic content, pH range of 4.0 to 5.5, free of sticks, wood or other debris. Peat shall be a natural product 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. 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.
- F. Elemental sulfur shall be finely ground horticultural grade material containing at least 95 percent purity.

2.7 PLANTING SOIL MIXTURE

- A. The planting soil mixture shall be composed of 3 parts topsoil, and 1 part peat moss or organic matter.
- B. Planting mix will be utilized for backfill mixture and planting bed mixture.

2.8 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.

2.9 MEMBRANES

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.)

2.10 MULCH

See Section 32 95 16, STONE TOPDRESS

2.11 EROSION CONTROL

- A. Erosion control net material shall be heavy, twisted jute mesh weighing 25 g/m² (pounds per square yard). Openings between strands approximately 12 mm square (inches square) . Openings between strands shall be approximately 13 mm square (1/2 inch square). Material will be secured with 150 mm (6 inch) wire staples made by the same manufacturer as the netting. All erosion control material is to be installed according to the respective manufacturer's recommendations.
- B. Erosion control blanket material shall be cellulose fiber blanket bonded to 6 mm (1/4 inch) square plastic net weighing 10 kg/100 m² (20 pounds per 1000 square feet) in 1250 mm (50 inch) wide rolls.

2.12 TREE WRAP

- A. Crinkle Paper Tree wrap shall be two thicknesses of crinkled paper cemented together with a layer of bituminous material. Wrapping material

shall be a minimum of 100 mm (4 inches) in width and have a stretch factor of 33-1/3 percent. Twine for tying shall be lightly tarred medium or coarse sisal yarn.

- B. Breathable synthetic fabric tree wrap. White in color, delivered in 75 mm (3 in.) wide rolls, specifically manufactured for tree wrapping. Tree wrap shall be "Breathable Fabric Tree Wrap" as manufactured by the Dewitt Company, Inc., Sikeston, MO, or approved equal. Submit manufacturer literature for approval.

2.13 STAKES AND GUYING STRAPS

- A. Provide stakes for tree support of rough sawn wood, free from knots, rot, cross grain, or other defects that would impair the strength. Stakes shall be a minimum of 50 mm by 50 mm (2 inches by 2 inches), or 65 mm (2-1/2 inches) in diameter, by 2400 mm (8 feet) long and pointed at one end or galvanized steel pipe 32 mm (1 1/4 in.) x 3000 mm (10') with cap, primed with 2 coats flat black exterior enamel.
- B. Hose chafing guards shall be new or used 2-ply reinforced rubber or plastic hose of all the same color on the project.
- C. Flags to be fastened to guys shall be surveyor's plastic tape, white in color and 150 mm (6 inches) in length.
- D. Guying straps shall be a fabric material designed specifically to guy newly planted trees. No wire should ever be used for this purpose.
- E. Turnbuckles shall be galvanized or cadmium-plated and have a 75 mm (3 inch) minimum lengthwise opening fitted with screw eyes.
- F. Eye bolts shall be galvanized or cadmium plated having a 50 mm (one inch) diameter eye with a minimum screw length of 40 mm (1-1/2 inches).
- G. Deadmen shall be 100 mm by 200 mm (4 inch by 8 inch) rectangular, or 200 mm (8 inch) diameter by 900 mm (36 inch) long sound wood.
- H. Arrow shaped or auger iron anchors shall be noncorrosive, and sized according to the manufacturer's recommendation.

2.14 EDGE RESTRAINT

See Section 32 14 13, PRECAST CONCRETE UNIT PAVING, for gravel flower strip edging.

2.15 WATER

Water shall not contain elements toxic to plant life. It shall be obtained as specified in Section 01 00 00, GENERAL REQUIREMENTS, paragraph, Temporary Services.

2.16 ANTIDESICCANT

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

2.17 HERBICIDES AND OTHER PESTICIDES

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.

2.18 TOPDRESS MATERIALS

See section 32 95 16, STONE TOPDRESS

PART 3 - EXECUTION

3.1 LAYOUT

Stake plant material locations and bed outlines on project site for approval by the Resident Engineer/COTR before any plant pits or beds are dug. The Resident Engineer/COTR may approve adjustments to plant material locations to meet field conditions. If layouts are not understood or if surface or subsurface obstructions are encountered that are not indicated, do not proceed with planting operations until alternative plant locations have been selected and approved in writing by the Resident Engineer/COTR.

3.2 EXCAVATION FOR PLANTING

- A. 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. Barricade existing trees, shrubbery, and beds that are to be preserved in a manner that will effectively protect them during the project construction.
- B. 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/COTR may select other locations for plant material.
- C. Dig plant pits by any approved method so that they have vertical sides and flat bottoms. When pits are dug with an auger or other mechanical diggers and the sides of the pits become glazed, scarify the glazed surface.
- D. Excavate planting beds to the depth shown on the drawings and replace with specified planting soil mixture, bringing the grades to a smooth and even surface which, when settled, will conform to established grades. Remove excavated material to an off-site location or area on-site designated by the Resident Engineer/COTR.
- E. Where poor soil percolation is probable, test drainage by filling planting pits with 12 inches of water. Record the drainage time for each pit and if, in the opinion of the Resident Engineer/COTR, the water

does not adequately drain off within 24 hours, drill and shatter the substrate to a minimum depth of 3 feet below the bottom of the pit. Retest the drainage. If poor drainage persists, install drains as directed.

- F. In areas of new grading where existing soil is being replaced for the construction of new plant beds, remove 300 mm (12 inches) of existing soil and replace with planting mix unless otherwise noted. Plant beds shall be brought to a smooth and even surface conforming to established grades.

3.3 SETTING PLANTS

- A. Handle balled and burlapped and container-grown plants only by the ball or 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 or ball. Set the plant to the grade indicated on the details and face to give the best appearance or relationship to one another and views from the roads and plazas.
- B. For balled and burlapped plants, carefully fold back the top half of the burlap and remove tying materials. Any wire caging or similar material, must be completely removed from pit. Where plastic wrap or treated burlap is used in lieu of burlap, completely remove these materials before backfilling. Backfill planting pit approximately two-thirds full, add water and allow planting mixture to settle. After the water has been absorbed, complete backfilling and tamp lightly to grade, and form a watering basin of the size indicated.
- C. Container-grown stock: Plant as specified above for balled and burlapped plants, and as modified herein. Remove containers and make at least five vertical cuts 1 inch deep around the root ball; thoroughly loosen the roots on the outside of the ball.
- D. Using topsoil, form earth saucers or water basins for watering around plants. Basins to be 2" high for shrubs and 4" high for trees.
- E. 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.

3.4 TRUNK WRAPPING

Wrap the trunks of deciduous trees immediately after planting. Wrap the trunks of deciduous trees, 40 mm (1-1/2 inches) or greater in caliber with the specified material beginning at the base and extending to the first branches. Remove wrapping after one year. When using Crinkled

Paper Wrap, securely tie wrapping at the top and bottom and at 450 mm (18 inch) maximum intervals with twine.

3.5 STAKING AND GUYING

- A. Stake and guy plants as shown on the drawings and as specified.
- B. Drive stakes vertically into the ground to a depth of 800 to 900 mm (2-1/2 to 3 feet) in such a manner as not to injure the ball or roots, unless otherwise shown on the drawings.
- C. Place deadmen not less than 450 mm (18 inches) below the surface of the ground, unless otherwise shown on the drawings.
- D. Install iron anchors according to manufacturer's recommendations.
- E. Fasten flags securely on each guy strap approximately 2/3 of the distance up from ground level.
- F. Remove stakes and guy straps after one year.

3.6 MULCHING PLANTS

See Section 32 95 16, STONE TOPDRESS

3.7 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. Do not pole trees or remove the leader. Remove trimmings from the site. Do not use any type of wound dressing on pruning cuts.
- B. Employ workers experienced in this type of work.

3.8 FINISH GRADING

See Section 32 95 16, STONE TOPDRESS

3.9 APPLICATION OF FERTILIZER

Prior to or during planting, amend all backfill and bed mixes at rates specified under Parts 2.1 and 2.2.

3.10 WATERING

Contractor shall deep water all trees twice each week during the Plant Establishment Period, providing water penetration throughout the root zone to the full depth of the planting pits, as verified in the field by the Resident Engineer/COTR. Watering shall cease at the first hard frost in the fall and shall resume upon ground thaw in the spring.

3.11 EROSION CONTROL MATERIAL

- A. Install and maintain erosion control material meeting the requirements of this specification on the designated areas as shown and specified. Prepare, fertilize and vegetate the area(s) to be covered, as specified, before the erosion material is placed. Immediately following the planting operations lay the material evenly and smoothly and in contact

with the soil throughout. Omit the straw mulch from all seeded areas receiving the erosion control material.

- B. For waterways, unroll the material in the direction of water flow. When two or more strips are required to cover a ditch area, they shall overlap at least 100 mm (4 inches). In case a strip is to be spliced lengthwise, the ends of the strips shall overlap at least 150 mm (6 inches) with the upgrade section on top.
- C. When using erosion control material on slopes, place the material either horizontally or vertically to the slope with the edges and ends of adjacent strips butted tightly against each other.
- D. Staple each strip in three rows (each edge and center with the center row alternately spaced) with staples spaced not more than 1200 mm (4 feet) longitudinally. When using two or more strips side by side on slopes, use a common row of staples on the adjoining strips. Staple all end strips at 300 mm (one foot) intervals at the end. Firmly embed staples in the underlying soil.
- E. Maintenance shall consist of repairs made necessary by erosion, wind, or any other cause. Maintain, protect, repair, or replace the erosion control material until the Termination of the Plant and Warranty Period.

3.12 RESTORATION AND CLEAN-UP

Where existing or new stone topdress 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 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.

3.13 ENVIRONMENTAL PROTECTION

All work and Contractor operations shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

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SECTION 32 95 16
STONE TOPDRESS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

Work included: Provide all labor, materials and installation necessary to complete the fine grading, incidental grading, and supplying and spreading imported topdress materials, including rap per civil plans and related work as required.

1.3 RELATED WORK:

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- B. Edge Restraint: Section 32 14 13, PRECAST CONCRETE UNIT PAVING
- C. Section 32 90 00, PLANTING

1.4 MOCK-UPS

Contractor shall provide on project site a 4' x 4' sample panel for review of each material prior to installation. Once reviewed and approved by the Resident Engineer (RE)/Contracting Officer's Technical Representative (COTR) the sample panel area shall be used as a reference for the rest of the project.

1.5 SAMPLES

- D. General: Comply with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- E. Provide one 1-gallon Ziploc bag of each material for review and approval by RE/COTR.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Use locally available materials and gradations that exhibit a satisfactory record of previous installations
- B. Any imported materials must match size, gradation, and color of existing site granite as approved by RE/COTR.
- C. Pre-emergent Herbicide: As specified in Section 32 90 00 Planting.

2.2 TOPDRESS TYPES

- A. Decomposed Granite Mulch in Planting areas: "Coco Brown" ¼" minus or approved equal. 2" minimum depth.

B. Decomposed Granite for channel and restoration beyond landscaped areas:
"Santa Fe Gold" ¾" minus or approved equal. 2" minimum depth except
for channel topdress seeding- see Contract Drawings.

C. Gravel Flower Strip: "Rebel Red": 3/8" screened, washed as provided by
Kalamazoo Materials, Inc (kalamazoomaterials.com) or approved equal.
12" minimum depth - full coverage, refer to detail.

PART 3 - EXECUTION

3.1 COORDINATION

Coordinate as required with other trades to assure proper and adequate
provision in the work of those for interface with the work of this
Section. Coordinate schedules for installation of the work of this
Section with schedules for other installations, to assure orderly
progress of the total construction sequence.

3.2 DECOMPOSED GRANITE

A. Refer to plans for specific areas to receive topdress and install as
follows:

1. Grade Control: Establish and maintain required lines and
elevations. All areas shall be graded according to the drawings,
prior to the placement of any top-dress material
2. Installation only to occur when schedule of site activity can limit
access to areas where decomposed granite is to be placed to prevent
disturbance to finish of granite
3. Decomposed granite shall be applied and raked to the finished grade,
depth as indicated on Drawings. Water settle fines and roll to
finish grade.
4. Apply pre-emergent herbicide weed control per manufacturer's printed
instructions.
5. See Contract Drawings for channel restoration method.

3.3 GRAVEL FLOWER STRIP

Placing stone topdress: Topdress shall be applied and raked to 1/2"
below adjacent finished grade, depth as indicated on Drawings. Water
settle fines and roll to achieve a final depth 1" below finish grade.

3.4 CLEAN-UP

Remove all waste and debris; clean all pavement of debris created by
this work from site.

- - - E N D - - -

SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies construction of outside, underground storm sewer systems. The storm sewer systems shall be complete and ready for operation, including all drainage structures, frames, grate and covers, connections to new buildings, structure service lines, existing storm sewer lines and existing drainage structures and all required incidentals.

1.2 RELATED WORK:

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 11, EARTH MOVING (SHORT FORM).
- C. Concrete Work, Reinforcing, Placement and Finishing: Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE.

1.3 QUALITY ASSURANCE:

- A. Products Criteria:
 - 1. Multiple Units: 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.
- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to public storm sewer lines and the extension, and/or modifications to Public Utility systems.

1.4 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers' Literature and Data: Submit the following as one package:
 - 1. Piping.
 - 2. Jointing material.
 - 3. Manhole, inlet and catch basin material.
 - 4. Frames and covers.
 - 5. Steps.
 - 6. Resilient connectors and downspout boots.

1.5 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 Society for Testing and Materials (ASTM):
- A48-03/A48M-03.....Gray Iron Castings
 - A536-84(2004).....Ductile Iron Castings
 - A615-05/A615M-05.....Deformed and Plain-Billet Steel Bars for
Concrete Reinforcement
 - A655-04e1/A655M-04e1... Reinforced Concrete D-Load Culvert, Storm Drain
and Sewer Pipe
 - A742-03/A742M-03.....Steel Sheet, Metallic Coated and Polymer
Precoated for Corrugated Steel Pipe
 - A760-01a/A760M-01a.....Corrugated Steel Pipe, Metallic-Coated for
Sewers and Drains
 - A762-00/A762M-00.....Corrugated Steel Pipe, Polymer Precoated for
Sewers and Drains
 - A798-01/M798M-01.....Installing Factory-Made Corrugated Steel Pipe
for Sewers and Other Applications
 - A849-00.....Post-Applied Coatings, Pavings, and Linings for
Corrugated Steel Sewer and Drainage Pipe
 - A929-01/A929M-01.....Steel Sheet, Metallic Coated by the Hot Dip
Process for Corrugated Steel Pipe
 - C76-05a/C76M-05a.....Reinforced Concrete Culvert, Storm Drain and
Sewer Pipe
 - C139-03.....Concrete Masonry Units for Construction of
Catch Basins and Manholes
 - C150-04ae1.....Portland Cement
 - C443-05/C443M-05.....Joints for Concrete Pipe and Manholes, Using
Rubber Gaskets
 - C478-03a/C478M-03a.....Precast Reinforced Concrete Manhole Sections
 - C506-05/C506M-05.....Reinforced Concrete Arch Culvert, Storm Drain
and Sewer Pipe
 - C507-05a/C507M-05a.....Reinforced Concrete Elliptical Culvert, Storm
Drain and Sewer Pipe
 - C655-04e1/C655M-04e1... Reinforced Concrete D-Load Culvert, Storm Drain
and Sewer Pipe

C1433-04e1/C1433M-04e1...Precast Reinforced Concrete Box Sections for
Culverts, Storm Drains and Sewers

C828-03.....Low-Pressure Air Test of Vitrified Clay Pipe
Lines

C857-95(2001).....Minimum Structural Design Loading for
Underground Precast Concrete Utility Structures

C923-02/C923M-02.....Resilient Connectors between Reinforced
Concrete Manhole Structures, Pipes and
Materials

C924-02/C924M-02.....Testing Concrete Pipe Sewer Lines by Low
Pressure Air Test Method

C1103-03/C1103M-03.....Joint Acceptance Testing of Installed Precast
Concrete Pipe Sewer Lines

D698-00ae1.....Laboratory Compaction Characteristics of Soil
Using Standard Effort (12,400 ft-lbf/ft³ (600
kN-m/m³))

D1056-00.....Flexible Cellular Materials-Sponge or Expanded
Rubber

D2412-02.....Determination of External Loading
Characteristics of Plastic Pipe by Parallel
Plate Loading

D2321-04e1.....Underground Installation of Thermoplastic Pipe
for Sewers and Other Gravity Flow Applications
.

D3034-04a.....Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe
and Fittings

D3212-96a(2003)e1.....Joints for Drain and Sewer Plastic Pipes Using
Flexible Elastomeric Seals

D3350-04.....Polyethylene Plastics Pipe and Fittings
Materials

D4101-05a.....Polypropylene Injection and Extrusion Materials

F477-02e1.....Elastomeric Seals (Gaskets) for Joining Plastic
Pipe

F679-03.....Poly (Vinyl Chloride) (PVC) Large-Diameter
Plastic Gravity Sewer Pipe and Fittings

F714-05.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based
on Outside Diameter

F794-03.....Poly (Vinyl Chloride)(PVC) Profile Gravity
Sewer Pipe and Fittings Based on Controlled
Inside Diameter
F894-98a.....Polyethylene (PE) Large Diameter Profile Wall
Sewer and Drain Pipe
F949-03.....Poly (Vinyl Chloride) (PVC) Corrugated Sewer
Pipe with Smooth Interior
F1417-92(2005).....Installation Acceptance of Plastic Gravity
Sewer Lines Using Low-Pressure Air

1. NOTE: ASTM test methods shall be the current version as of the date
of advertisement of the project.

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

HB17.....Standard Specifications for Highway Bridges
M190-04.....Bituminous Coated Corrugated Metal Culvert Pipe
and Pipe Arches
M198-05.....Joints for Circular Concrete Sewer and Culvert
Pipe Using Flexible Watertight Gaskets
M294-04.....Corrugated Polyethylene Pipe, 300-1500 mm (12
to 60 inches) Diameter

PART 2 - PRODUCTS

2.1 PIPING:

A. Gravity Lines (Pipe and Appurtenances):

1. High Density Polyethylene (HDPE):

- a. Smooth Wall PE Pipe: Shall comply with ASTM F714, DR 21 for pipes
75 to 600 mm (3 to 24 inches), and SDR 26 for pipes 650 to 1200
mm (26 to 48 inches). Pipe shall be produced from PE certified by
the resin producer as meeting the requirements of ASTM D3350,
minimum cell class 335434C.
- b. Corrugated PE Pipe: Shall have smooth interior and annular
exterior corrugations and shall comply with AASHTO M252, Type S
for pipes 100 to 250 mm (4 to 10 inches).
- c. Corrugated PE Pipe: Shall have smooth interior and annular
exterior corrugations and shall comply with AASHTO M294, Type S
for pipes 300 to 1500 mm (12 to 60 inches). Pipe walls shall have
following minimum properties:

<u>Nominal Size</u>	<u>Minimum Wall Area</u>	<u>Min. Moment of Inertia mm⁴/mm (in⁴/in)</u>
300 mm (12 in)	3200 mm ² /m (1.50 in ² /ft)	390 (.024)
375 mm (15 in)	4000 mm ² /m (1.91 in ² /ft)	870 (.053)
450 mm (18 in)	4900 mm ² /m (2.34 in ² /ft)	1020 (.062)
600 mm (24 in)	6600 mm ² /m (3.14 in ² /ft)	1900 (.116)
750 mm (30 in)	8300 mm ² /m (3.92 in ² /ft)	2670 (.163)
900 mm (36 in)	9500 mm ² /m (4.50 in ² /ft)	3640 (.222)
1050 mm (42 in)	9900 mm ² /m (4.69 in ² /ft)	8900 (.543)
1200 mm (48 in)	10900 mm ² /m (5.15 in ² /ft)	8900 (.543)
1350 mm (54 in)	12000 mm ² /m (5.67 in ² /ft)	13110 (.800)
1500 mm (60 in)	13650 mm ² /m (6.45 in ² /ft)	13110 (.800)

- d. Profile Wall PE Pipe: Shall comply with ASTM F894, Class 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, Minimum cell class 334433C. Pipe walls shall have following minimum properties:

<u>Nominal Size</u>	<u>Minimum Wall Area</u>	<u>Min. Moment of Inertia mm⁴/mm (in⁴/in)</u>
450 mm (18 in)	6300 mm ² /m (2.96 in ² /ft)	850 (.052)
525 mm (21 in)	8800 mm ² /m (4.15 in ² /ft)	1150 (.070)
600 mm (24 in)	9900 mm ² /m (4.66 in ² /ft)	1330 (.081)
675 mm (27 in)	12500 mm ² /m (5.91 in ² /ft)	2050 (.125)
750 mm (30 in)	12500 mm ² /m (5.91 in ² /ft)	2050 (.125)
825 mm (33 in)	14800 mm ² /m (6.99 in ² /ft)	2640 (.161)
900 mm (36 in)	17100 mm ² /m (8.08 in ² /ft)	3310 (.202)
1050 mm (42 in)	16500 mm ² /m (7.81 in ² /ft)	4540 (.277)
1200 mm (48 in)	18700 mm ² /m (8.82 in ² /ft)	5540 (.338)

2.2 JOINTING MATERIAL:

A. PE Plastic Pipe:

1. Smooth Wall PE Plastic Pipe: Pipe shall be joined using butt fusion as recommended by the manufacturer.
2. Corrugated PE Plastic Pipe: 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.

3. Profile Wall PE Plastic Pipe: Joints shall be gasket or thermal weld type with integral bell in accordance with ASTM F894.

2.3 MANHOLES, INLETS AND CATCH BASINS:

A. Manholes, inlets and catch basins shall be constructed of precast concrete segmental blocks, precast reinforced concrete rings, precast reinforced sections, or cast-in-place concrete. Manholes, inlets and catch basins shall be in accordance with State Department of Transportation standard details, and the following VA requirements, in case of variance, VA requirements supersede:

1. Precast Concrete Segmental Blocks: Blocks shall conform to ASTM C139 and shall not be less than 150 mm (6 inches) thick for manholes to a depth of 3.6 m (12 feet); not less than 200 mm (8 inches) thick for manholes deeper than 3.6 m (12 feet) deep. Blocks shall be not less than 200 mm (8 inches) in length. Blocks shall be shaped so that joints seal and bond effectively with cement mortar. Parge structure interior and exterior with 15 mm (1/2 inch) of cement mortar applied with a trowel and finished to an even glazed surface.
2. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on the drawings, and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
3. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top sections shall be eccentric. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
4. Flat top manhole tops shall be reinforced concrete.
5. Precast Catch Basins: Concrete for precast sections shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C-857.

6. Mortar:

- a. Precast Concrete Segmental Block Structures: By volume, 1 part of Portland cement, 1/4 part lime hydrate, and 3 parts sand.
 - b. Precast Reinforced Concrete Ring and Riser Structures: By volume, 1 part of Portland cement and 2 parts sand. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 21L (5-1/2 gallons) per sack of cement.
7. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet AASHTO M-198B.
8. Manhole steps shall be polypropylene plastic coated on a No. 4 deformed rebar conforming to ASTM C478, Polypropylene shall conform to ASTM D4101. Steps shall be a minimum of 250 mm (10 inches) wide and project a minimum of 125 mm (5 inches) away from the wall. The top surface of the step shall have a studded non-slip surface. Steps shall be placed at 300 mm (12 inch) centers.
9. Ladders, brackets and hardware shall be constructed of welded aluminum, rails shall be 9 mm (3/8 inch) by 63 mm (2-1/2 inches) spaced a minimum of 400 mm (16 inches) apart. Rungs shall be 35 mm (1-3/8 inches) in diameter and have a non-slip surface. Standoffs shall offset the ladder 180 mm (7 inches) from the wall. The ladder assembly shall be rated for a minimum of 2200 N (500 pounds).
- B. Frame and Cover for Gratings: Frame and cover for gratings shall be cast gray iron conforming to ASTM A48; cast ductile iron conforming to ASTM A536. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the drawings.

2.4 CONCRETE:

Concrete shall be in accordance with Illinois Department of Transportation standard specification. For concrete not specified in above standards, concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform to the provisions of Division 03 of these specifications.

2.5 REINFORCING STEEL:

Reinforcing steel shall be deformed bars, ASTM A615, Grade 40 unless otherwise noted.

2.6 FLARED END SECTIONS:

Flared End Sections: High Density Polyethylene (HDPE) flared end sections conforming to requirements of ASTM D3350, minimum cell classification 213320C. Each end section shall have a minimum carbon black additive for UV protection.

2.7 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS:

- A. Resilient Connectors: Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.
- B. Downspout Boots: Boots used to connect exterior downspouts to the storm drainage system shall be of gray cast iron conforming to ASTM A48, Class 30B or 35B.

2.8 WARNING TAPE:

Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape non-detectable type, green with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

PART 3 - EXECUTION

3.1 EXCAVATION FOR STORM DRAINS AND DRAINAGE STRUCTURES:

Excavation of trenches and for appurtenances and backfilling for storm drains, shall be in accordance with the applicable portions of Section 31 20 11, EARTH MOVING (SHORT FORM).

3.2 PIPE BEDDING:

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 with the lowest one-fourth 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.

3.3 GENERAL PIPING INSTALLATION:

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade.
- B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.

- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. 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.
- E. 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.
- F. 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.
- G. Do not lay sewer pipe in same trench with another pipe or other utility.
- H. Do not walk on pipe in trenches until covered by layers of shading to a depth of 300 mm (12 inches) over the crown of the pipe.
- I. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
 - 1. High Density Polyethylene (HDPE) Piping: Comply with manufacturer's recommendations with gasketed joints.
- J. Warning tape shall be continuously placed 300 mm (12 inches) above storm sewer piping.

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, the Contractor shall 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.
- C. The Contractor shall comply with all OSHA confined space requirements when working within existing structures.

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 MANHOLES, INLETS, CATCH BASINS AND YARD DRAINS:

A. General:

1. Circular Structures:

- a. 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.
- b. 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.
- c. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

2. Rectangular Structures:

- a. Reinforced concrete structures shall be installed in accordance with Division 03, CONCRETE of these specifications.
 - b. 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 inches) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D 698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
3. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
 4. 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.

5. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1:12 (25mm per 300mm, 1-inch per foot) nor more than 1:6 (50mm per 300mm, 2 inches per foot). Bottom slab and benches shall be concrete.
6. The wall that supports access rungs or ladder shall be 90 degrees vertical from the floor of structure to manhole cover.
7. 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.
8. 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 inches) thick, by 300 mm (12 inches) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.7 INSPECTION OF SEWERS:

- A. Inspect and obtain the COTR's approval. Thoroughly flush out before inspection. Lamp between structures and show full bore indicating sewer is true to line and grade. Lip at joints on inside of sewer is prohibited.

3.8 TESTING OF STORM SEWERS:

- A. Gravity Sewers (Select one of the following):
 1. Air Test: Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.
 2. Exfiltration Test:
 - a. Subject pipe to hydrostatic pressure produced by head of water at depth of 900 mm (3 feet) above invert of sewer at upper manhole under test. In areas where ground water exists, head of water shall be 900 mm (3 feet) above existing water table. Maintain head of water for one hour for full absorption by pipe body before testing. During 1 hour test period, measured maximum allowable rate of exfiltration for any section of sewer shall be 11L (3.0 gallons) per hour per 30 m (100 feet).

- b. If measurements indicate exfiltration is greater than maximum allowable leakage, take additional measurements until leaks are located. Repair and retest.

- - - E N D - - -

APPENDIX A

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**REPORT ON GEOTECHNICAL
INVESTIGATION**



DESIGNATION: National Memorial Cemetery of Arizona

LOCATION: 23029 N. Cave Creek Road
Phoenix, Arizona

CLIENT: JJR LLC

PROJECT NO: 111207SA

DATE: November 15, 2011

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APPENDIX A – Field and Lab Test Data



1.0 INTRODUCTION

This report presents the results of a subsoil investigation carried out at the site of the proposed cemetery improvements. The proposed improvements are to be constructed within a one acre area in the middle of the National Memorial Cemetery of Arizona located at 23029 N. Cave Creek Road in Phoenix, Arizona.

Preliminary information calls for the construction of a free standing memorial wall, a pre-fabricated bridge structure and the expansion of Columbarium sections. The free standing wall is expected to have both precast and cast-in-place elements, with a width of 2 to 3 ft and a height of 5 ft to 6 ft. The bridge is expected to be pre-fabricated with a single span of about 25 feet, and the Columbarium will be approximately 4 ft to 5 ft wide and 5 ft to 6 ft in height.

No loading information was provided at the time of this report. It is anticipated that structural loads will be light to moderate. No special considerations regarding settlement tolerances are known at this time.

2.0 GENERAL SITE AND SOIL CONDITIONS

2.1 Site Conditions

The site lies within the middle of the National Memorial Cemetery. Existing Columbarium sections reside to the west, additional Columbarium sections and vacant land are to the north, an access road and services building to the east, and graves to the south. There was no visual evidence of mass fill in the proposed construction area. The area is flat, generally clear with a few trees and a concrete lined canal that crosses through the area.

2.2 Geologic Conditions

The site is **located well outside known areas** that have undergone considerable subsidence due to groundwater removal. Areas of subsidence are known to produce earth fissuring, which has affected areas within several miles of the site. Subsidence is a basin wide phenomenon that would result in differential elevation changes over long distances, which would not affect the type of buildings proposed for this site. No evidence of earth fissures was observed on the site. Fissure gullies form over subsurface irregularities such as bedrock highs, which cause tensional stresses and differential subsidence. Where such anomalies are not present, subsidence tends to be uniform over a wide area, this having minimal effect on surficial structures. The closest known earth fissures are located near Cactus Road and 40th Street in Phoenix. Based on local experience, subsidence and earth fissures historically have **not** been a problem in this area.

2.3 Seismic Design Parameters

The project area is located in a seismic zone that is considered to have low historical seismicity. The seismicity of the Phoenix area has had only two magnitude 3.0 events in over 100 years. Liquefaction is not considered a concern due to the depth to the groundwater table (>60ft), and the relatively low probability of seismic activity.

Although borings were not advanced to 100 feet, based on the nature of the subsoils encountered in the borings and geology in the area, a Site Class Definition, Class C (Table 1613.5.2, 2006 & 2009 IBC) may be used for design of the structures. In addition, the following seismic parameters may be used for design:

Table 2.3.1 Seismic Parameters

MCE ¹ spectral response acceleration for 0.2 second period, S_S :	0.218g
MCE ¹ spectral response acceleration for 1.0 second period, S_1 :	0.068g
Site coefficient, F_a :	1.2
Site coefficient, F_v :	1.7
MCE ¹ spectral response acceleration adjusted for site class, S_{MS} :	0.261g
MCE ¹ spectral response acceleration adjusted for site class, S_{M1} :	0.116g
5% Damped spectral response acceleration, S_{DS} :	0.174g
5% Damped spectral response acceleration, S_{D1} :	0.077g
NOTE 1: MCE = maximum considered earthquake	

2.4 General Subsurface Conditions

Subsoil conditions at the site consist primarily of clayey sand, and sandy clay to a depth of 17 to 22 feet. These soils are then underlain by layers of sand and gravel with cobbles that halted further drilling resulting in auger refusal. Moderate to hard degrees of calcareous cementation were encountered throughout the profile. The standard penetration resistance test (SPT) values range from 4 to 50+ blows per foot. No groundwater was encountered during this investigation. Based on visual and tactile observation, the surficial soils were in a 'dry' state at the time of investigation.

Laboratory testing indicates in-situ dry densities of the upper soils on the order of 87 to 104 pcf and water contents on the order of 5 to 7 percent at the time of investigation. Liquid limits range from 25 to 30 percent. Plasticity indices are on the order of 9 to 15 percent. The upper clayey soils exhibit volume increase (swell) due to wetting of approximately 2.1 percent when compacted to moisture and density levels normally expected during construction. An undisturbed sample displayed additional compression due to inundation under a maximum confining load of 3,200 psf.

3.0 ANALYSIS AND RECOMMENDATIONS

3.1 Analysis

Analysis of the field and laboratory data indicates that subsoils at the site are favorable for the support of the proposed structures on shallow foundations, or drilled shaft construction subject to some remedial earthworks.

The potential for compressible soils is a concern. Laboratory and field testing indicates that the shallow upper soils are of low density and capable of post-construction settlement when subjected to inundation. This could cause excessive settlement resulting in distress in the proposed structures. Therefore, the recommendations for heavier structures such as the bridge abutments are made to over-excavate and re-compact the bearing soils to increase density and reduce the potential for collapse or use drilled shafts.

For lightly loaded elements and other minor structures such as the columbarium and free standing memorial walls, it is recommended to allow for shallow spread footings bearing on compacted native soils at a minimal depth of 18 inches below existing grade. In order to help minimize settlement, it is recommended that the exposed bottom of footing excavation be moisture conditioned to optimum (± 2 percent) and compacted to at least 95 percent of maximum dry density as determined by ASTM D-698.

Shallow excavation operations should be relatively straightforward using conventional equipment. Groundwater is not expected to be a factor in the design or construction of foundations and underground utilities.

The swell potential of the fine portion of the upper clayey soils is a minor concern. The potential is usually strong enough to cause differential movements of slabs-on-grade such as floors and sidewalks and lightly loaded foundation but not enough to cause damage to heavier structures. Accordingly, it is paramount to provide proper drainage to limit the potential for water infiltrating under slabs. A minimum slope of at least 5 percent for a distance of 10 feet is recommended for unpaved landscaped areas. Typical recommendations to reduce the swell potential include reducing the compaction requirements and

requiring higher moisture contents during pad preparation. Roof drains must be directed to the pavement or storm drains. They should not be allowed to discharge into planters adjacent to the structure. Irrigated planters adjacent to the structures should be kept at a minimum and/or the use of low water use plants (xeriscape). Storm water retention basins should be kept at least 10 feet away from the structure.

For exterior slabs on grade, frequent jointing is recommended to control cracking and reduce tripping hazards should differential movement occur. It is also recommended to pin the landing slab to the building floor/stem wall. This will reduce the potential for the exterior slab lifting and blocking the operation of out-swinging doors. Pinning typically consists of 24 inch long No. 4 reinforcing steel dowels placed at 12-inch centers.

3.2 Site Preparation

The entire area to be occupied by the proposed construction should be stripped of all vegetation, debris, rubble, and obviously loose surface soils. Any existing structures and foundation elements to be demolished should be removed in their entirety along with soil disturbed by this activity. Carefully remove all concrete and other elements as well as any deleterious materials that may be encountered.

The removal of any existing underground services is not known at this time. If any utility is located within 5 feet of any proposed foundation, relocation and/or abandonment of the utility should be provided. They should either be removed and replaced with engineered fill or abandoned in-place. In the case of manholes and pipelines, it may be possible to abandon them in-place. The tops of manholes should be removed and filled with a weak (>500 psi) cementitious grout. Pipelines larger than 6 inches should be capped and filled with grout.

Prior to placing structural fill below footing bottom elevation, the exposed grade should be scarified to a depth of 8 inches, moisture conditioned to optimum (± 2 percent) and compacted to at least 95 percent of maximum dry density as determined by ASTM D-698. Pavement areas should be scarified, moisture conditioned and compacted in a similar manner.

All cut areas and areas above footing bottom elevation that are to receive floor slab only fill should be scarified 8 inches, moisture conditioned to at least optimum to 2 percent above optimum and lightly but uniformly compacted to 90 but not more than 95 percent of maximum dry density as determined by ASTM D-698.

3.3 Foundation Design

If the Site Preparation and Analysis sections of this report are followed, the existing site soils will provide sufficient support for the proposed structures. The following bearing capacities can be utilized for design:

Table 3.3.1 Foundation Bearing Capacities

Foundation Options	Foundation Type	Foundation Depth	Bearing Medium	Bearing Capacity	Comments
A	Spread	1.5 feet	Compacted Native	1,500 psf	1
B		2.0 feet	2' of Engineered Fill	2,500 psf	2
C	Drilled Shafts	12 feet	Dense Native Soils	8,000 psf	3

Notes:

- 1) Shallow spread footings bearing on compacted native soils at a minimum depth of 1.5 feet below **existing** grade. The exposed bottom of footing excavation must be moisture conditioned to optimum (± 2 percent) and compacted to at least 95 percent of maximum dry density as determined by ASTM D-698. With this option maximum continuous strip footings should not exceed 5 kips per linear foot and maximum column loads should not exceed 75 kips.
- 2) Shallow spread footings bearing on at least 2 feet of engineered fill, plus 8 inches of pre-compacted subgrade, at a minimum depth of 24 inches below **lowest finished exterior grade** within 5 feet of the structure. Footings should bear solely on engineered fill.
- 3) Dilled Shafts drilled into the dense to very dense native soils at a minimum depth of 12 feet below existing grade. A minimum shaft diameter of 24 inches is recommended.

These bearing capacities refer to the total of all loads, dead and live, and are net pressures. They may be increased one-third for wind, seismic or other loads of short duration. All footing excavations should be level and cleaned of all loose or disturbed materials. **Positive drainage away from the proposed structures must be maintained at all times.**

Caissons should consist of drilled shaft foundations bearing in the dense to very dense clayey sand zone. Tie beams between caissons are not considered necessary for lateral loads up to 10 percent of the vertical load. A minimum caisson length of 12 feet is recommended. Design and construction should assume straight shaft caissons. Sloughing could occur in the upper sandy layers resulting in concrete quantities higher than neat dimension calculations. Drilled shafts should not be left over night to reduce the amount of sloughing (or water intrusion) that may occur. A minimum shaft diameter of 24 inches is recommended to allow access for cleaning and inspection. All caissons should be examined by a representative of the geotechnical engineer to verify cleaning, depth, dimensions and proper bearing strata.

Straight shaft caissons may be "machine cleaned" provided the contractor can show the ability to adequately remove loose material. Adjacent caisson base (tip) elevations should not vary by more than 45 degrees.

A minimum allowable distance of 3 caisson diameters, center-to-center, is recommended between caissons for reasons of construction safety and to reduce group action. This limitation ensures that newly placed caissons are not damaged during the subsequent placement of adjacent caissons. This distance may be reduced to 2 diameters if one of the caissons has been in place for enough time to allow concrete to set and cure. A load bearing reduction factor of 0.7 should be applied to individual caissons within a proximity of two diameters, center-to-center, of each other. If adjacent caissons are of different diameters, an average of the diameters should be used for determining spacing.

Continuous wall footings and isolated rectangular footings should be designed with minimum widths of 16 and 24 inches respectively, regardless of the resultant bearing pressure. Lightly loaded interior partitions (less than 800 plf) may be supported on reinforced thickened slab sections (minimum 12 inches of bearing width).

Estimated settlements under design loads are on the order of ½ to 1-inch, virtually all of which will occur during construction. Post-construction differential settlements will be on the order of ½ the total settlement, under existing and compacted moisture contents. Additional localized settlements of the same magnitude could occur if native supporting soils were to experience a significant increase in moisture content. **Positive drainage away from structures, and controlled routing of roof runoff should be provided to prevent ponding adjacent to perimeter walls.** Care should be taken in design and construction to insure that domestic and interior storm drain water is contained to prevent seepage.

Continuous footings and stem walls should be reinforced to distribute stresses arising from small differential movements, and long walls should be provided with control joints to accommodate these movements. Reinforcement and control joints are suggested to allow slight movement and prevent minor floor slab cracking.

3.4 Lateral Pressures

The following lateral pressure values may be utilized for the proposed construction and are based on the foundations bearing in the dense to very dense native soils or on re-compacted native soils:

Active Pressures

Unrestrained Walls	38 pcf
--------------------	--------

At-Rest Pressures

Restrained Walls	60 pcf
------------------	--------

Passive Pressures

Continuous Footings	350 pcf
Spread Footings and Drilled Shafts	400 pcf
Coefficient of Friction (w/ passive pressure)	0.35
Coefficient of Friction (w/out passive pressure)	0.45

All backfill must be compacted to not less than 95 percent (ASTM D-698) to mobilize these passive values at low strain. These values do not include a factor of safety and they assume drained conditions. Expansive soils should not be used as retaining wall backfill, except as a surface seal to limit infiltration of storm/irrigation water. The expansive pressures could greatly increase active pressures.

3.5 Fill and Backfill

Native soils are considered suitable for use in grading fills provided they are moisture conditioned to at least optimum to 3 percent above optimum, and lightly but uniformly compacted to at least 90 percent but not more than 95 percent of maximum dry density if placed in the top foot of pad fill. A preferable method would be to top out the pad with 12 inches of low or non-expansive fill.

If imported common fill for use in site grading is required, it should be examined by a Soils Engineer to ensure that it is of low swell potential and free of organic or otherwise deleterious material. In general, the fill should have 100 percent passing the 3-inch sieve and no more than 60 percent passing the 200 sieve. For the fine fraction (passing the 40 sieve), the liquid limit and plasticity index should not exceed 30 percent and 10 percent, respectively. It should exhibit less than 1.5 percent swell potential when compacted to 95 percent of maximum dry density (ASTM D-698) at a moisture content of 2 percent below optimum, confined under a 100 psf surcharge, and inundated.

Fill should be placed on subgrade, which has been properly prepared and approved by a Soils Engineer. Fill must be wetted and thoroughly mixed to achieve optimum moisture content, ± 2 percent (optimum to +3 percent for under-slab fill). Fill should be placed in horizontal lifts of 8-inch thickness (or as dictated by compaction equipment) and compacted to the percent of maximum dry density per ASTM D-698 set forth as follows:

- | | | |
|----|--|-------------|
| A. | Building Areas | |
| 1. | Below footing level | 95 |
| 2. | Below slabs-on-grade (non-expansive soils) | 95 |
| 3. | Below slabs-on-grade (expansive soils) | 90-95 (max) |

B.	Pavement Subgrade or Fill	95
C.	Utility Trench Backfill	95
D.	Aggregate Base Course	
1.	Below floor slabs	95
2.	Below asphalt paving	100
E.	Landscape Areas	90

3.6 Utilities Installation

Trench excavations for utilities can be accomplished by conventional trenching equipment. Trench walls should stand near-vertical for the short periods of time required to install shallow utilities although some sloughing may occur in looser and/or sandier soils requiring laying back of side slopes and/or temporary shoring. Adequate precautions must be taken to protect workmen in accordance with all current governmental regulations.

Backfill of trenches may be carried out with native excavated material. This material should be moisture-conditioned, placed in 8-inch lifts and mechanically compacted. Water settling is not recommended. Compaction requirements are summarized in the "Fill And Backfill" section of this report.

3.7 Slabs-on-Grade

To facilitate fine grading operations and aid in concrete curing, a 4-inch thick layer of granular material conforming to the gradation for aggregate base (A.B.) as per M.A.G. Specification Section 702 should be utilized beneath the slab. Dried subgrade soils **must** be re-moistened prior to placing the aggregate base if allowed to dry out, especially if fine-grained soils are used in the top 12-inches of the pad.

The native soils are capable of storing a significant amount of moisture, which could increase the natural vapor drive through the slab. Accordingly, if moisture sensitive flooring and/or adhesive are planned, the use of a vapor barrier directly below the concrete is recommended. Vapor barriers should be a minimum 15-mil thick polyolefin (or equivalent), which meets ASTM E 1745 Class A specifications. Vapor barriers do increase the potential for slab curling and water entrapment under the slab. Accordingly, if a vapor barrier is used, additional precautions such as low slump concrete, frequent jointing and proper curing will be required to reduce curling potential and detailed to prevent the entrapment of outside water sources.

3.8 Asphalt Concrete Pavement

It was not indicated if the pavement areas will be improved. The existing appears to be in fair condition and will continue to provide adequate services with continued maintenance. If earthwork in new paved areas is carried out to finish subgrade elevation as set forth herein, the subgrade will provide adequate support for pavements. The location designation is for reference only. The designer/owner should choose the appropriate sections to meet the anticipated traffic volume and life expectancy. The section capacity is reported as daily ESALs, Equivalent 18 kip Single Axle Loads. Typical heavy trucks impart 1.0 to 2.5 ESALs per truck depending on load. It takes approximately 1200 passenger cars to impart 1 ESAL.

Table 3.8.1 Pavement Sections

Area of Placement	Daily 18-kip ESALs		Flexible		Rigid
	AC	PCCP	AC (0.39)	ABC (0.12)	PCCP
Auto Parking	7.5	7	2.0"	6.0"	5.0"
Main Drives & Fire Lanes	29	19	3.0"	6.0"	6.0"
	60	43	3.0"	8.0"	7.0"

Notes:

1. Designs are based on AASHTO design equations and ADOT correlated R-values.
2. The PCCP thickness is increased to provide better load transfer, and reduce potential for joint and edge failures. Design PCCP per ACI 330R-87.
3. Full depth asphalt or increased asphalt thickness can be increased by adding 1.0-inch asphalt for each 3 inches of base course replaced.

Pavement Design Parameters:

Assume:	One 18 kip Equivalent Single Axle Load(ESAL)/Truck
Life:	20 years
Subgrade Soil Profile:	
% Passing #200 sieve:	51%
Plasticity Index:	11
k:	100 pci (assumed)
R value:	32 (per ADOT tables)
M _R :	19,400 (per AASHTO design)

These designs assume that all subgrades are prepared in accordance with the recommendations contained in the "Site Preparation" and "Fill and Backfill" sections of this report, and paving operations carried out in a proper manner. If pavement subgrade preparation is not carried out

immediately prior to paving, the entire area should be proof-rolled at that time with a heavy pneumatic-tired roller to identify locally unstable areas for repair.

Pavement base course material should be aggregate base per M.A.G. Section 702 Specifications. Asphalt concrete materials and mix design should conform to M.A.G. 710. It is recommended that a ½ inch or ¾ inch mix designation be used for the pavements. While a ¾ inch mix may have a somewhat rougher texture, it offers more stability and resistance to scuffing, particularly in truck turning areas. Pavement installation should be carried out under applicable portions of M.A.G. Section 321 and municipality standards. The asphalt supplier should be informed of the pavement use and required to provide a mix that will provide stability and be aesthetically acceptable. Some of the newer M.A.G. mixes are very coarse and could cause placing and finish problems. A mix design should be submitted for review to determine if it will be acceptable for the intended use.

For sidewalks and other areas not subjective to vehicular traffic a 4-inch section of concrete will be sufficient. For pavement areas with anticipated vehicular traffic a minimum section of 5 inches of concrete will provide adequate service. For trash and dumpster enclosures a thicker section of 6 inches of concrete is recommended.

Portland Cement Concrete Pavement must have a minimum 28-day flexural strength 550 psi (compressive strength of approximately 3,700 psi). It may be cast directly on the prepared subgrade with proper compaction (reduced) and the elevated moisture content as recommended in the report. Lacking an aggregate base course, attention must be paid to using low slump concrete and proper curing, especially on the thinner sections. No reinforcing is necessary. Joint design and spacing should be in accordance with ACI recommendations. Construction joints should contain dowels or be tongue and grooved to provide load transfer. Tie bars are recommended on the joints adjacent to unsupported edges. Maximum joint spacing in feet should not exceed 2 to 3 times the thickness in inches. Joint sealing with a quality silicone sealer is recommended to prevent water from entering the subgrade allowing pumping and loss of support. If joint sealing is not used, it is recommended to use a 4-inch aggregate subbase to reduce potential for loss of support due to water infiltration.

Proper subgrade preparation and joint sealing will reduce (but not eliminate) the potential for slab movements (thus cracking) on the expansive native soils. Frequent jointing will reduce uncontrolled cracking and increase the efficiency of aggregate interlock joint transfer.

3.9 Alternative Pavement

It is understood that portions of the onsite pavement may consist of concrete interlocking pavers. The brand and/or style are not known at this time. Design guidelines from the Interlocking Concrete Pavement Institute (ICPI) indicate that 80 mm (3.2 in.) pavers should be used for areas subject to vehicular traffic, especially truck traffic. The interlocking pavers should be installed per the manufacture recommendations including 1 to 1½ inches of washed concrete sand between the concrete pavers and base material. To reduce rutting and increase lateral support, the pavers should be installed in a herringbone pattern in accordance with the manufacture's recommendations.

Adequate drainage will be critical for long-term performance of the parking lot. Special attention must be paid to proper crowning (crossfall) and/or longitudinal slope to prevent ponding on the completed surface.

Table 3.9.2 Interlocking Pavement Sections

Area	Interlocking Paver Alternative		
	Surface	Base	Subgrade
Non-Vehicle Areas	60 mm Stone	8" ABC	8"
	80 mm Stone	4" ABC	8"
Subject to Vehicle Traffic	60 mm Stone	4" Concrete	8"
	80 mm Stone	8" ABC	8"
Notes: 1. Aggregate base should consist of crushed AB per M.A.G. Section 702. 2. If 60 mm stones are used in traffic areas, provide a minimum of 4 inches lean concrete base meeting M.A.G. 725 Class B concrete directly below the sand bed. 3. The exposed grade should be scarified to a depth of 8 inches, moisture conditioned to optimum (± 2 percent) and compacted to at least 95 percent of maximum dry density as determined by ASTM D-698.			

4.0 GENERAL

The scope of this investigation and report does not include regional considerations such as seismic activity and ground fissures resulting from subsidence due to groundwater withdrawal, nor any considerations of hazardous releases or toxic contamination of any type.

Our analysis of data and the recommendations presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific sample locations. Our work has been performed in accordance with generally accepted engineering principles and practice; this warranty is in lieu of all other warranties expressed or implied.

We recommend that a representative of the Soils Engineer observe and test the earthwork and foundation portions of this project to ensure compliance to project specifications and the field applicability of subsurface conditions which are the basis of the recommendations presented in this report. If any significant changes are made in the scope of work or type of construction that was assumed in this report, we must review such revised conditions to confirm our findings if the conclusions and recommendations presented herein are to apply.

Respectfully submitted,
SPEEDIE & ASSOCIATES, INC.


Timothy J. Rheinschmidt, R.G.




Keith R. Gravel, P.E.



APPENDIX A

FIELD AND LABORATORY INVESTIGATION

SOIL BORING LOCATION PLAN

SOIL LEGEND

LOG OF TEST BORINGS

TABULATION OF TEST DATA

CONSOLIDATION TEST

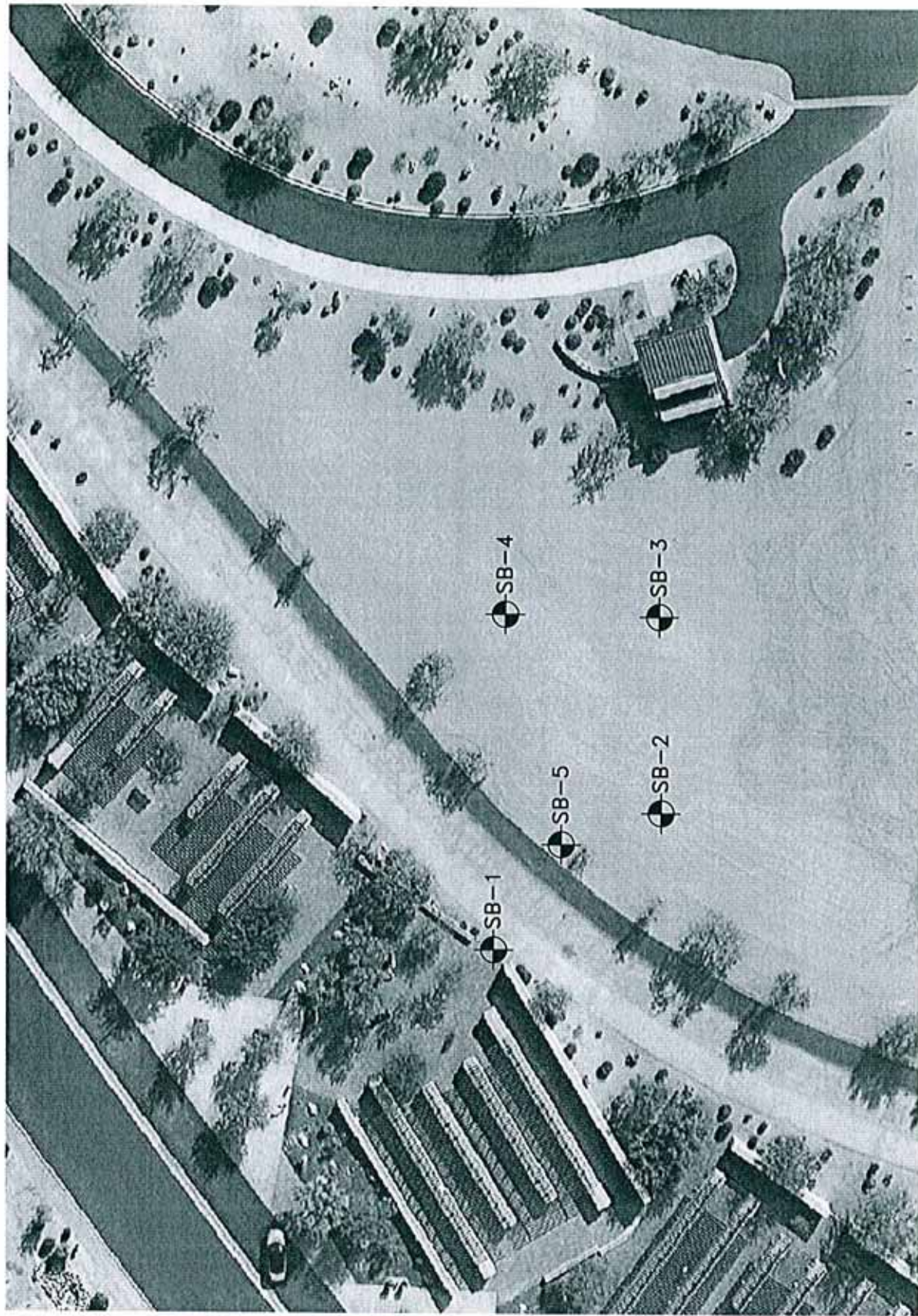
MOISTURE-DENSITY RELATIONS

SWELL TEST DATA

FIELD AND LABORATORY INVESTIGATION

On October 3, 2011, soil test borings were drilled at the approximate locations shown on the attached Soil Boring Location Plan. All exploration work was carried out under the full-time supervision of our staff engineer, who recorded subsurface conditions and obtained samples for laboratory testing. The soil borings were advanced with a truck-mounted CME-75 drill rig utilizing 7-inch diameter hollow stem flight augers. Detailed information regarding the borings and samples obtained can be found on an individual Log of Test Boring prepared for each drilling location.

Laboratory testing consisted of moisture content, dry density, grain-size distribution and plasticity (Atterberg Limits) tests for classification and pavement design parameters. Remolded swell tests were performed on samples compacted to densities and moisture contents expected during construction. Compression tests were performed on a selected ring sample in order to estimate settlements and determine effects of inundation. All field and laboratory data is presented in this appendix.




 - APPROXIMATE BORING LOCATIONS










IMAGE COURTESY OF: MARICOPA COUNTY ASSESSOR

















SOIL BORING LOCATION PLAN		NATIONAL MEMORIAL CEMETERY OF ARIZONA 23029 N. CAVE CREEK ROAD PHOENIX, ARIZONA	
DR:	BJA	CHK:	REV:
DATE: 10/5/2011		PROJECT NO. 111207SA	

SPEEDIE AND ASSOCIATES
 GEOTECHNICAL/ENVIRONMENTAL/MATERIALS ENGINEERS
 3331 E. WOOD ST.
 PHOENIX, ARIZONA 85046
 (602) 987-6361

SOIL LEGEND

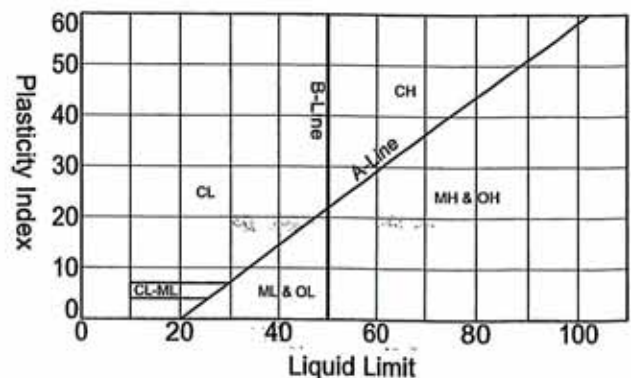
SAMPLE DESIGNATION		DESCRIPTION	
	AS	Auger Sample	A grab sample taken directly from auger flights.
	BS	Large Bulk Sample	A grab sample taken from auger spoils or from bucket of backhoe.
	S	Spoon Sample	Standard Penetration Test (ASTM D-1586) Driving a 2.0 inch outside diameter split spoon sampler into undisturbed soil for three successive 6-inch increments by means of a 140 lb. weight free falling through a distance of 30 inches. The cumulative number of blows for the final 12 inches of penetration is the Standard Penetration Resistance.
	RS	Ring Sample	Driving a 3.0 inch outside diameter spoon equipped with a series of 2.42-inch inside diameter, 1-inch long brass rings, into undisturbed soil for one 12-inch increment by the same means of the Spoon Sample. The blows required for the 12 inches of penetration are recorded.
	LS	Liner Sample	Standard Penetration Test driving a 2.0-inch outside diameter split spoon equipped with two 3-inch long, 3/8-inch inside diameter brass liners, separated by a 1-inch long spacer, into undisturbed soil by the same means of the Spoon Sample.
	ST	Shelby Tube	A 3.0-inch outside diameter thin-walled tube continuously pushed into the undisturbed soil by a rapid motion, without impact or twisting (ASTM D-1587).
	--	Continuous Penetration Resistance	Driving a 2.0-inch outside diameter "Bullnose Penetrometer" continuously into undisturbed soil by the same means of the spoon sample. The blows for each successive 12-inch increment are recorded.

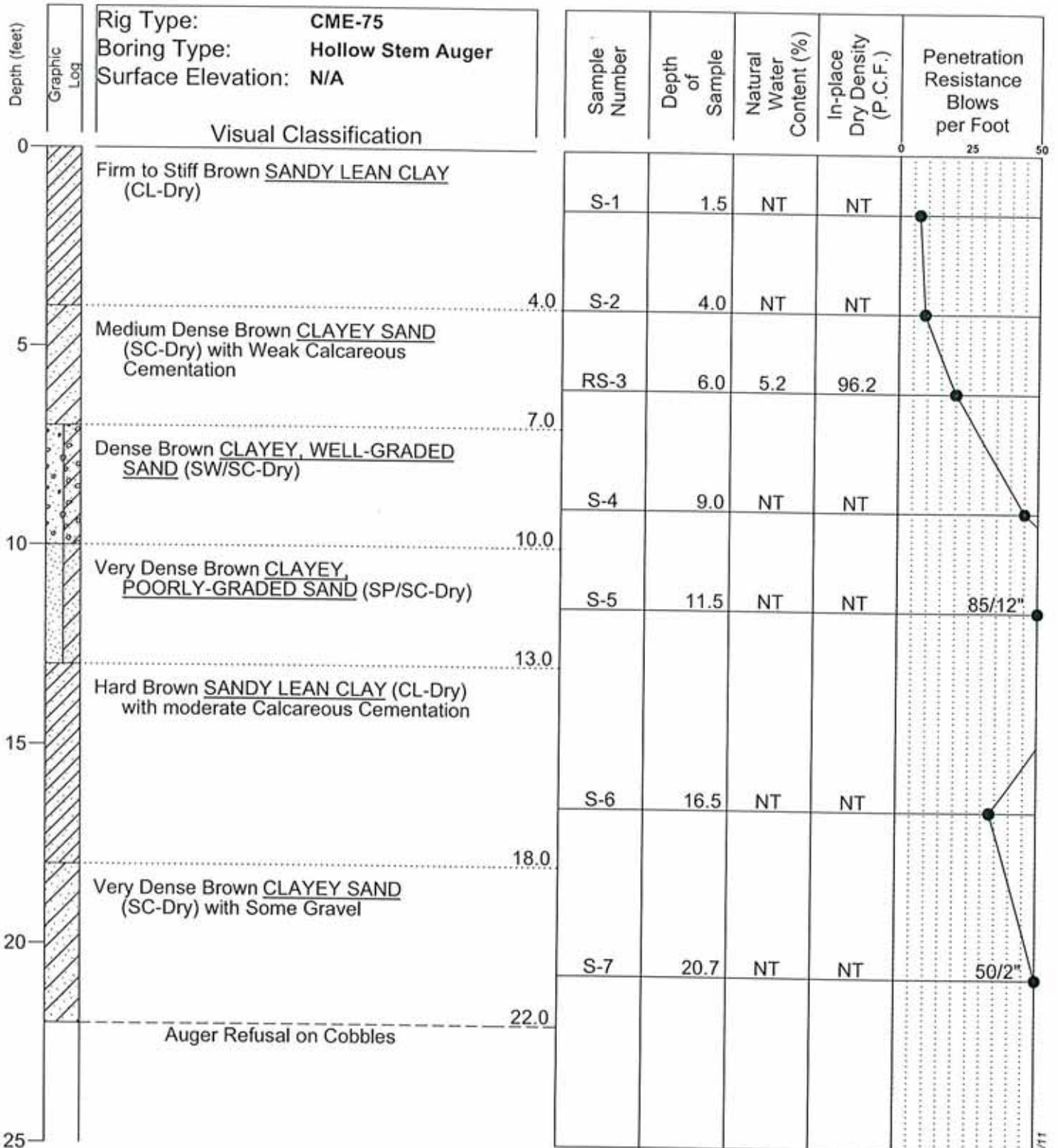
CONSISTENCY			RELATIVE DENSITY	
Clays & Silts	Blows/Foot	Strength (tons/sq ft)	Sands & Gravels	Blows/Foot
Very Soft	0 - 2	0 - 0.25	Very Loose	0 - 4
Soft	2 - 4	0.25 - 0.5	Loose	5 - 10
Firm	5 - 8	0.5 - 1.0	Medium Dense	11 - 30
Stiff	9 - 15	1 - 2	Dense	31 - 50
Very Stiff	16 - 30	2 - 4	Very Dense	> 50
Hard	> 30	> 4		

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
FINE GRAINED SOILS	SAND AND SANDY SOILS	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		LIQUID LIMIT LESS THAN 50		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
		LIQUID LIMIT LESS THAN 50		MH	INORGANIC SILTS, MICACEOUS OR OATONACEOUS FINE SAND OR SILTY SOILS
HIGHLY ORGANIC SOILS	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		CH	INORGANIC CLAYS OF HIGH PLASTICITY
		LIQUID LIMIT GREATER THAN 50		OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
		LIQUID LIMIT GREATER THAN 50		PT	PEAT, MARL, SWAMP SOILS WITH HIGH ORGANIC CONTENTS
	HIGHLY ORGANIC SOILS			PT	PEAT, MARL, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL OR MODIFIED SYMBOLS MAY BE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS OR TO PROVIDE A BETTER GRAPHICAL PRESENTATION OF THE SOIL

MATERIAL SIZE	PARTICLE SIZE			
	Lower Limit		Upper Limit	
	mm	Sieve Size *	mm	Sieve Size *
SANDS				
Fine	0.075	#200	0.42	#40
Medium	0.420	#40	2.00	#10
Coarse	2.000	#10	4.75	#4
GRAVELS				
Fine	4.75	#4	19	0.75" x
Coarse	19	0.75" x	75	3" x
COBBLES	75	3" x	300	12" x
BOULDERS	300	12" x	900	36" x
*U.S. Standard		*Clear Square Openings		





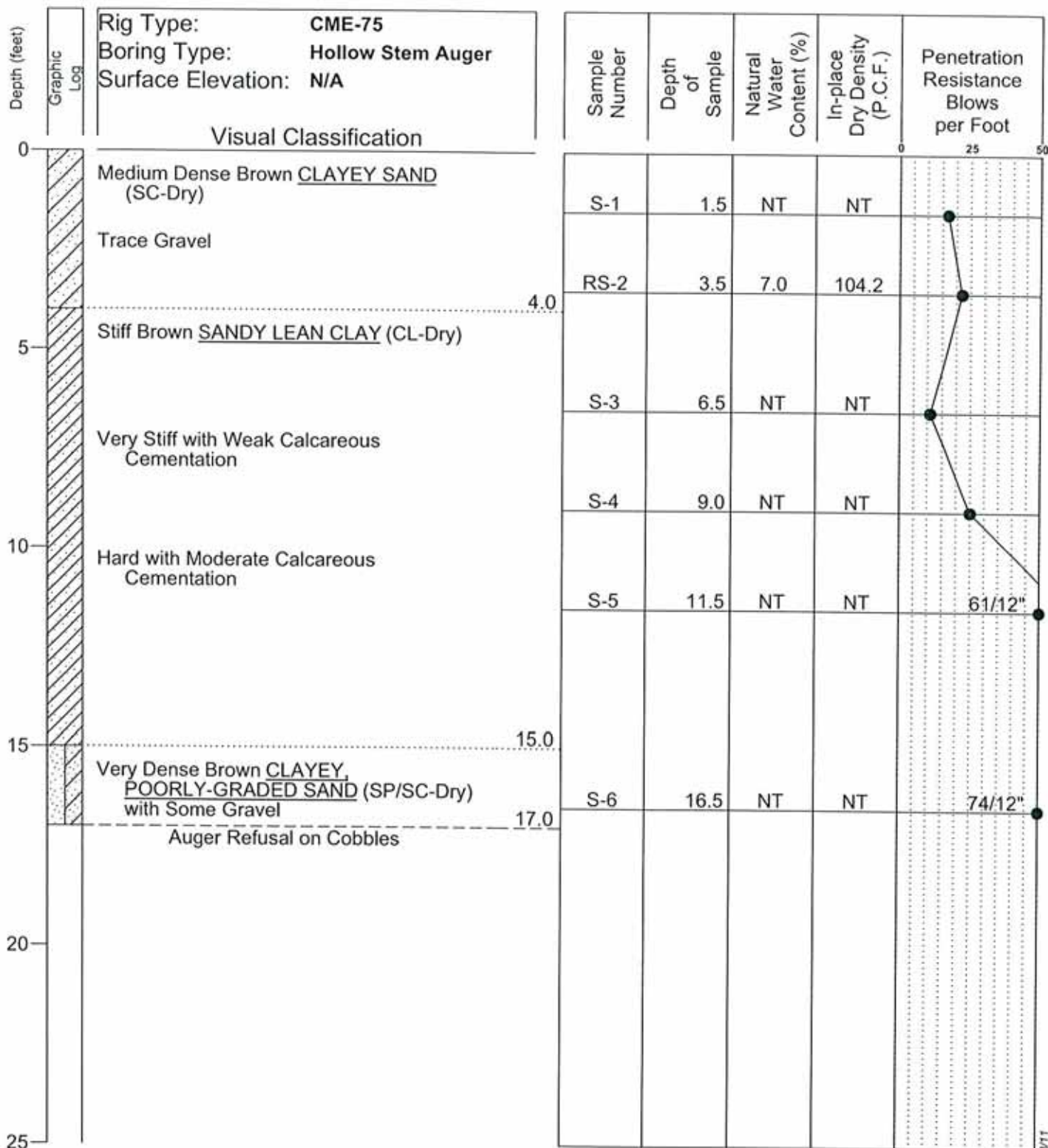
Boring Date: 10-3-11
 Field Engineer/Technician: B. Amos
 Driller: C. Riley
 Contractor: Geomechanics SW

Water Level		
Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES
Log of Test Boring Number: SB-1
National Cemetery of Arizona 23029 N. Cave Creek Rd Phoenix, Arizona Project No.: 111207SA

SPEEDIE 111207SA.GPJ GENGEO.GDT 10/18/11



Boring Date: 10-3-11
 Field Engineer/Technician: B. Amos
 Driller: C. Riley
 Contractor: Geomechanics SW

Water Level		
Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

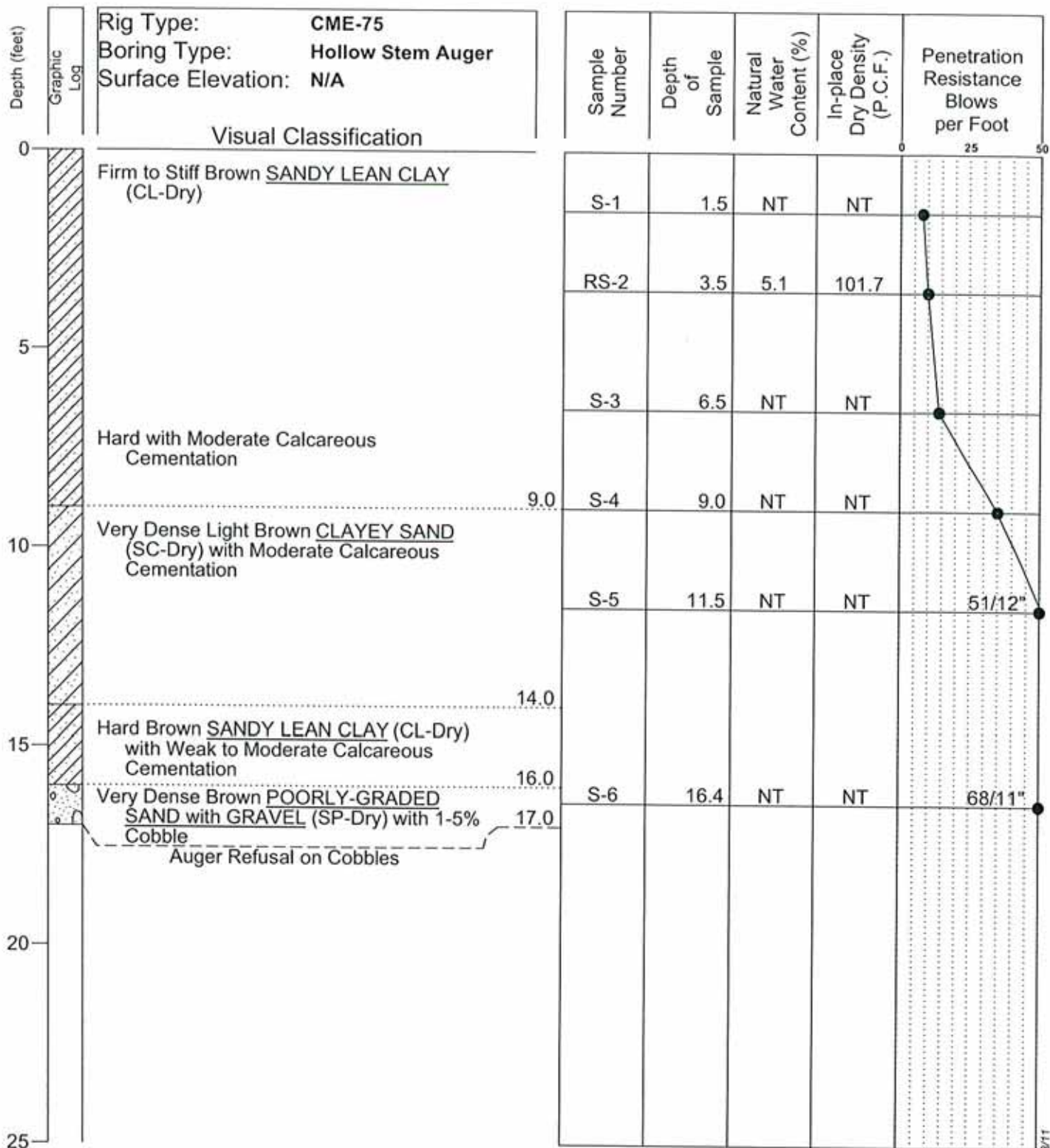
Log of Test Boring Number: **SB-2**

National Cemetery of Arizona

23029 N. Cave Creek Rd

Phoenix, Arizona

Project No.: 111207SA



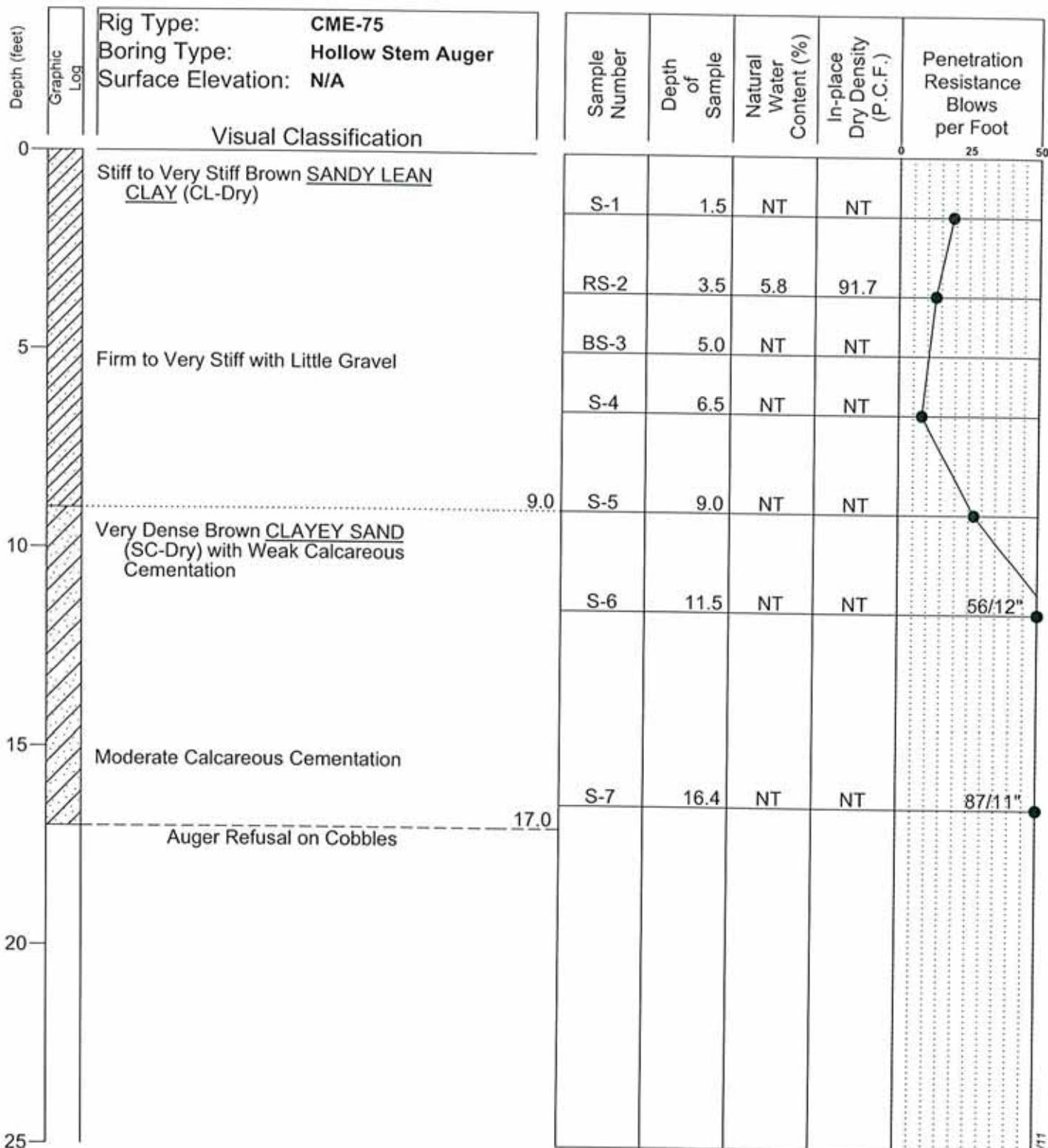
Boring Date: **10-3-11**
 Field Engineer/Technician: **B. Amos**
 Driller: **C. Riley**
 Contractor: **Geomechanics SW**

Water Level		
Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES
Log of Test Boring Number: SB-3
National Cemetery of Arizona 23029 N. Cave Creek Rd Phoenix, Arizona
Project No.: 111207SA

SPEEDIE 111207SA.GPJ GENOEQ.GDT 10/18/11



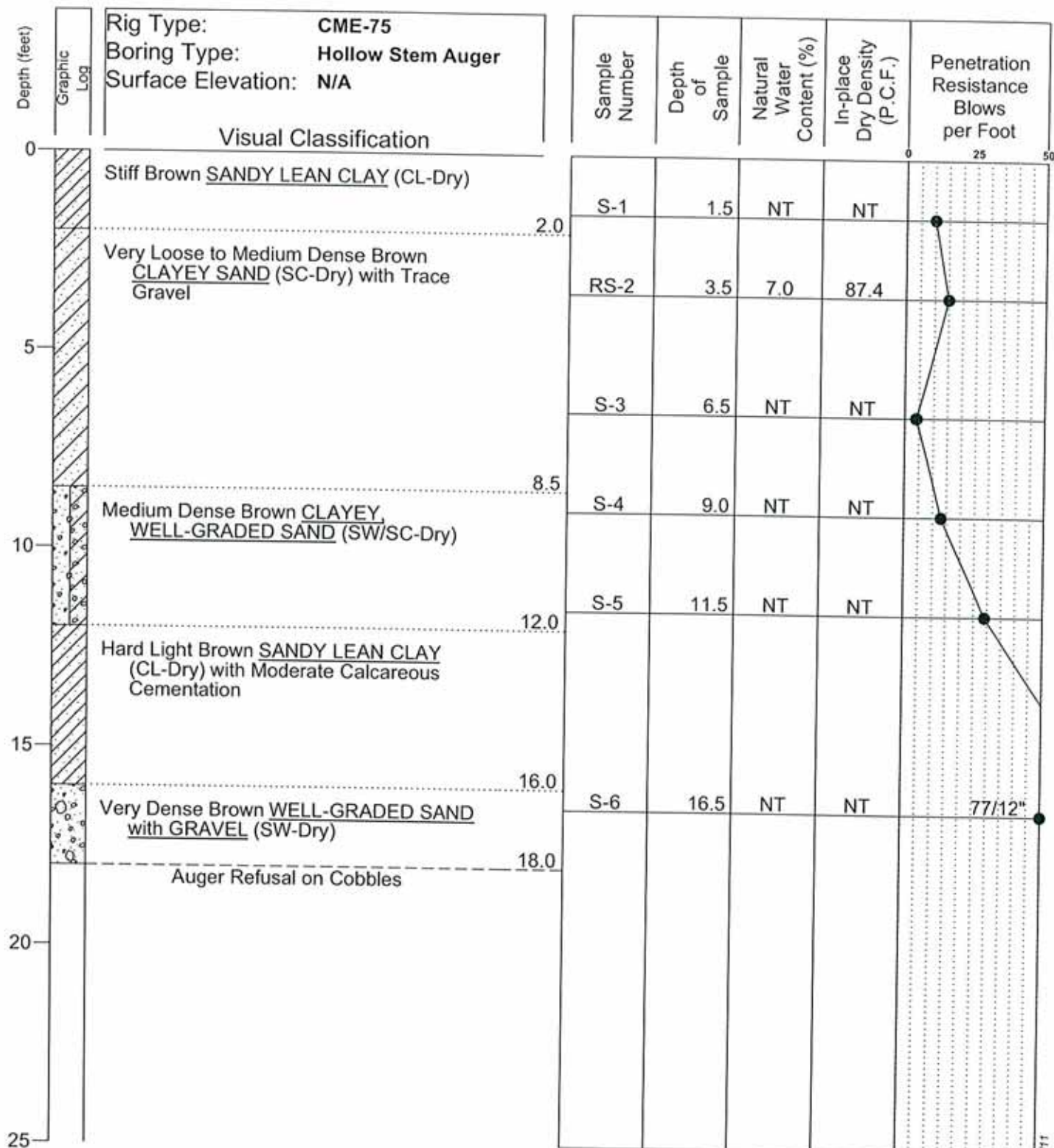
Boring Date: 10-3-11
 Field Engineer/Technician: B. Amos
 Driller: C. Riley
 Contractor: Geomechanics SW

Water Level		
Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES
Log of Test Boring Number: SB-4
National Cemetery of Arizona
23029 N. Cave Creek Rd
Phoenix, Arizona
Project No.: 111207SA

SPEEDIE 111207SA.GPJ GENGEO.GDT 10/18/11



Boring Date: 10-3-11
Field Engineer/Technician: B. Amos
Driller: C. Riley
Contractor: Geomechanics SW

Water Level		
Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

**SPEEDIE
AND ASSOCIATES**

Log of Test Boring Number: SB-5

National Cemetery of Arizona

23029 N. Cave Creek Rd

Phoenix, Arizona

Project No.: 111207SA

SPEEDIE 111207SA.GPJ GENGEO.GDT 10/18/11

TABULATION OF TEST DATA

SOIL BORING or TEST PIT NUMBER	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE INTERVAL (ft)	NATURAL WATER CONTENT (Percent of Dry Weight)	IN-PLACE DRY DENSITY (Pounds Per Cubic Foot)	PARTICLE SIZE DISTRIBUTION (Percent Finer)					ATTERBERG LIMITS			UNIFIED SOIL CLASSIFICATION	SPECIMEN DESCRIPTION
						#200 SIEVE	#40 SIEVE	#10 SIEVE	#4 SIEVE	3" SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
SB-1	RS-3	RING	5.0 - 6.0	5.2	96.2	60	74	87	95	100	30	15	15	CL	SANDY LEAN CLAY
SB-2	RS-2	RING	2.5 - 3.5	7.0	104.2	NT	NT	NT	NT	NT	NT	NT	NT		
SB-3	RS-2	RING	2.5 - 3.5	5.1	101.7	36	53	73	89	100	27	18	9	SC	CLAYEY SAND
SB-4	BS-3	BULK	0.1 - 5.0	NT	NT	59	72	86	95	100	25	14	11	CL	SANDY LEAN CLAY
SB-4	RS-2	RING	2.5 - 3.5	5.8	91.7	NT	NT	NT	NT	NT	NT	NT	NT		
SB-5	RS-2	RING	2.5 - 3.5	7.0	87.4	50	63	80	91	100	25	15	10	SC	CLAYEY SAND

Sieve analysis results do not include material greater than 3". Refer to the actual boring logs for the possibility of cobble and boulder sized materials.

NT=Not Tested

Sheet 1 of 1

National Cemetery of Arizona
23029 N. Cave Creek Rd
Phoenix, Arizona
Project No. 111207SA

SPEEDIE
AND ASSOCIATES

CONSOLIDATION TEST

PROJECT: National Cemetery of Arizona

PROJECT NO.: 111207SA

LOCATION: 23029 N. Cave Creek Rd

DATE: 10/3/11

BORING NO.: SB-3

SAMPLE NO.: RS-2

SAMPLE DEPTH: 2.5 to 3.5

LABORATORY NO.:

LIQUID LIMIT:

27

PLASTIC LIMIT:

18

PLASTICITY INDEX:

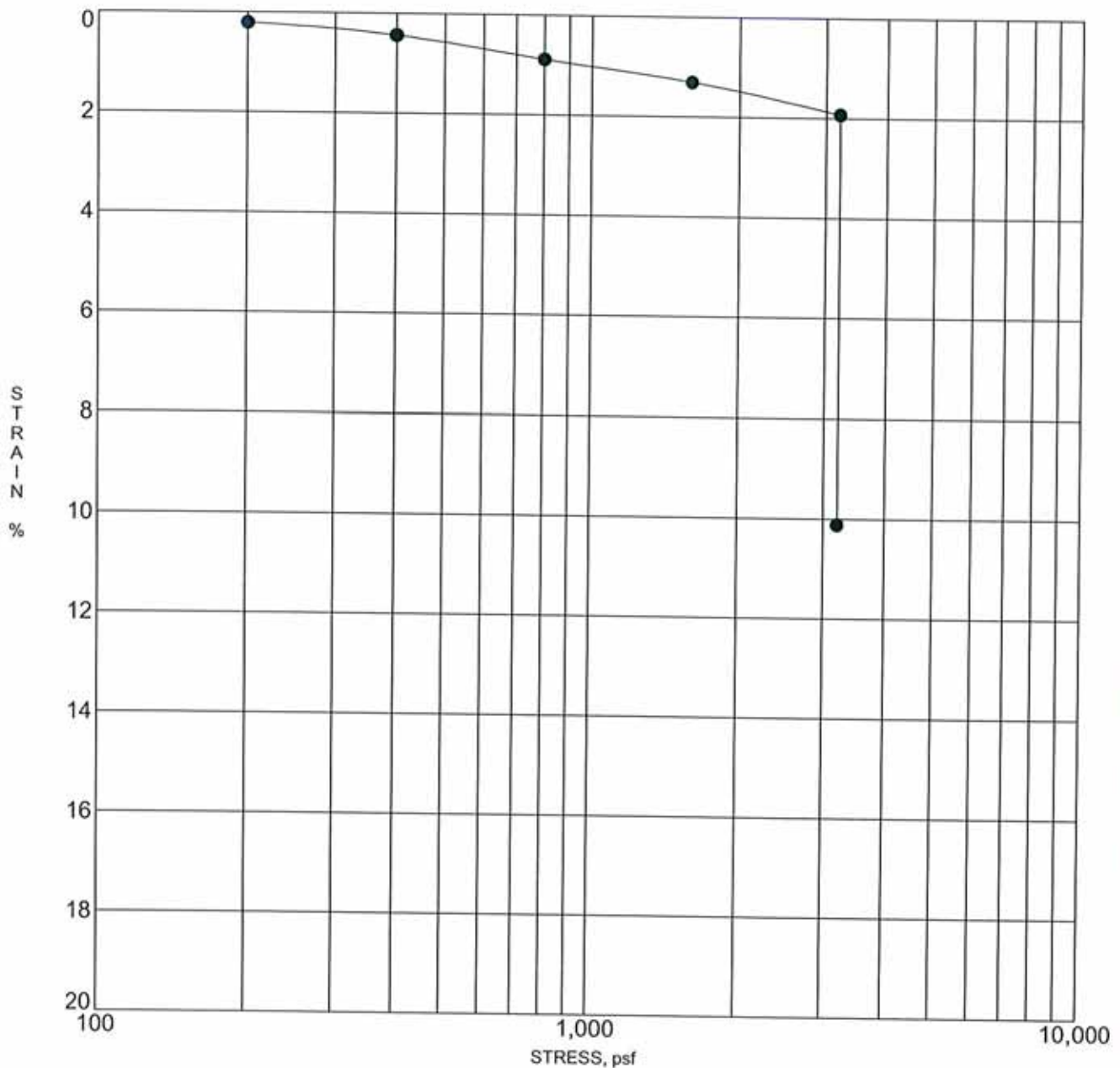
8

CLASSIFICATION:

SC

ASTM SOIL DESCRIPTION:

CLAYEY SAND



SPEEDIE
AND ASSOCIATES

CONSOLIDATION TEST

PROJECT: National Cemetery of Arizona

PROJECT NO.: 111207SA

LOCATION: 23029 N. Cave Creek Rd

DATE: 10/3/11

BORING NO.: SB-4

SAMPLE NO.: RS-2

SAMPLE DEPTH: 2.5 to 3.5

LABORATORY NO.:

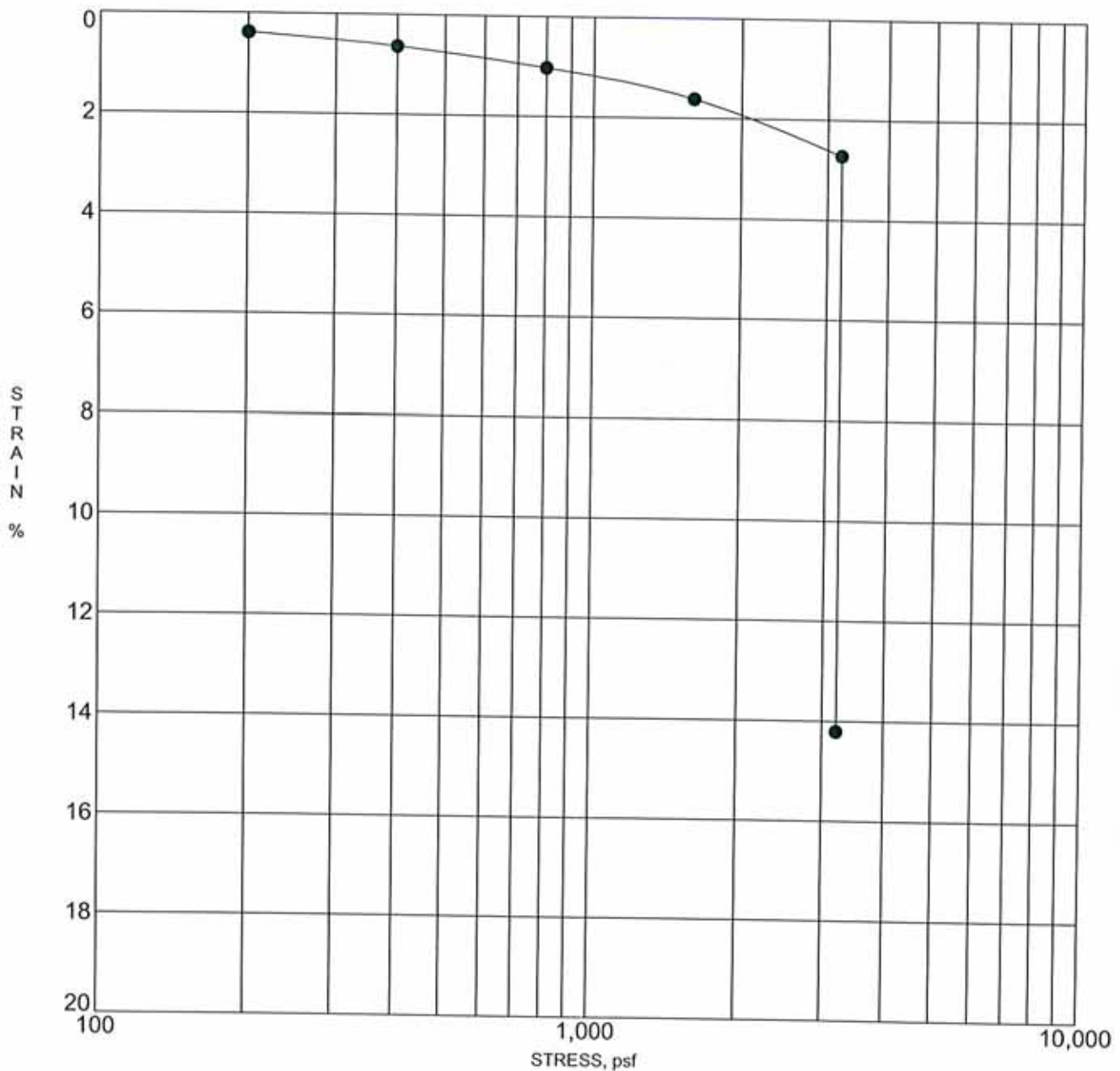
LIQUID LIMIT:

PLASTIC LIMIT:

PLASTICITY INDEX:

CLASSIFICATION:

ASTM SOIL DESCRIPTION:



SPEEDIE
AND ASSOCIATES

CONSOLIDATION TEST

PROJECT: National Cemetery of Arizona

PROJECT NO.: 111207SA

LOCATION: 23029 N. Cave Creek Rd

DATE: 10/3/11

BORING NO.: SB-5

SAMPLE NO.: RS-2

SAMPLE DEPTH: 2.5 to 3.5

LABORATORY NO.:

LIQUID LIMIT:

25

PLASTIC LIMIT:

15

PLASTICITY INDEX:

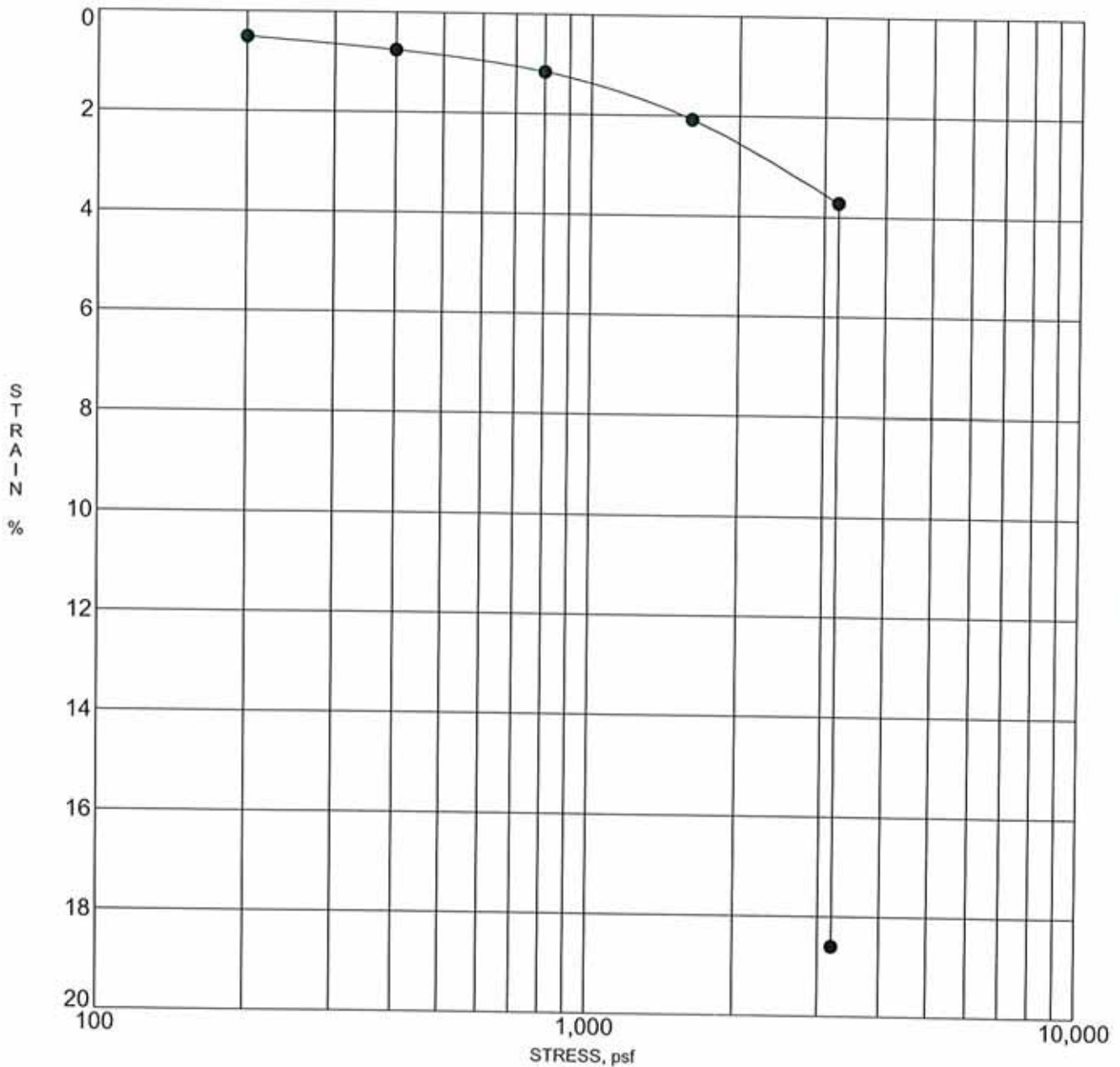
10

CLASSIFICATION:

SC

ASTM SOIL DESCRIPTION:

CLAYEY SAND



Sample inundated at end of test at 3200 psf

**SPEEDIE
AND ASSOCIATES**

MOISTURE-DENSITY RELATIONS

PROJECT: National Cemetery of Arizona

PROJECT NO.: 111207SA

LOCATION: 23029 N. Cave Creek Rd

DATE: 10/3/11

BORING NO.: SB-4 SAMPLE NO.: BS-3

SAMPLE DEPTH: 0.1 to 5

LABORATORY NO.:

METHOD OF COMPACTION: D698A

LIQUID LIMIT: 25

PLASTIC LIMIT: 14

PLASTICITY INDEX:

11

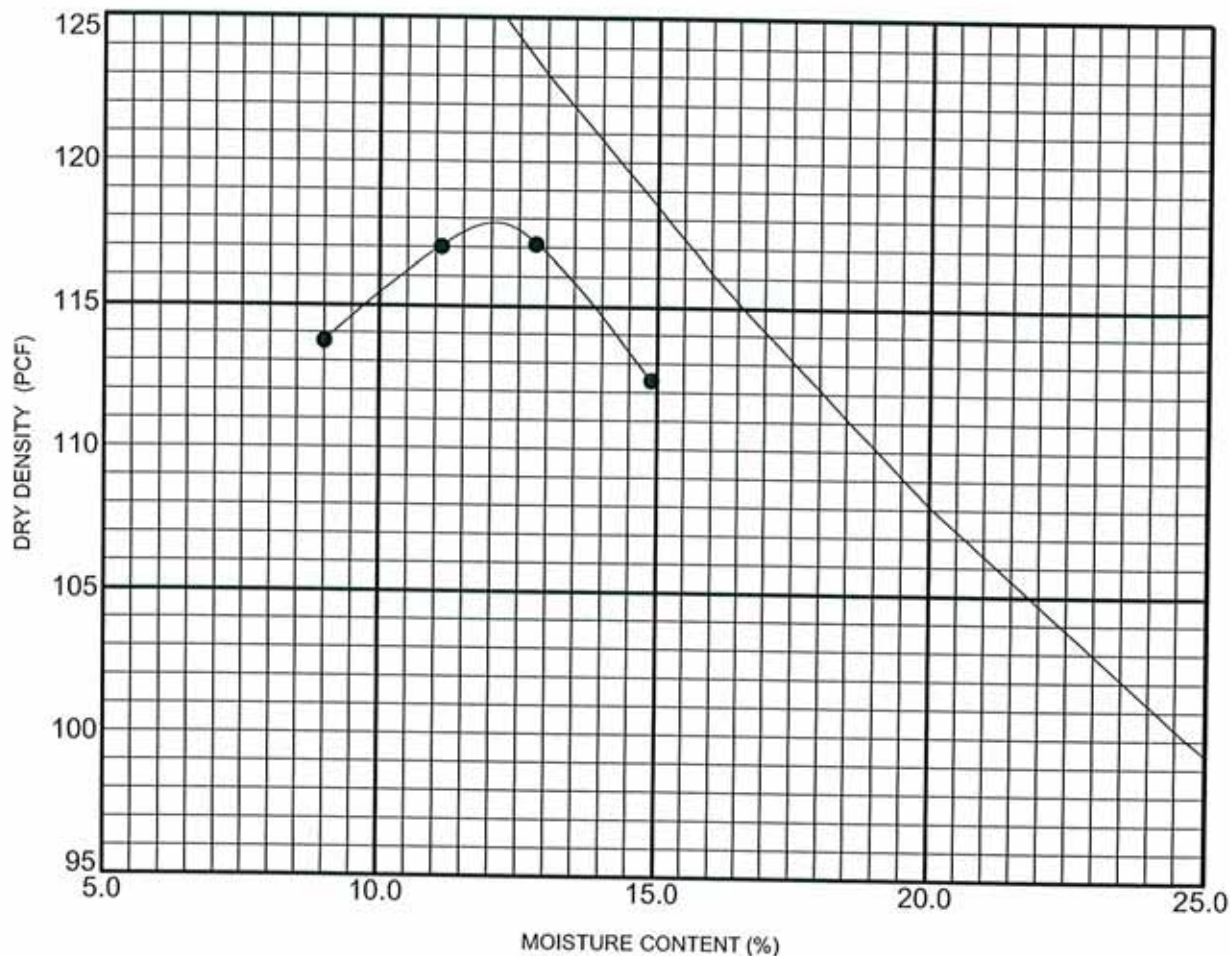
CLASSIFICATION: CL

ASTM SOIL DESCRIPTION:

SANDY LEAN CLAY

MAXIMUM DRY DENSITY: 117.9 PCF

OPTIMUM MOISTURE CONTENT: 12.1%



**SPEEDIE
AND ASSOCIATES**

SWELL TEST DATA

BORING or TEST PIT No.	SAMPLE DEPTH, ft	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)	REMOLDED DRY DENSITY (pcf)	INITIAL MOISTURE CONTENT (%)	PERCENT COMPACTION	FINAL MOISTURE CONTENT (%)	CONFINING LOAD (psf)	TOTAL SWELL (%)
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SB-4, BS-3	5.0	117.9	12.1	111.7	10.5	94.7	17.1	100	2.1
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National Cemetery of Arizona
23029 N. Cave Creek Rd
Phoenix, Arizona
Project No. 111207SA

**SPEEDIE
AND ASSOCIATES**