

**SECTION 32 30 00
SITE FURNISHINGS**

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Reference specification 010002 "General Requirements".

1.2 DESCRIPTION

- A. Work Included: Provide manpower, materials, tools 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. Provide indicated drainage facilities to free drain water.
 2. Steel Pipe Bollards, Chain and Locks

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 00: CAST-IN-PLACE-CONCRETE

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):
 - B221-08 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
 - A53/A53M-2012Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - A865/A865M-06(2017)Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints
- 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

- A. Flower watering station materials, dimensions, functionality, construction, finishes and colors shall fully comply with the specifications and Contract Drawings or be deemed as approved 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 approved 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 by the reviewer as being less than that specified and shown in the Contract Drawings, then the process for attempting approval as an approved equal shall NOT be performed as a submittals process and the submittal will be returned unapproved. Any further attempt to have the product approved for use in the project shall 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. The elements included in the flower watering station to which this paragraph is applicable are:

1. TRASH RECEPTACLE (Paragraph 2.2 of this Specification Section)
2. FLOWER VASE RECEPTACLE (Paragraph 2.3 of this Specification Section)
3. WATER SPIGOT ASSEMBLIES (Paragraph 2.4 of this Specification Section)

2.2 TRASH RECEPTACLE

- A. Trash receptacles shall completely meet the specifications and Contract Drawings or be approved as an equal.
- B. MATERIALS
 1. Main body construction shall be 3/8" x 1" vertical solid steel bar; 1/4" x 2-1/2" horizontal solid steel bands; 3/8" x 3" steel support bars; 5/8" solid steel top ring; leveling feet with 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 36-gallon capacity high density plastic inner liner with its weight not to exceed (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. Standard colors: Victor Stanley Standard Bronze.
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 where the thickness of the resulting finish averages a minimum of 200-250 microns.
2. Project location has been determined to be a high salt abusive climate. Hot dip galvanizing before powder coating is required. Hot dip galvanizing will provide greater protection in salty climates (or where deicing chemicals possibly containing salt may be used) but yields a slightly less smooth coating finish. All of the fabricated metal components and castings shall be hot dip galvanized.

2.3 FLOWER VASE RECEPTACLE

- A. Flower vase receptacles shall completely meet the specifications and Contract Drawings or be approved as an equal.

B. MATERIALS:

1. All fabricated metal components are steel shot blasted, 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 where the thickness of the resulting finish averages a minimum of 200-250 microns.
2. Project location has been determined to be a high salt abusive climate. Hot dip galvanizing before powder coating is required. Hot dip galvanizing will provide greater protection in salty climates (or where deicing chemicals possibly containing salt may be used) but yields a slightly less smooth coating finish. All of the fabricated metal components and castings shall be hot dip galvanized.
3. Flower vase receptacles shall or 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 Victor Stanley color as the trash receptacles, with the following exceptions:
 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

- A. See drawings for requirements, and other specification sections for pipe and other component requirements. Submit for approval.

2.5 STEEL PIPE BOLLARDS AND CHAIN AND LOCK

- A. Provide steel pipe bollard, ASTM A-53, Grade B, seamless, galvanized steel, Schedule 40, where shown on the contract drawings. Fittings to meet ASTM A865. See specification 221100 for more information on requirements for bollard pipe/fittings. Minimum pipe bollard requirements are as follows: install a 4" diameter galvanized steel bollard, capped at the top, per above material requirements and bury entire length in an 18" diameter cylindrical concrete foundation which shall be from ground level down to a depth of 48". Provide between 1.5-3.0" concrete cover distance from bottom of galvanized steel bollard and the bottom of the concrete foundation. Note this concrete foundation will be installed in close proximity to a stone drain pit for the Water Station drain. Submit a shop drawing showing both the concrete foundation and the stone pit such that both will function as intended.

PART 3 - EXECUTION

3.1 INSPECTION

- 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 should immediately notify the Resident Engineer.

3.2 PREPARATION

- A. Stake alignment and locations for all site furnishings for review and approval by Resident Engineer. 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 033000 – 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. All anchoring hardware shall be stainless steel. Coordinate all work with other trades.
4. Following installation of water spigot, install washed stone for splash area.

B. Pipe Bollards:

1. Install galvanized steel pipe bollards in concrete footings, 4,000 PSI @ 28 days, conforming to dimensions as indicated in Contract Drawings and in accordance with SECTION 033000 - CAST-IN-PLACE CONCRETE.
2. Backfill and compact excavation around bollard or sleeve in accordance with SECTION 31 20 00 – EARTH MOVING.
3. Ensure that all bollards are plumb and aligned within a maximum one-fourth inch tolerance of indicated location on plans or by requirement of regulatory requirements, whichever is more stringent.
4. Fill pipe bollard with concrete as shown. Provide rounded smooth, trowel finish top for positive drainage.
5. Clean any excess material from surface of bollard, and apply finish according to specifications.
6. Furnish and install galvanized steel eyebolts with washers and nuts as indicated for the chain and lock attachment. Furnish and install the chain and padlock(s) and provide spare locks and keys to the Resident Engineer.

3.4 CLEAN UP

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

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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.

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

C. Degree of Compaction: Degree of compaction is expressed as a percentage of maximum density obtained by the test procedure presented in any of the following: // AASHTO // T99 // T180 // Method A. // ASTM // D698 // D1557 // Method A. //

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.

1.4 CLASSIFICATION OF EXCAVATION

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

B. Classified Excavation: Removal and disposal of all material not defined as rock.

C. Rock Excavation:

1. Solid ledge rock (igneous, metamorphic, and sedimentary rock).
2. Bedded or conglomerate deposits so cemented as to present characteristics of solid rock which cannot be excavated without blasting; or the use of a modern power excavator (shovel, backhoe, or similar power excavators) of no less than 0.75 m³ (1 cubic yard) capacity, properly used, having adequate power and in good running condition.
3. Boulders or other detached stones each having a volume of 0.4 m³ (1/2 cubic yard) or more.

1.5 MEASUREMENT AND PAYMENT FOR ROCK EXCAVATION

- A. Measurement: Cross section and measure the uncovered and separated materials, and compute quantities by the Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 02, GENERAL REQUIREMENTS. Do not measure quantities beyond the following limits:
1. 300 mm (12 inches) outside of the perimeter of formed footings.
 2. 600 mm (24 inches) outside the face of concrete work for which forms are required, except for footings.
 3. 150 mm (6 inches) below the bottom of pipe and not more than the pipe diameter plus 600 mm (24 inches) in width for pipe trenches.
 4. The outside dimensions of concrete work for which no forms are required (trenches, conduits, and similar items not requiring forms).

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Rock Excavation Report:
1. Certification of rock quantities excavated.
 2. Excavation method.
 3. Labor.
 4. Equipment.
 5. Land Surveyor's or Civil Engineer's name and official registration stamp.
 6. Plot plan showing elevations.
- C. Furnish to Project Engineer and COR, soil samples, suitable for laboratory tests, of proposed off site or on site fill material.

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 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
- ASTM D6707 / D6707M - 06(2016)e1:
Standard Specification for Circular-Knit Geotextile for Use in Subsurface Drainage Applications
- ASTM D5034 - 09(2017): Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)
- E. Standard Specifications of State Department of Transportation, latest revision.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fills: Materials approved from on site and off site sources having a minimum dry density of 1760 kg/m³ (110 pcf), a maximum Plasticity Index of 6, and a maximum Liquid Limit of 30.
- B. Granular Fill:
1. Under concrete slab, crushed stone or gravel graded from 25 mm (1 inch) to 4.75 mm (No. 4).
 2. Bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No. 4).
- C. Fertilizer: (5-10-5) delivered to site in unopened containers that clearly display the manufacturer's label, indicating the analysis of the contents.
- D. Seed: Grass mixture comparable to existing turf delivered to site in unopened containers that clearly display the manufacturer's label, indicating the analysis of the contents.
- E. Sod: Comparable species with existing turf. Use State Certified or State Approved sod where possible. Deliver sod to site immediately after cutting and in a moist condition. Thickness of cut must be 19 mm to 32

mm (3/4 inch to 1 1/4 inches) excluding top growth. There shall be no broken pads and torn or uneven ends.

- F. Crushed Stone: Material conforming to the state's Standard Specifications for No. 2 Stone.
- G. Subbase Course: Material conforming to the state's Standard Specifications for Subbase Course, Type 2.
- H. Bedding / Drainage stone (aggregate) for foundation drainage and storm sewer pipe: AASHTO #57 stone.
- I. Buried Warning and Identification Tape: Metallic core or metallic-faced, acid- and alkali-resistant polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specific below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil. Warning tape color codes:
 - Red: Electric
 - Yellow: Gas, Oil, Dangerous Materials
 - Orange: Telephone and Other Communications
 - Blue: Water Systems
 - Green: Sewer Systems
- J. Separation Fabric: Fabric shall be non-woven with elongation greater than 50 percent and be on the state's Department of Transportation Approved Material List for separation application.
- K. Geotextile Filter Fabric: Geotextile fabric shall be needle punched non-woven geotextile composed of polypropylene fibers and conform to ASTM D6707. Elongation shall be greater than 50 percent and the flow rate shall be a minimum of 95 gpm/sqft. The filaments shall consist of a long-chain synthetic polymer and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure. The fabric shall have a minimum physical strength meeting industry standards when tested in accordance with ASTM D 5034 using the grab test method with 1 square inch jaws and a constant rate of travel of 12 inches per minute. The fabric shall be constructed so that the filaments will retain their relative position with respect to each other. The edges of the fabric shall be selvaged or otherwise finished to prevent the outer material from pulling away from the fabric. The fabric shall be woven into a width that may be installed as shown without longitudinal seams.

PART 3 - EXECUTION**3.1 SITE PREPARATION**

- A. Clearing: Clearing within the limits of earthwork operations as described or designated by the Project Engineer or COR. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash and any other obstructions. Remove materials from the Cemetery Property.
- B. Grubbing: Remove stumps and roots 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 Project Engineer or COR. Remove materials from the Cemetery Property. Trees and shrubs, shown to be transplanted, shall be dug with a ball of earth and burlapped in accordance with the latest issue of the, "American Standard for Nursery Stock", of the American Association of Nurserymen, Inc. Transplant trees and shrubs to a permanent or temporary position within two hours after digging. Maintain trees and shrubs held in temporary locations by watering as necessary and feeding semi-annually with liquid fertilizer with a minimum analysis of 5 percent nitrogen, 10 percent phosphorus and 5 percent potash. Maintain plants moved to permanent positions as specified for plants in temporary locations until the conclusion of the contract. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in the construction area. Repair immediately damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including the roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Building materials shall not be stored closer to trees and shrubs, that are to remain, than the farthest extension of their limbs.
- D. Stripping Topsoil: Unless otherwise indicated on the drawings, the limits of earthwork operations shall extend anywhere the existing grade is filled or cut or where construction operations have compacted or otherwise disturbed the existing grade or turf. Strip topsoil as defined herein, or as indicated in the geotechnical report, from within the limits of earthwork operations as specified above unless specifically

indicated or specified elsewhere in the specifications or shown on the drawings. Topsoil shall be fertile, friable, natural topsoil of loamy character and characteristic of the locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by the COR. Eliminate foreign material, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials, larger than 0.014 m³ (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on the station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work, shall not, under any circumstances, be carried out when the soil is wet so that the tilth of the soil will be destroyed.

1. Cemetery Projects: Recommend that the top soil be tested for chemicals, pesticides and fertilizers if topsoil is to be removed from lands formerly utilized as farmland, to verify suitability for use as topsoil in the cemetery where new lawn areas are to be established.
2. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from the Cemetery Property.

E. 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 Project Engineer or COR, at no additional cost to the Government. Do not remove shoring until permanent work in

excavation has been inspected and approved by Project Engineer or COR.

- B. Excavation Drainage: Operate pumping equipment, and/or provide other materials, means and equipment as required, to keep excavations free of water and subgrades dry, firm, and undisturbed until approval of permanent work has been received from the Project Engineer or COR. Approval by the Project Engineer or COR is also required before placement of the permanent work on all subgrades. When subgrade for foundations has been disturbed by water, remove the disturbed material to firm undisturbed material after the water is brought under control. Replace disturbed subgrade in trenches by mechanically tamped sand or gravel. When removed disturbed material is located where it is not possible to install and properly compact disturbed subgrade material with mechanically compacted sand or gravel, the Project Engineer or COR should be contacted to consider the use of flowable fill.
- C. Blasting: Blasting shall be permitted only when authorized by the Project Engineer or COR. Blasting shall be done with explosives of such quantity and power, and fired in such sequence and locations as to not injure personnel, damage or crack rock against which concrete is to be placed, damage property, or damage existing work or other portions of new work. The Contractor shall be responsible for damage caused by blasting operations.
- D. Building Earthwork:
 - 1. Excavation shall be accomplished as required by drawings and specifications.
 - 2. Excavate foundation excavations to solid undisturbed subgrade.
 - 3. Remove loose or soft material to solid bottom.
 - 4. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete, poured separately from the footings.
 - 5. Do not tamp earth for backfilling in footing bottoms, except as specified.
- E. 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 Project Engineer or COR.

2. Sanitary and 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.
- F. Site Earthwork: Excavation shall be accomplished as required by drawings and specifications. Remove subgrade materials that are determined by the Project Engineer or COR 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 Project Engineer or COR, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. Testing of the soil shall be performed by the contractor's Testing Laboratory. 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.
- G. Finished elevation of subgrade shall be as follows:
- 1. Pavement Areas - bottom of the pavement or base course as applicable.
 - 2. Planting and Lawn Areas - 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 Project Engineer or COR.

- B. Proof-rolling Existing Subgrade: Proof-roll with a fully loaded dump truck. Make a minimum of one pass in each direction. Remove unstable uncompactable material and replace with granular fill material completed to mix requirements specified.
- C. Placing: Place material in horizontal layers not exceeding 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 Project Engineer or COR. 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 until there is no evidence of further compaction and to not less than 95 percent of the maximum density determined in accordance with any of the following test methods: // AASHTO // T99 // T180 // Method A // ASTM // D698 // D1557 Method A //.

3.4 GRADING

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
- B. Cut rough or sloping rock to level beds for foundations. In unfinished areas fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside the building away from the building walls for a minimum distance of 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 Project Engineer or COR 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 LAWN AREAS

- A. General: Harrow and till to a depth of 100 mm (4 inches), new or existing lawn areas to remain, which are disturbed during construction. Establish existing or design grades by dragging or similar operations. Do not carry out lawn areas earthwork out when the soil is wet so that the tilth of the soil will be destroyed. Plant bed must be approved by Project Engineer or COR before seeding or sodding operation begins.
- B. Finished Grading: Begin finish grading after rough grading has had sufficient time for settlement. Scarify subgrade surface in lawn areas to a depth of 100 mm (4 inches). Apply topsoil so that after normal compaction, dragging and raking operations (to bring surface to indicated finish grades) there will be a minimum of 100 mm (4 inches) of topsoil over all lawn areas; make smooth, even surface and true grades, which will not allow water to stand at any point. Shape top and bottom of banks to form reverse curves in section; make junctions with undisturbed areas to conform to existing topography. Solid lines within grading limits indicate finished contours. Existing contours, indicated by broken lines are believed approximately correct but are not guaranteed.
- C. Fertilizing: Incorporate fertilizer into the soil to a depth of 100 mm (4 inches) at a rate of 12 kg/100 m² (25 pounds per 1000 square feet).
- D. Seeding: Seed at a rate of 2 kg/100 m² (4 pounds per 1000 square feet) and accomplished only during periods when uniform distribution may be assured. Lightly rake seed into bed immediately after seeding. Roll seeded area immediately with a roller not to exceed 225 kg/m (150 pounds per foot) of roller width.
- E. Sodding: Topsoil shall be firmed by rolling and during periods of high temperature the topsoil shall be watered lightly immediately prior to laying sod. Sod strips shall be tightly butted at the ends and staggered in a running bond fashion. Placement on slopes shall be from the bottom to top of slope with sod strips running across slope. Secure sodded slopes by pegging or other approved methods. Roll sodded area with a

roller not to exceed 225 kg/m (150 pounds per foot) of the roller width to improve contact of sod with the soil.

- F. Watering: The contractor is responsible for having adequate water available at the site. As sodding or seeding is completed in any one section, the entire area shall be thoroughly irrigated by the contractor. For sod areas, this shall be done to a sufficient depth that the underside of the new sod pad and soil, immediately below sod, is thoroughly wet. Cemetery will be responsible for seed or sod areas once the area is accepted by the Government AND the required establishment period is completed by the contractor (if required, see specification 32 90 00 Planting for more information).

3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Cemetery property.
1. Remove 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 Project Engineer or COR 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 90 00
PLANTING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plants, soils, turf, and landscape materials and accessories.

1.2 RELATED REQUIREMENTS

- A. Topsoil Materials, Stripping and Stockpiling: Section 31 20 11, EARTH MOVING.
- B. Topsoil Testing: Section 01 45 29, TESTING LABORATORY SERVICES.
- C. Erosion control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- D. Protection of Trees and Plantings: Section 02 41 10, DEMOLITION AND SITE CLEARING.
- E. Topsoil Placement and Compaction Test: Section 31 20 11, EARTH MOVING.
- F. Landscape Irrigation: Section 32 84 00, PLANTING IRRIGATION.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American National Standards Institute (ANSI) Publications:
 1. ANSI Z60.1-2014 - Nursery Stock.
 2. ANSI Z133.1-2012 - Tree Care Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush- Safety Requirements.
- C. ASTM International (ASTM):
 1. C33/C33M-16-Concrete Aggregates.
 2. C136/C136M-14 - Sieve Analysis of Fine and Coarse Aggregates.
 3. D698-12 - Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 4. D977-13e1 - Emulsified Asphalt.
 5. D2028/D2028M-15 - Cutback Asphalt (Rapid-Curing Type).
 6. D2103-15 - Polyethylene Film and Sheeting.
- D. Hortus Third, most current edition: A Concise Dictionary of Plants Cultivated in the United States and Canada.
- E. National Cemetery Administration (NCA):
 1. Handbook 3410 - Integrate Pest Management.
 2. Handbook 3420-11 - Turfgrass Maintenance.
- F. Turfgrass Producers International (TPI):
 1. 2006 Guideline Specifications to Turfgrass Sodding.

- G. United States Department of Agriculture (USDA):
 - 1. Federal Seed Act-2011 - Rules and Regulations of the Secretary of Agriculture.
- H. United States Environmental Protection Agency (EPA):
 - 1. 40 CFR Part 503-1993 - Biosolids Rule.

1.4 PREINSTALLATION MEETINGS

- A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.
 - 1. Required Participants:
 - a. Contracting Officer's Representative (COR).
 - b. COR (RE).
 - c. Contractor.
 - d. Installer.
 - 2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
 - a. Inspection of planting materials.
 - b. Installation schedule.
 - c. Installation sequence.
 - d. Preparatory work.
 - e. Protection before, during, and after installation.
 - f. Installation.
 - g. Inspecting.
 - h. Environmental procedures.
 - 3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.5 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Description of each product.
 - a. Seeds.
 - b. Sod.
 - c. Soil amendments.
 - d. Antidesiccant.
 - e. Erosion control materials.
 - f. Hydro mulch.
 - g. Non-Asphaltic Trackifier.

- h. Herbicide.
 - i. Weed Control.
 - j. Mulches.
 - k. Edging.
2. Plant list: List of local/regional suppliers for each species to be installed. Include quantities, plant dimension (height x spread) and container/root ball size. Certify in writing, confirmed orders for plants by submitting a Bill of Sale for each plant to be installed. Each plant of the same species shall be supplied by one grower only unless otherwise approved by COR.
- a. Requests for substitutions of plants not available in size, quantity or type specified must be made within 30 days after Contract award. Submit written evidence that a specified plant cannot be obtained and has been unobtainable since Contract award.
 - b. Substitutions will only be authorized when a plant (or its alternates as specified) is not obtainable and COR, in consultation with District Agronomist, authorizes a change order for use of nearest equivalent obtainable size or variety of plant having same essential characteristics with an equitable adjustment of contract price.
3. Warranty shall match the standard 1 year period.
- C. Samples: Submit before beginning Work of this section:

Inert Mulch	2.3 kg (5 lb.) of each type to be used.
Organic Mulch	2.3 kg (5 lb.) of each type to be used.
Imported Topsoils	2.3 kg (5 lb.) of each type to be used.
Organic Amendments	2.3 kg (5 lb.) of each type to be used.

Inert Mulch	2.3 kg (5 lb.) of each type to be used.
All pesticides required such as preemergence or post emergence herbicides, insecticides, or fungicides.	EPA approved labeling and MSDS sheet for each such product selected for use.
Edging Materials	Manufacturer's standard size

D. Test reports: Certify products comply with specifications.

1. Imported Topsoil: Provide 2.3 kg (5 lbs.) representative sample from each proposed source for testing, analysis, and approval. Deliver samples to acceptable testing laboratory and have testing report sent directly to COR. Testing reports to include following tests and recommendations according to Association of Official Agricultural Chemists standards:

- a. Soil Composition: USDA particle size analysis indicating percentages of sand, silt and clay, and percent organic matter. Mechanical gradation (sieve analysis) and chemical (pH soluble salts) performed by public extension service agency, State Land Grant College, or certified private testing laboratory. Percentages of clay and silt to be determined by hydrometer.
- b. Percent of organics to be determined by loss on ignition of oven-dried samples. Test samples to be oven-dried to constant weight at 110 degrees C (230 degrees F), plus or minus 5 degrees C (41 degrees F).
- c. Macro and micro nutrient fertility tests as determined by Chemical analysis to include Macro and micro nutrient fertility tests as determined by pH, Salinity (EC), Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Soluble Copper, Zinc, Manganese, Iron, Saturation Extract Boron, Aluminum, Soluble Salts, Exchangeable Sodium Percentage (ESP), Sodium Adsorption Ratio (SAR).
- d. Tests, as specified, for gradation, organics, soil chemistry and pH to be performed by testing laboratory retained by National Cemetery Administration as described in Section 01 45 29, TESTING LABORATORY SERVICES.

- e. Include recommendations for soil additives to correct soils deficiencies, as necessary, and for fertilizing and to adjust soil pH to optimum range for the site and the specified sod type's liming applications to support successful turfgrass growth.
2. Organic Soil Amendment:
- a. Testing: Provide testing by an independent laboratory, with the experience and capability to conduct the testing indicated following U.S. Composting Council Seal of Testing Assurance (STA) procedures, or equivalent.
 - b. Soil Amendment Analysis: Provide documentation from supplier that compost has reached a monitored temperature of 140 degrees Fahrenheit for at least one week. Engage an independent soil testing laboratory to test representative samples of compost and provide compost analysis report for the following parameters:
 - 1) Percent organic matter, percent moisture, percent inerts (foreign matter), pH, soluble salts, and particle size.
 - 2) Nutrient content, including: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), and Magnesium (Mg) and Sulfur s.
 - 3) Trace Metals, including: Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), and Zinc (Zn).
 - 4) Maturity Indicator. Provide bioassay results. Provide Carbon-Nitrogen ratio.
 - 5) Stability Indicator: Provide respiration test results.
3. Amended Soil (in place): Following incorporation of amendments and additives, provide minimum six (6) samples per 3,700 sq. m (40,000 sq. ft.), 150 mm (6 inch) depth by 75 mm (3 inch) diameter core samples of amended soil taken from project site for testing, analysis, and approval. Locate each samples as directed by COR from areas designated to be planted in turfgrass. Deliver samples to testing laboratories and have testing report sent directly to COR. Obtain amended soil sample acceptance before seeding or hydroseeding.
- E. Certificates: Certify products comply with specifications.
- F. Before delivery, submit notarized certificates for approval to COR attesting that following materials meet specified requirements:

1. Plant Materials (Department of Agriculture certification by State Nursery Inspector from the state in which the plant material originates declaring material to be free from insects and disease).
 2. Fertilizers: Four certificates of analysis for each type of fertilizer.
 3. Lime
 4. Gypsum
 5. Soil Sulfur
 6. Humates
 7. Mycorrhizae
 8. Peat
 9. Seed: Include guaranteed percentages of purity, weed content and germination of seed, and net weight and date of shipment.
 10. Sod.
 11. Membranes.
 12. M-Binder
 13. Hydro Mulching: Number of kilograms (pounds) of materials to be used per liter (gallon) of water.
- G. Maintenance Data:
1. Care instructions for each plant material.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Regularly installs specified materials and products.
 2. Installed specified products with satisfactory service on five similar installations for minimum five years.

1.7 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.
- D. Bulk Products:
1. Deliver bulk products away from buildings, utilities, pavement, and existing turf and planted areas. Maintain dry bulk product storage away from contaminants. Protect products from weather.
 2. Install erosion control materials to prevent erosion or displacement of bulk products.

- E. Notify COR of delivery schedule five days in advance, minimum. COR will inspect materials upon arrival. Remove unacceptable plant materials from project site immediately.
- F. Protect plants during delivery to prevent damage to root balls or desiccation of leaves.
- G. Protect trees during transport by covering root balls and tying branches.
- H. Machine dug plants are permitted provided root balls are sized according to ANSI Z60.1 and tops are protected from damage.
- I. Protect sod from drying out.

1.8 STORAGE AND HANDLING

- A. Store seeds, soil amendments, fertilizers, and packaged materials in dry locations away from contaminants.
- B. Keep sod moist and protect from exposure to wind and direct sunlight.
- C. Store plants not installed on day of arrival at project site as follows:
 1. Shade and protect plants from wind when stored outside.
 2. Heel in bare root plants.
 3. Protect plants by covering roots with moist wood chips, shredded bark, peat moss, or similar mulching material.
 4. Keep plants moist including those in containers, by watering with fine mist spray until planted.

1.9 FIELD CONDITIONS

- A. Seasons and Conditions: unless more strictly noted herein, install products during their seasonally appropriate times. Note specific earliest date below for turfgrass.
- B. Perform turfgrass installation operations within following dates: Do not install turfgrass during the summer season until September 7th or later.
- C. Restrictions: Do not plant when ground is frozen, snow covered, saturated or in otherwise unsuitable condition for planting. Special conditions may exist that warrant variance in specified planting dates or conditions. Submit written request for approval to COR stating special conditions and proposal variance.

1.10 WARRANTY

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

- B. Comply with "Warranty" requirements in including the following supplements:
1. One Year Plant and Turfgrass Warranty: Warranty begins when Government accepts plants and turfgrass but not before end of Landscape Plant and Turfgrass Establishment Period.
 2. Replace any dead plant material and any areas void of turfgrass immediately during warranty period and during an active growing season. One year warranty for replaced plants and turfgrass begins on day replacement work is completed and accepted.
 3. Replacement of relocated plants, not furnished, is not required unless they die from improper handling and care. Loss due to improper handling, care, or negligence requires replacement in kind and size.
 4. Government will inspect replacement plants and turfgrass at end of Warranty period. Replace any dead, missing, or defective plant material and turfgrass immediately and during growing season. Warranty ends on date of this inspection provided work specified in this section is complied.
 5. Remove stakes, guys wires/straps at end of one year warranty.

PART 2 - PRODUCTS

2.1 PRODUCTS - GENERAL

- A. Provide each product from one source or manufacturer.
- B. Plant and Turf Grasses: Comply with the varieties specified or shown in plant list.
- C. Warrant plants are true to botanical name as listed in Hortus Third.
- D. Maintain equipment, tools and machinery on project site in sufficient quantities and capacity for proper execution of Work.

2.2 ORGANIC SOIL AMENDMENT

- A. Organic Soil Amendment: Dark brown or black and capable of enhancing plant growth. Ninety-eight percent of material passes 25 mm (1 inch) screen. No admixture of refuse (i.e. noticeable inert contamination) or materials toxic to plant growth are permitted, free of all woody fibers, seeds, leaf structures, plastic, petroleum products, and toxic and non-organic matter.
 1. Acceptable Organic Soil Amendments: Peat moss, humus or peat, and commercially available combinations thereof.

2. Acceptable Compost: Natural organic sources such as food or animal residuals, or yard trimmings.
3. Unacceptable Sole Sources of Organic Matter: Untreated sludge from wastewater treatment plants, fresh manure, sawdust, and immature composts.

2.3 PLANTS

- A. Plants: ANSI Z60.1, except as otherwise stated in this section or shown on drawings. Where drawings or specifications are in conflict with ANSI Z60.1, drawings and specification will prevail.
 1. Provide well-branched and formed planting stock, sound, vigorous, and free of disease, sunscald, windburn, abrasion, harmful insects or insect eggs with healthy, normal, and unbroken root systems.
 2. Provide single stemmed trees, with a single leader, unless otherwise indicated.
 3. Provide trees and shrubs of uniform, symmetrical growth, with straight boles or stems, free from objectionable disfigurements, and with branch spread of branches typical of variety.
 4. Provide ground cover and vine plants with number and length of runners for size, and proper age for grade of plants specified. Provide well established plants in removable containers, integral containers, or formed homogeneous soil sections.
 5. Provide plants grown under climatic conditions similar to those in project locality.
- B. Minimum acceptable sizes of all plants, measured with branches in normal position, to conform to plant list and ANSI Z60.1. Larger plants with COR's approval, at no additional cost to the Government. Increase ball of earth or spread of roots according to ANSI Z60.1 when larger plants are provided.
- C. Do not handle plants by trunk or stem. Trees must be moved by lifting root ball, box or container.
- D. Bare-root (BR) plants to have root system substantially intact, but with earth carefully removed. Cover roots with thick coating of mud by "puddling" after the plants are dug.
- E. Container grown plants to have sufficient root growth to hold earth intact when removed from containers, but not be root bound.
- F. When existing plants are to be relocated, ball sizes to conform to ANSI Z60.1 requirements for collected plants, with plants dug, handled, and replanted according to applicable requirements of this section.

2.4 LABELS

- A. Legibly tag each plant, or group and bundles or containers of the species, variety, and size of plant with durable, waterproof and weather-resistant label indicating correct plant name and size specified in plant list. Labels to be securely attached and not removed until acceptance by the Government.

2.5 TOPSOIL

- A. Topsoil: Provide well-graded soil of good uniform quality, natural, friable soil representative of productive soils in project vicinity. Topsoil to be free of subsoil, foreign matter, objects larger than 25 mm (1 inch) in any dimension, toxic substances, weeds and any material or substances that may be harmful to plant growth and have pH value of minimum 6.0 and maximum 7.0, and be best suited to region, climate and plant material specific to project.
- B. Obtain material from stockpiles established under Section 31 20 11, EARTH MOVING, subparagraph, Stripping Topsoil that meet general requirements stated above. Amend topsoil not meeting pH range specified by the addition of pH adjusters.
- C. When sufficient topsoil is not available on project site to specified depth, provide additional topsoil. Minimum 10 days before topsoil delivery, notify COR of sources from which topsoil will be furnished. Obtain topsoil meeting general requirements stated above and comply with requirements specified in Section 01 45 29, TESTING LABORATORY SERVICES. Amend topsoil not meeting pH range specified by adding pH adjusters.

2.6 INORGANIC SOIL AMENDMENTS

- A. Lime: Agricultural limestone, minimum 90 percent calcium and magnesium carbonates. Grind lime fineness, minimum 90 percent passes No. 8 mesh and minimum 25 percent passes No. 100 mesh. Maximum moisture, 10 percent.
 - 1. Dolomitic Lime: Natural, agricultural limestone (calcium and magnesium carbonate), minimum of 20 percent calcium and 11 percent magnesium and as follows:
 - a. Screen Analysis: 100 percent passing through No.30 sieve; 70 percent passing through No. 100 sieve; minimum 30 percent passing through No.325 sieve. Provide lime in form of granulated, prilled, dolomitic limestone.

2. Calcitic Lime: Natural, agricultural limestone (calcium carbonate), minimum of 36 percent calcium and as follows:
 - a. Screen Analysis: minimum of 100 percent passing through No. 10 sieve; minimum of 80 percent passing through No. 100 sieve.
Provide lime in form of granulated, prilled, limestone.
3. Agricultural Gypsum: Finely ground, minimum of 90 percent calcium sulfate, or 85 percent calcium sulfate dihydrate.
4. Sulfur: Granular, biodegradable, minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
5. Iron Sulfate: Granulated ferrous sulfate minimum of 20 percent iron and 10 percent sulfur.
6. Aluminum Sulfate: Commercial grade, unadulterated.
7. Sand: Clean washed river sand, free of calcium, chlorides and other deleterious substances.
8. Humates: Derived from mined Gypsum and with guaranteed minimum analysis; Calcium Sulfate dihydrate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) 35.00%; Calcium (Ca) 7.00%; Sulfur s 5.00%, plus Humic Acids 1.5% derived from Leonardite. Pelletized product used for ease of application.
9. Mycorrhizae: Endomycorrhizal powder inoculum consisting of the following 4 species blend of propagules of arbuscular mycorrhizal fungi: *Glomus intraradices*, *Glomus mosseae*, *Glomus aggregatum*, and *Glomus etunicatum*. Minimum 100,000 spores/propagules per pound. The powder particle size shall be less than 300 microns (100 percent passing the #50 screen).

2.7 ORGANIC SOIL AMENDMENTS

- A. Peat: Natural product of sphagnum moss peat, peat moss, hypnum moss, peat reed-sedge peat, peat humus, derived from fresh-water site conforming to Fed. Spec. Q-P-166, except as otherwise specified. Shred and granulate peat to pass 13 mm (1/2 inch) mesh screen and condition in storage piles for minimum six months after excavation.
- B. Perlite: Horticulture grade.
- C. Vermiculite: Horticultural grade, free of any toxic materials.
- D. Organic Matter: Commercially prepared compost, composted sufficiently to be free of all woody fibers, seeds, and leaf structures, and free of toxic and nonorganic matter.

2.8 PLANTING SOIL MIXTURE

- A. Ornamental Plantings: Planting soil mixture composed of 3 parts topsoil and 1 part, peat moss or compost.
- B. Native Plantings: 100 percent native on-site soil free of clods and subsoil. Do not amend soils intended for native planting.

2.9 PLANT FERTILIZERS

- A. Provide commercial grade plant fertilizer of uniform composition and complying with applicable state and federal regulations.
- B. For new plant material, provide uniform free-flowing granular complete analysis fertilizer based on recommendations of soils reports, containing minimum 10 percent nitrogen, phosphoric acid and potash by weight with minimum 50 percent of nitrogen from controlled release source such as sulfur coated urea (SCU), polymer coated urea (PCU), and sulfur-coated/polymer coated urea (PCSCU).
- C. For existing trees, provide a uniform free-flowing granular fertilizer bearing manufacturer's warranted statement of analysis. Granular fertilizer to contain minimum 10 percent nitrogen by weight (50 percent from controlled release source such as sulfur coated urea), 10 percent available phosphoric acid, and 10 percent potash.

2.10 TURFGRASS FERTILIZER

- A. Provide commercial grade granular fertilizer, free flowing, uniform in composition, and complying with applicable state and federal regulations. Submit fertilizer manufacturer's warranted statement of analysis. Fertilizer contain minimum 20 percent nitrogen by weight (50 percent from controlled release source such as sulfur coated urea), 5 percent available phosphoric acid, and 15 percent potash. Liquid starter fertilizer for hydro mulch slurry, commercial type with 50 percent of nitrogen from controlled release source.

2.11 MEMBRANES

- A. Polyethylene: Comply with ASTM D2103, 0.1 mm (4 mils) thick, and clear in color.
- B. Fiberglass Mat: Lime borosilicate glass fibers with 0.3 mm (0.01 inch) average fiber diameter and 50 to 100 mm (2 to 4 inch) strands of fiber bonded with phenol formaldehyde resin. Provide 100 percent textile glass fiber mat. Mat to be roll type, water permeable, and minimum 6 mm (1/4 inch) and maximum 13 mm (1/2 inch) thick with 12 kg/cu. m (3/4 lb. per cu. ft.) minimum density.

- C. Landscape Fabric: Spun bonded polyester fabric weighing 18 g/sq. m (3/4 oz./sq. yd.) with 9,000 liter per minute flow rate per sq. m (225 gal. per minute flow rate per sq. ft.) Woven needle-punched polypropylene weighing 113 g/sq. m (4.8 oz./sq. yd.) with 950 liter per minute flow rate per sq. m (90 gal. per minute flow rate per sq. ft.)

2.12 MULCH

- A. Mulch: Free of deleterious materials and stored to prevent inclusion of foreign material.
- B. Mineral Mulch: Riverbank stone, granite chips, marble chips, volcanic rock or similar and ranging from 25 mm (1 inch) to 65 mm (2-1/2 inches) according to ASTM C 136.
- C. Organic Mulch: Wood based products such as chips, nuggets or shredded hardwood:
1. Straw for turfgrass seedbed mulch: Stalks from oats, wheat, rye, barley, or rice free of noxious weeds, mold or other objectionable material. Straw to be air-dried and suitable for placing with blower equipment.
 2. Wood cellulose fiber mulch for hydraulic application (Hydro mulch) with fertilizer: Specially prepared wood cellulose fiber, processed with no growth or germination-inhibiting factors, and dyed an appropriate color to facilitate visual metering of application of materials. Do not apply any turfgrass seed in this type mixture. Maximum 12 percent moisture dry weight, plus or minus three percent at time of manufacture. pH range from 3.5 to 5.0. Manufacture wood cellulose fiber for application as follows:
 - a. After addition and agitation in slurry tanks with fertilizers, water, and other approved additives, fibers will become uniformly suspended to form a homogenous slurry.
 - b. When hydraulically sprayed, material will form blotter-like cover.
 - c. Cover allows absorption of moisture and allow rainfall or applied water to percolate to underlying soil.
- D. Non-Asphaltic Tackifier:
1. M-Binder: 100 percent organic, non-toxic, biodegradable, free of plant-growth or germination inhibitors; a botanical glue used in hydroseeding, to stabilize soils and for dust control. Derived from the seed of the plantago plant (*Plantago insularis*). Protein

content: 1.62; Ash content: 2.70; Fiber: 4.00; ph: 6.8; Settleable solids: 5.00.

2.13 EROSION CONTROL

- A. Erosion Control Blanket: Cellulose fiber blanket bonded to 6 mm (1/4 inch) square plastic net weighing 10 kg/100 sq. m (20 lbs./1000 sq. ft.) in 1250 mm (50 inch) wide rolls.

2.14 STAKES AND GUYING STRAPS

- A. Tree Support Stakes: Rough sawn wood, free of knots, rot, cross grain, or other defects that impair strength. Minimum 65 mm (2-1/2 inches) diameter by 2400 mm (8 feet) long and pointed at one end or galvanized steel pipe 32 mm (1-1/4 inches) by 3000 mm (10 feet) with cap, primed with 2 coats flat black exterior enamel.
- B. Hose Chafing Guards: New or used 2-ply reinforced rubber or plastic hose, all same color.
- C. Flags: White surveyor's plastic tape, 150 mm (6 inches) long, fastened to guying wires or cables.
- D. Guying Straps: Fabric designed specifically to guy newly planted trees. Wire will not be permitted.
- E. Turnbuckles: Galvanized or cadmium-plated steel with minimum 75 mm (3 inch) long openings fitted with screw eyes.
- F. Eye Bolts: Galvanized or cadmium plated steel with 50 mm (1 inch) diameter eye and minimum 40 mm (1-1/2 inches) screw length.
- G. Deadmen: 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. Anchors: Arrow shaped or auger iron anchors, noncorrosive, sized according to manufacturer's instructions.

2.15 EDGING

- A. Machine Cut Divot Edge: 'V'-shaped trench used as separation between lawn and mulched planting beds. Fill machine cut divot edge with planting bed mulch as detailed in the drawings.

2.16 WATER

- A. Water: Contains no elements toxic to plant life. Always assume for bidding purposes that water for irrigation is not available from the cemetery. Survey for specific options and clarify pre-bid if so desired.

2.17 ANTIDESICCANT

- A. Antidesiccant: Emulsion manufactured for agricultural use to provide protective film over plant surfaces permeable enough to permit transpiration.

2.18 SEED

- A. Seed: State-certified seed of latest season's crop delivered in original sealed packages, bearing producer's warranted analysis for percentages of mixtures, purity, germination, weed seed content, and inert material. Label complying with USDA Federal Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will not be acceptable. Onsite seed mixing will only be acceptable in presence of COR. Apply turfgrass seed separate from and before mulch material application.
- B. Minimum Acceptable Seed Quality Standards: Purity 95 percent, Germination 85 percent, Weed Seed Content less than 0.5 percent, Noxious Weeds 0.0 percent, Inert Material less than 3 percent, Germination Test Date no older than 6 months.

2.19 SOD

- A. Sod: Nursery grown, certified sod as classified in TPI "Guideline Specifications to Turfgrass Sodding." Sod must also conform to turfgrass species limitations as outlined in seeding mixtures above.
- B. Sod shall be produced from Blue Tag certified seed as classified in the TPI Guideline Specifications to Certified Turf Grass Sod. The composition of the grass species in the sod shall be a mix of 100% Turf Type Tall Fescue.

2.20 HERBICIDES AND OTHER PESTICIDES

- A. Properly label and register pesticides with U.S. Environmental Protection Agency. Keep all pesticides in original labeled containers indicating analysis and method of use.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Examine areas to receive planting for compliance with requirements and other conditions affecting performance.

- D. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Stake plant material locations and bed outlines for COR's approval before any plant pits or beds are dug. COR may make adjustments to plant material locations to meet field conditions.
- F. Identify and review all underground utility locations before commencing work and exercise caution when working close to utilities. Notify COR of apparent conflicts with construction and utilities to plan adjustment before installation.

3.2 FINE GRADING AND ORGANIC AND INORGANIC SOIL AMENDMENT INCORPORATION

- A. Obtain COR's written approval of previously completed rough grading work before incorporating organic soil amendments.
- B. Immediately before dumping and spreading approved organic soil amendment, clean subgrade of stones larger than 50 mm (2 inches) and debris or rubbish and remove from project site. Before spreading organic soil amendment, rip subgrades too compact to drain water or based upon compaction tests with claw 305 mm (12 inches) deep, pulled by bulldozer 610 mm (24 inches') on center, both directions, then regrade surface.
- C. Place and uniformly spread soil amendment materials, humates, and mycorrhizae over approved sub-grades. Apply inorganic soil amendments as recommended by soils report. Apply organic amendments to depth sufficiently greater than specified depth so after natural settlement and light rolling, specified minimum settled depth conform to lines, grades and elevations indicated on drawings. Incorporate soil amendment by disc harrowing, rototilling or other means in uniform manner. Incorporate upon organic matter deep enough to produce finished soil with organic matter content of between 4 and 6 percent. Provide additional organic soil amendment material, after in-place testing and approval, as required for organic matter content and finished grades at no additional cost to Government.
- D. Spread organic soil amendment material minimum 100 mm (4 inches) deep to finished grade at disturbed areas outside project limits.
- E. Do not handle subsoil or organic soil amendment material when wet or frozen.
- F. Set sufficient number of grade stakes to check finished grades. Set stakes in bottom of swales and at top of slopes. Connect contours and spot elevations with even slope.

- G. After incorporating soil amendments material into subsoil, prepare by scarifying or harrowing and hand raking. Remove large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove stones over 38 mm (1-1/2 inch) diameter from amended soil bed. Amended soil also to be free of smaller stones in excessive quantities as determined by COR.

3.3 EXCAVATION FOR PLANTING

- A. Compact whole surface with roller or by other suitable means to achieve 88 to 85 percent maximum dry density according to ASTM D698. During compaction process, fill all depressions caused by settling or rolling with additional organic soil amendment. Regrade and roll surface until presenting smooth and even finish corresponding to required grades. Acceptable finished soil grade condition for all new turfgrass areas is "fine textured and firm." Satisfactory firmness test requires surface soil not be fluffy or powdery and able to support weight of average adult person without creating visible depression.
- B. Verify location of underground utilities before plant pit or bed excavation. Repair damaged utility lines. Where lawns have been established before planting, cover and protect before beginning excavations. Protect existing trees, shrubbery, and beds with barricades during project construction.
- C. Remove rocks and other underground obstructions to depth necessary to permit proper planting according to Drawings. Where underground utilities, construction, or solid rock ledges are encountered, COR may select other locations for plant material.
- D. Dig plant pits by approved method to provide vertical sides and flat bottoms. When sides of pit become glazed, scarify glazed surface.
- E. Where ground cover and planting beds occur in existing turfgrass areas, remove turfgrass to depth that will ensure removal of entire root system. Prepare bed as follows:
 - 1. Where existing soil is to be used in place, till beds 150mm (6 inches) deep. Spread soil amendment uniformly over bed 50 mm (2 inches) deep and thoroughly incorporate into existing soil 150mm (6 inches) deep using a roto-tiller or similar equipment to obtain uniform and well pulverized soil mix. Where existing soil is compacted (former roadways, parking lots, etc.) till soil to necessary depth to support growth of new planting. Remove all sticks, stones, roots, and other objectionable materials. Bring

plant beds to smooth and even surface to comply with established grades.

- F. In newly grading areas where existing soil will be removed and replaced to prepare new planting beds, remove 150mm (6 inches) of existing soil and replace with topsoil. Bring plant beds to smooth and even surface to comply with established grades. Till 50 mm (2 inches) of soil amendment into topsoil as specified.
- G. Form earth saucers around plants with topsoil. Provide 50 mm (2 inch) high basins for shrubs and 100 mm (4 inch) high basins for trees.
- H. Treat plant saucers, shrub, and ground cover bed areas, before mulching, with approved preemergence granular ornamental herbicide. Apply herbicide at 90 kg/hectare (200 lbs./acre) before both early spring and early fall weed seed germination. Plant ground cover in areas to receive erosion control material through that material after material is in place.

3.4 SETTING PLANTS

- A. Move balled and burlapped and container-grown plants only by supporting ball or container. Remove container, taking care to prevent damage to plants or root system. Set plants plumb and hold in position until sufficient soil has been firmly placed around roots or ball. Set plants with root crown 25 mm (1 inch) above surrounding grade. Plant ground cover plants after mulch is in place. Avoid contaminating mulch with planting soil.
- B. Backfill balled and burlapped and container-grown plants with native soil removed from planting hole to approximately half ball depth, then tamp and water. Use native soil to backfill hole. Carefully fold back top half of burlap and remove tying materials. Completely remove all wire caging or similar material. Where plastic wrap or treated burlap is used in lieu of burlap, completely remove these materials before backfilling. Tamp and water remainder of backfill, then form earth saucers or water basins around isolated plants with topsoil.
- C. Plant bare-rootstock arranging roots in natural position. Form hill or mound in center of planting hole to allow plant to sit at proper depth. Spread roots out, over, and down mound in natural position. Mound to be firm to avoid settlement of entire plant. Remove damaged roots with clean cut. Carefully work native soil in among roots. Tamp and water remainder of native soil, then form earth saucers or water basins around isolated plants with topsoil.

3.5 STAKING AND GUYING

- A. Stake and guy plants as indicated on drawings and as specified.
- B. Drive stakes vertically to depth of 800 to 900 mm (2-1/2 to 3 feet) into ground outside plant pit, unless otherwise shown on drawings Do not injure root ball.
- C. Place deadmen minimum 450 mm (18 inches) below ground surface, unless otherwise indicated on drawings.
- D. Install iron anchors according to manufacturer's instructions.
- E. Fasten flags securely to each guy strap approximately 2/3 of the distance above ground level.
- F. Remove stakes and guy straps after one year.

3.6 EDGING PLANT BEDS

- A. Uniformly edge beds using machine to provide clear cut "V"-shaped trench between planted area and adjacent turfgrass. Fill trench with mulch.

3.7 MULCHING PLANTS

- A. Apply approved preemergence granular ornamental herbicide and mulch within 48 hours after planting. Apply before both early spring and early fall weed seed germination.
- B. Placing Inert Material: Place polyethylene sheet or fiberglass mat landscape fabric with edges lapped 150 to 300 mm (6 to 12 inches) to receive inert mulch material. Punch 6 mm (1/4 inch) grid drainage holes in polyethylene sheet or fiberglass mat 300 mm (one foot) on centers over entire area. Spread inert mulch to uniform thickness over membrane as indicated on drawings.
- C. Placing Organic Material: Spread wood-base mulch to uniform 50 to 75 mm (2 to 3 inch) thickness. Rake smooth. Flush mulch with adjacent lawn, curbs and paving. Taper mulch thickness 50mm (2 inches) where planting beds meet adjacent areas.
- D. Keep mulch out of shrub crowns, away from tree trunks, and off buildings, sidewalks, light standards, and other structures.

3.8 PRUNING

- A. Do not prune new plants unless otherwise directed by arborist and approved by the COR. Prune indicated existing plant material as follows:
 - 1. Remove dead, broken and crossing branches.

2. Make cuts with sharp instruments as close as possible to branch collar. Do not make flush cuts.
 3. Do not make "Headback" cuts at right angles to line of growth. Do not pole trees or remove leader.
 4. Remove trimmings from project site.
 5. Do not apply tree wound dressing to cuts.
- B. Prune existing trees as indicated on Drawings. Perform tree pruning and cavity work by licensed arborist according to ANSI Z133.1. Remove 13 mm (1/2 inch) diameter or larger dead wood, branches interfering with or hindering healthy growth of trees, and diseased branches with clean cut made flush with branch collar. Prune trees according to their natural growth characteristics leaving trees well shaped and balanced. Use of climbing spurs is not acceptable. Remove stubs or limbs improper cuts or breaks.

3.9 FERTILIZATION OF EXISTING TREES

- A. Apply fertilizer to existing trees shown on drawings at rate recommended by soil test. Apply in 300 mm to 450 mm (4 inch to 8 inch) deep holes 40 to 50 mm (1-1/2 to 2 inches) in diameter, made by an earth auger, distributed evenly at maximum 600 mm (2 feet) on center throughout outer half of branch spread zone of each tree. Fertilize to within 100 mm (4 inches) of surrounding grade. Use topsoil to bring surface up to surrounding grade. When using fertilizer in packet, tablet, or wedge form, apply according to manufacturer's instructions.

3.10 TILLAGE FOR LAWN AREAS

- A. Thoroughly rip subgrades minimum 150 mm (6 inches) deep by scarifying, disking, harrowing, or other approved methods. Remove debris and stones on surface larger than 25 mm (1 inch) on surface after tillage. Do not till areas of 3: 1 slope ratio or greater. Scarify these areas to 50 mm (1 inch) depth and remove debris and stones.

3.11 FINISH GRADING

- A. After ripping subgrade for topsoil/subsoil bonding, spread topsoil evenly to minimum 150 mm (6 inches) deep. Incorporate topsoil at least 50 to 75 mm (2 to 3 inches) into subsoil to avoid soil layering. Spread additional topsoil as required to meet finish grades. Do not spread topsoil when frozen or excessively wet or dry. Correct irregularities in finished surfaces to eliminate depressions. Protect finished lawn

areas from damage by vehicular or pedestrian traffic. Complete lawn work only after areas are brought to finished grade.

3.12 APPLICATION OF FERTILIZER AND SOIL AMENDMENTS FOR TURFGRASS AREAS

- A. Apply turfgrass fertilizer and adjust soil acidity as recommended by soil test results. Add soil conditioners as specified for suitable topsoil in PART 2.
- B. Spread soil amendments as recommended by soil test results.
- C. Incorporate soil amendments into soil to minimum 100 mm (4 inches) deep or to a depth as recommended by soil test results in finish grading operation. Lightly mix starter fertilizer with top 13 mm (1/2 inch) of soil. Immediately restore soil an even condition before seeding or sod placement.

3.13 MECHANICAL SEEDING

- A. Broadcast seed or Drill-seed with approved equipment rate as outlined in "Seed" article above. Plant turfgrass seed before application of mulch material. Uniformly distribute seed in 2 directions at right angles to each other. Drag seeded area using approved device.
- B. Immediately after dragging, firm entire area with roller maximum 225 kg/m (150 lbs./ft.) of roller width.
- C. Immediately after preparing seeded area, evenly spread straw mulch at 0.5 kg/sq. m (2 tons/acre). Anchor mulch by mulch tiller, non-asphaltic tackifier, twine, or netting.

3.14 HYDRO-MULCHING

- A. Hydro-Mulching: Mix slow release starter fertilizer and approved wood cellulose mulch material, and tackifier in required amount of water to produce homogenous slurry. Uniformly apply slurry under pressure to deliver recommended quantity of fertilizer per 100 sq. m (1000 sq. ft.).

3.15 SODDING

- A. Place sod according to TPI Guideline Specifications for sodding. Lay sod at right angles to slope or the flow of water. On slope areas, start at bottom of slope.
 - (1) Prior to delivery of sod, the contractor shall have the COR(s) inspect the work area. Any discrepancies in the ground preparation shall be corrected prior to the laying of sod in the work area.
 - (2) The sod shall be cut in rolls with the width not varying more than 0.5 inch and should be no more than 0.75 to 1 inch thick to ensure

easier installation and a uniform appearance and shall be delivered to the work site the same day of installation. Contractor shall make all necessary arrangements to protect delivered sod from excessive drying and wind damage. Any sod that shows signs of yellow leaves, straw color or signs of mold or mildew may indicate that the sod has remained stacked or on pallets too long, has reduced vigor and may establish poorly. This sod shall be rejected for installation by the project COR. Sod shall be laid in rolls expeditiously without interruption, until the work area is completely sodded. Sod shall be cut and fitted around all headstones and other obstructions, butted tightly together while not overlapping. The Contractor shall also stagger the joints of each piece when installing to help keep the sod stable. In order to stabilize sod on any slopes or hills during the rooting process and to eliminate the chances of erosion, the Contractor shall use sod pins in adequate amounts during sod installation to secure the sod until rooting has taken place. All sod shall be rolled by the Contractor to smooth the surface and bring the bottom of the sod layer into proper contact with the soil surface.

- (3) As sod is a living turf with a limited root system, the Contractor shall make sure to keep the soil bed and sod moist until a new root system develops. The sod shall be watered within 20-30 minutes of installation with a thorough irrigation to a six inch depth to keep the sod adequately moist. Until the root system of the new sod begins to develop the sod shall need to be irrigated often enough to keep the sod pad moist. This shall require irrigating 0.25 inch per day for the first week after the installation. After the root system has developed, the Contractor can reduce the irrigation frequency and irrigate to a depth of 4 to 6 inches every 3-4 days depending on current temperature and weather conditions.

- B. Finishing: After sodding, blend edges of sod smoothly into surrounding area. Roll with lightweight roller to eliminate air spaces between sod and firmed soil.

3.16 WATERING

- A. Watering: Start watering turfgrass areas immediately after installation at sufficient rate to ensure thorough wetting of soil to minimum 50 mm (2 inches) deep. Supervise watering operation to prevent run-off. Supply necessary pumps, hoses, pipelines, and sprinkling equipment. Repair all areas damaged by water operations. Keep soil surface constantly moist, not wet, until turfgrass plants are well established.
- B. Deep water all trees twice each week during Plant Establishment Period, providing water penetration throughout root zone to full depth of planting pits, as verified by COR. Discontinue watering at first hard frost in fall and resume at ground thaw in spring.

3.17 EROSION CONTROL MATERIAL

- A. Install and maintain erosion control material on designated areas as shown on drawings. Prepare, fertilize and vegetate areas to be covered, before erosion material is placed. Immediately following planting operations, lay erosion control material evenly and smoothly and in contact with soil throughout. Omit straw mulch from all seeded areas receiving erosion control material.
- B. For waterways, unroll erosion control material in direction of water flow. When two or more strips are required to cover ditch area, overlap strips minimum 100 mm (4 inches). For strips to be spliced lengthwise, overlap ends minimum 150 mm (6 inches) with upgrade section on top.
- C. On slopes, place erosion control material either horizontally or vertically to slope with edges and ends of adjacent strips butted tightly against each other.
- D. Staple each erosion control strip in three rows (each edge and center with center row alternately spaced) with staples spaced maximum 1200 mm (4 feet) longitudinally. For two or more strips side by side on slopes, install common row of staples on adjoining strips. Staple all end strips at 300 mm (12 inch) intervals at end. Firmly embed staples in underlying soil.
- E. Provide erosion control maintenance to repair damage by erosion, wind, or any other cause. Maintain, protect, repair, or replace erosion control material until Termination of the Plant and Warranty Period.

3.18 LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD

- . The Establishment Period for turf which is thirty (30) days shall begin immediately after the complete sod installation of a section(s) with the approval of the COR or designee. During that period the Contractor shall:
 - 1. Eradicate all weeds. Fertilize, re-sod, and perform any other operation necessary to promote the growth of uniform, healthy, high quality turf.
 - 2. Replant areas void of turf 1 ft (one square foot) and larger in area.
 - 3. Begin mowing when grass is firmly rooted into the soil and the turf growth is 4 inches in height. Turf shall be mowed to and maintained at a height of 3 inches.
 - 4. Apply water to the sod immediately after installation and regularly until the sod a root into the soil bed and is healthy.
- A.** The contractor shall mow the new grass a minimum of three times once the grass reaches a height of 4". The final height after each cutting is to be 3". The VA shall not accept the new turf before the three cuttings have been performed.

- B.** In areas where turf work has been completed, clear the area of all debris. Any areas damaged during establishment operations must be restored to their original condition.

3.19 LANDSCAPE PLANT AND TURFGRASS ACCEPTANCE

- A. Landscape plant and turfgrass acceptance will occur after completion of LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD. Contractor to have completed, located, and installed all plants and turfgrass according to drawings and specifications. All plants and turfgrass are expected to be living and in healthy condition at time of inspection and acceptance. Make written request two weeks before final inspection of landscape plants and turfgrass. Upon inspection, when work is found to not meet specifications, PLANT AND TURFGRASS ESTABLISHMENT PERIOD will be extended at no additional cost to 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 replacements have been installed.
 4. Remedial measures directed by COR have been completed.
- C. Criteria for Acceptance of Turfgrass:
1. Sod: Living sod grass plants uniform in color and leaf texture and well rooted into soil below so that gentle pulling of turfgrass leaves by hand does not dislodge sod. Bare spots to be maximum 1250 sq. mm (2 sq. inches). Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
 2. Seed: Living turfgrass plants with 98 percent coverage, uniform in color and leaf texture. Bare spots to be maximum 0.05 sq. m (0.5 sq. ft.).

3.20 CLEANING

- A. Remove and legally dispose of all debris, rubbish, and excess material from project site.
- B. Where existing or new turfgrass areas have been damaged or scarred, restore disturbed areas to original condition.
- C. In areas where planting and turfgrass work have been completed, clear the area of all debris, spoil piles, and containers.

- D. Maintain minimum one paved pedestrian access route and one paved vehicular access route to each building clean at all times.
- E. Clear other paved areas when work in adjacent areas are completed.

3.21 PROTECTION

- A. Protect plants and turfgrass areas from traffic and construction operations. Erect barricades, as required, and place approved signs at appropriate intervals until final acceptance.
- B. Remove protective materials immediately before acceptance.
- C. Repair damage.

3.22 ENVIRONMENTAL PROTECTION

- A. All work and operations to comply with requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

- - - E N D - - -

SECTION 03 30 00

**CAST-IN-PLACE AND PRE-
CAST CONCRETE**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies cast-in place concrete for concrete repairs of thickness exceeding three inches, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Slabs-on-grade including concrete sidewalks.
 - 2. Concrete foundations.
- B. This Section also specifies pre-cast concrete requirements, which shall meet (or exceed) the requirements in this specification section.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.
- E. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
 2. Admixtures, including compatibility certification.
 3. Form materials and form-release agents.
 4. Steel reinforcement and accessories.
 5. Fiber reinforcement.
 6. Floor and slab treatments.
 7. Bonding agents.
 8. Semirigid joint filler.
 9. Joint-filler strips.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- G. For the purposes of this Specification, all concrete is considered to be "exposed to public view".
- H. The Contractor shall keep the following references at the project site:
1. ACI 301 (latest edition) "Specification for Structural Concrete for Buildings".
 2. ACI 305R "Hot Weather Concreting".
 3. ACI 306.1 "Cold Weather Concreting".

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.

- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, Grade 60 or 80, deformed.
- C. Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, ASTM A 767/A 767M, Class II zinc coated after fabrication and bending.
- D. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, ASTM A 775/A 775M or ASTM A 934/A 934M, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.
- E. Deformed-Steel Wire: ASTM A 496.
- F. Epoxy-Coated Wire: ASTM A 884/A 884M, Class A, Type 1 coated, deformed-steel wire, with less than 2 percent damaged coating in each 12-inch wire length.
- G. Deformed-Steel Welded Wire Reinforcement (noted as welded wire mesh or welded wire fabric on drawings/SOW): ASTM A1064 / A1064M - 17, flat sheet.

- H. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from galvanized steel wire into flat sheets.
- I. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, deformed steel.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, ASTM A 775/A 775M epoxy coated.

- C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.
- D. Epoxy for doweling threaded or reinforcing bars, or securing metal railings:
 - 1. High performance, two component adhesive anchoring system for threaded and reinforcing bars in concrete.
 - 2. Minimum strength as follows for ½" diameter steel grade 60 anchor, embedment depth of 4", for 4000psi concrete: 3200 lbs tension and 4300 lbs shear strength.
 - 3. Submit system for approval, showing installation instructions.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
- F. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I. Use one brand of cement throughout Project unless otherwise acceptable to both the NCA Project Engineer and the design build engineer (if design build is applicable). When permitted, supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 - 2. See Paragraph 2.10.B. for limitation of use for supplementary cementitious materials.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: ¾ inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to

alkali in cement.

- C. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.

- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

- C. Non-Set-Accelerating Calcium Nitrite Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Available Products:
 - a. Grace Construction Products, W. R. Grace & Co.; DCI-S.
 - b. OR approved equal.
2. Add three (3) gallons per cu. yd. of concrete in cast-in-place application as required.

- D. Silica Fume:

1. Add 35 lbs./cu. yd. of concrete for cast-in-place application as required. Use of dry silica fume product is not acceptable unless approved in writing by the both the NCA Project Engineer and the design build engineer (if design build is applicable).
2. Silica Fume shall come from the same source throughout the project.
3. Subject to compliance with requirements, provide one of the following products:

- a. "Force 10,000", W.R. Grace and Co.
- b. "Eucon MSA", Euclid Chemical Co.
- c. "Sikacrete 950DP", Sika Corp.

2.6 FIBER REINFORCEMENT

- A. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

1. Available Products:

a. Monofilament Fibers:

- 1) Axim Concrete Technologies; Fibrasol IIP.
- 2) Euclid Chemical Company (The); Fiberstrand 100.
- 3) FORTA Corporation; Forta Mighty Mono.
- 4) Grace Construction Products, W. R. Grace & Co.; Grace MicroFiber.
- 5) Metalcrete Industries; Polystrand 1000.
- 6) SI Concrete Systems; Fibermesh 150.

b. Fibrillated Fibers:

- 1) Axim Concrete Technologies; Fibrasol F.
- 2) Euclid Chemical Company (The); Fiberstrand F.
- 3) FORTA Corporation; Forta Econo-Net.
- 4) Grace Construction Products, W. R. Grace & Co.; Grace Fibers.
- 5) SI Concrete Systems; Fibermesh.

2.7 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class C, or polyethylene sheet, ASTM D 4397, not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

1. Available Products:

- a. Fortifiber Corporation; Moistop Plus.
- b. Raven Industries Inc.; Dura Skrim 6.
- c. Reef Industries, Inc.; Griffolyn Type-65.
- d. Stego Industries, LLC; Stego Wrap, 10 mils.

- B. Bituminous Vapor Retarder: 110-mil- thick, semiflexible, 7-ply sheet membrane consisting of reinforced core and carrier sheet with fortified asphalt layers, protective weathercoating, and removable plastic release liner. Furnish manufacturer's accessories including bonding asphalt, pointing mastics, and self-adhering joint tape.

1. Product: Meadows, W. R., Inc.; Premoulded Membrane Vapor Seal.

2. Water-Vapor Permeance: 0.00 grains/h x sq. ft. x inches Hg; ASTM E 154.
3. Tensile Strength: 140 lbf/in.; ASTM E 154.
4. Puncture Resistance: 90 lbf; ASTM E 154.

2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 1. Available Products:
 - a. Axim Concrete Technologies; Cimfilm.
 - b. Burke by Edoco; BurkeFilm.
 - c. ChemMasters; Spray-Film.
 - d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film.
 - f. Euclid Chemical Company (The); Eucobar.
 - g. Kaufman Products, Inc.; Vapor Aid.
 - h. Lambert Corporation; Lambco Skin.
 - i. L&M Construction Chemicals, Inc.; E-Con.
 - j. MBT Protection and Repair, Div. of ChemRex; Confilm.
 - k. Meadows, W. R., Inc.; Sealtight Evapre.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
 - n. Sika Corporation, Inc.; SikaFilm.
 - o. Symons Corporation, a Dayton Superior Company; Finishing Aid.
 - p. Unitex; Pro-Film.
 - q. US Mix Products Company; US Spec Monofilm ER.
 - r. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.

2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 per ASTM D 2240.

- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types I and II, non-load bearing or IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.0217-inch- thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

2.10 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
 - 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 - 5. Silica Fume: 10 percent.
 - 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 - 7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent for prestressed or post-tensioned concrete and 0.15 percent for mildly reinforced concrete, by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11 CONCRETE MIXTURES - SPECIFIC REQUIREMENTS

- A. Unless specifically shown otherwise on the drawings or specification 010002, concrete mix design shall meet the following requirements: 4000 psi @ 28 days, and slump shall be between 3-5". Air entrainment shall be required. Air entrainment shall be between 4.5-7.5% and air content must conform with ACI 318 Table 4.4.1.

2.12 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

2.14 NON-WOVEN GEOTEXTILE FABRIC

- A. Fabric shall consist of needled nonwoven polypropylene fibers and meet the following properties at a minimum:
 1. Grab Tensile Strength (ASTM-D4632) \geq 120 lbs.
 2. Mullen Burst Strength (ASTM-D3786) \geq 225 psi
 3. Flow Rate (ASTM-D4491) \geq 95 gal/min/ft²
 4. UV Resistance after 500 hours (ASTM-D4355) \geq 70%
 5. Heat-set or heat-calendared fabrics are not permitted.
 6. Mirafi 140N, Amoco 4547, Geotex 451, or approved equal.

2.15 TRIAXLE GEOGRID REINFORCING POLYPROPYLENE SHEET

- A. Sheet shall be manufactured from a punched polypropylene sheet, oriented in three substantially equilateral directions. Shall be in accordance

with ASTM D4759-02. Sheet shall meet the following properties at a minimum:

1. Junction efficiency (%) (ASTM D6637-10 and D7737-11): 93
2. Radial stiffness at low strain (kN/m @ 0.5% strain) (ASTM D6637-10):
225
3. Resistance to chemical degradation (%) (EPA 9090): 100
4. UV and weather resistance (%) (subjected to 500 hours per ASTM D4355-05): 70

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 2. Class C, 1/2 inch for rough-formed finished surfaces.

- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- M. Do not use earth cuts as concrete formworks. Put simply, no earthen forms permitted.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls,

where flashing is shown at lintels, shelf angles, and other conditions.

3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 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 material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by both the NCA Project Engineer and the design build engineer (if design build is applicable).

3.4 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Retarders: Place, protect, and repair vapor retarders according to manufacturer's written instructions.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
- 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.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by both the NCA Project Engineer and the design build engineer (if design build is applicable).
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated in the Drawings but not more than 20 ft. o.c. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

- C. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by both the NCA Project Engineer and the design build engineer (if design build is applicable).
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 305 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete and as indicated.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. 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.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand

with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.
 1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings.

- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 1. Apply a trowel finish to surfaces indicated exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry

tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

2. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-foot-long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/4 inch
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- F. Broom Finish for Flatwork in Parking and Drive Areas: Apply a broom finish to all driving and parking areas, ramps, and elsewhere as indicated.
1. Bullfloat immediately after screeding. Complete before any excess moisture or bleed water is present on surface (ACI 302.1R, Article 7.2.3). Use of power-propelled rotary finisher shall be prohibited.
 2. After excess moisture or bleed water has disappeared and concrete has stiffened sufficiently to allow operation, give slab surface a coarse straight broom transverse finish scored 1/4 inch deep texture by drawing steel bristle broom across surface perpendicular to main traffic route. Texture shall be as accepted by both the NCA Project Engineer and the design build engineer (if design build is applicable) from sample panels. Coordinate with Traffic Topping manufacturer and applicator as to acceptability.
 3. Finishing Tolerance: Bullfloated floor finish tolerance per ACI 117 section 4.5.7. If required, more stringent tolerances shall be used to assure that the slabs drain freely to floor drains.
 4. Before installation of flatwork and after submittal, review, and approval of concrete mix design, Contractor shall fabricate one or more acceptable test panels simulating finishing techniques and final appearance to be expected and used on Project. Contractor shall finish panels following requirements of items 1, 2 and 3 above. both the NCA Project Engineer and the design build engineer (if design build is applicable) may reject finished panels, in which case Contractor shall repeat procedure until both the NCA Project Engineer and the design build engineer (if design build is applicable) acceptance is obtained. Accepted test panels shall be cured in accordance with specifications and may be incorporated into Project. Accepted test panels shall serve as basis for acceptance/rejection of final finished surfaces of all flatwork.
 5. Finish all concrete slabs to proper elevations to insure that all surface water will drain freely to floor drains, and that no puddle areas exist. Contractor shall bear cost of any corrections to provide for this positive drainage requirement.
 6. The Contractor shall arrange for and wet all slabs with water for the purpose of detecting any defects in the concrete that would result in leaks and/or inadequate drainage. Slab surfaces shall

be wetted until water flows freely to drains. No finished spaces shall be sealed or insulated or ceilings installed until drainage

test has been completed on the slab above and reviewed by the both the NCA Project Engineer and the design build engineer (if design build is applicable) for acceptance.

- a. Repair low spots, puddles, or bird baths with an area not less than four square feet of standing water with a visible sheen, isolated by drying concrete and smaller low spots that do not dry within 12 hours.
- b. Rout and seal leaking joints that are usually located at expansion joints, control joints, or construction joints. These leaking joints are located by water observed on the underside of the slabs and opposite faces of walls. If the expansion joint is not installed at the time of the flood test, this area shall be tested after it is installed.
- c. Rout and seal cracks that are located when water is observed on the underside of the slab. Cracks may also be observed on the top surface of the slab when the concrete slabs are drying and the cracks are highlighted with moisture.

3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.11 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the methods shown below. Use moisture curing, moisture-retaining cover curing, or a combination thereof under normal weather conditions. Use of curing compounds shall be allowed only in excessive hot or cold weather conditions subject to the approval of the Engineer.
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3.13 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and submit test reports.
- A. Inspections:
 - 1. Steel reinforcement placement, including welded wire mesh, rebar, dowels, epoxying of dowels or rebar and any other installations occurring and required inside the concrete placement area.
 - 2. Steel reinforcement welding.

3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of concrete, plus one additional composite sample per 15 cubic yards poured per day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each truck of concrete. Reduce frequency of tests when concrete tests results were consistently within acceptable range upon approval from Engineer.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each truck of concrete. Reduce frequency of tests when concrete tests results were consistently within acceptable range upon approval from Engineer.
4. Concrete 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 composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M; choose either 6"x12" specimens (two cylinders per set) or 4"x8" specimens (three cylinders per set) for standard cylinder testing., Test minimum 3 sets of standard cylinders for each composite sample. Mold and store cylinders for laboratory-cured test specimens for 28-day strength testing. Field-cured cylinders shall be maintained at the site under conditions identical to concrete represented by them.
 - a. Cast and field-cure 1 set of standard cylinder specimens for each composite sample.
 - b. Cast and laboratory-cure 2 sets of standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39/C 39M.
 - a. Test 1 set of field-cured specimens at 7 days, and 1 set of laboratory-cured specimens at 28 days. Retain 1 set of

laboratory-cured specimens in reserve for later testing if required.

- b. A compressive-strength test shall be the average compressive strength from a set of specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to both the NCA Project Engineer and the design build engineer (if design build is applicable), concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by both the NCA Project Engineer and the design build engineer (if design build is applicable) but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by both the NCA Project Engineer and the design build engineer (if design build is applicable). Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by both the NCA Project Engineer and the design build engineer (if design build is applicable).
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 03 30 00