

A. American Society for Testing and Materials (ASTM)

1. ASTM D422—Standard Test Method for Particle-Size Analysis of Soils
2. ASTM D653—Standard Terminology Relating to Soil, Rock, and Contained Fluids
3. ASTM D698—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
4. ASTM D1140—Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75- μ m) Sieve
5. ASTM D1556—Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
6. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
7. ASTM D2216—Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
8. ASTM D2423—Standard Test Method for Surface Wax on Waxed Paper or Paperboard
9. ASTM D2434—Standard Test Method for Permeability of Granular Soils (Constant Head)
10. ASTM D2487—Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
11. ASTM D2488—Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
12. ASTM D2937—Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
13. ASTM D2974—Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
14. ASTM D3740—Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
15. ASTM D4220—Standard Practices for Preserving and Transporting Soil Samples
16. ASTM D4318—Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
17. ASTM D4373—Standard Test Method for Rapid Determination of Carbonate Content of Soils
18. ASTM D4375—Standard Practice for Basic Statistics in Committee D-19 on Water
19. ASTM D4643—Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating
20. ASTM D4974—Standard Test Method for Hot Air Thermal Shrinkage of Yarn and Cord Using a Thermal Shrinkage Oven

21. ASTM D6026—Standard Practice for Using Significant Digits in Geotechnical Data
22. ASTM D6141—Standard Guide for Screening Clay Portion of Geosynthetic Clay Liner (GCL) for Chemical Compatibility to Liquids
23. ASTM D6938—Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
24. ASTM E329—Standard Specification for Agencies Engaged in Construction Inspection and/or Testing

- B. Occupational Safety and Health Administration (OSHA) - 29 CFR 1926 - Construction Industry.

1.06 QUALITY ASSURANCE

- A. The Owner will engage and pay for the services of an Engineer and a testing agency to perform Construction Quality Assurance (CQA) testing of geosynthetics. The Contractor shall help the Owner's agent with CQA sampling and testing by providing samples, personnel, and equipment necessary.
1. The Contractor shall provide a 10-gallon sample of Drainage Soil meeting requirements of Article 2.05 to the CQA Testing Agency for interface direct shear testing 30 days before shipment of Geocomposite in accordance with Specification Section 02070, Geocomposite.
 2. The Contractor shall provide a 10-gallon sample of Subgrade Fill meeting requirements of Article 2.03 to the CQA Testing Agency for interface direct shear testing 30 days before shipment of GCL in accordance with Specification Section 02072, Geosynthetic Clay Liner.
 3. The CQA tests will be the basis of acceptance of material and construction. The Contractor is responsible for the cost of retesting if the CQA test fails. The retest will be paid for by the Owner and reimbursed by the Contractor. The Contractor, at his discretion, may retain and bear all costs for a testing agency to confirm or dispute the results of the CQA tests.
- B. The Contractor shall coordinate construction and CQC activities with the Engineer.

1.07 WARRANTIES (NOT USED)

1.08 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.09 QUALIFICATIONS

- A. The Contractor shall provide the CQC Geotechnical Testing Agency's qualifications as specified in Article 1.03.

1.10 TESTING REQUIREMENTS (NOT USED – SEE PRODUCTS)

1.11 MAINTENANCE (NOT USED)

1.12 RECORD DRAWINGS

- A. Record Drawings shall be prepared, maintained, and submitted showing prepared Subgrade, Trench Gravel, Drainage Soil, Protective Soil, and top of stabilized base (see Section 02700, Paving) final constructed elevations in accordance with the requirements of the Contract Documents. Record Drawings shall be updated throughout the project and are subject to field review by the Engineer any time upon request.

1.13 DEFINITIONS

- A. *Anchor Trench Fill*: Soil fill that meets the characteristics in Article 2.03 and is placed over the liner in the anchor trench to specified relative compaction densities and moisture contents to lines and grades shown as Anchor Trench Fill on the Drawings.
- B. *Bedding*: The compacted soil fill that is placed over the excavated subgrade in a utility trench before laying pipe. Bedding material must meet the requirements of Drainage Soil in Article 2.04 excluding the permeability requirement.
- C. *Clearing*: The felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, stumps, roots, and rubbish occurring in the areas to be cleared.
- D. *Backfill*: Initial and Final Backfill is soil that meets the characteristics in Article 2.03 and is placed above the spring line of a pipe in a utility trench.
- E. *Completed Course*: Layer that is complete and ready for testing and/or the next layer or phase of construction.
- F. *Construction Quality Assurance (CQA)*: A planned system of activities that provides assurance that the materials to be installed on the project are in accordance with the contract plans and specifications. CQA includes inspections, testing, and evaluations to assess the quality of the materials and the construction.

CQA refers to the measures taken by the Owner to determine compliance and conformance of the materials with the contract specifications

- G. *Construction Quality Control (CQC)*: A planned system that provides procedures for delivering a construction project that meets the requirements defined in the contract plans and specification. CQC is performed by the Contractor and includes surveying, documentation, sampling, testing, and personnel qualifications.
- H. *Drainage Soil*: Soil fill that meets the characteristics in Article 2.04 and is placed over the liner and over the Trench Gravel to lines and grades shown as Drainage Soil on the drawings.
- I. *Embankment*: See Subgrade Soil Fill
- J. *Haunching*: Soil fill that is placed above the bedding and below the spring line of a pipe in a utility trench that meets the characteristics of Drainage Soil in Article 2.04 excluding the permeability requirement.
- K. *Lift*: Lift in these Specifications refers to a constructed segment of 12 inches thick (unless otherwise stated in the Specifications), loose, soil of one material type, over a defined area performed within 1 day.
- L. *Optimum Moisture Content*: Moisture content corresponding to the maximum dry density as determined by the Modified Proctor Method (ASTM D1557).
- M. *Protective Soil*: Soil fill that meets the characteristics in Article 2.06 and is placed over Drainage Soil to lines and grades shown as Protective Soil on the drawings.
- N. *Relative Compaction*: Ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by the Modified Proctor Method (ASTM D1557).
- O. *Stabilized Subgrade*: Top surface of soil immediately below limerock or crushed concrete base.
- P. *Stripping*: Removal of topsoil and 1 foot of unsuitable soil in the Ash Monofill Expansion area.
- Q. *Structural Fill*: Soil fill that meets the characteristics in Article 2.02 and is placed under and around structures to specified relative compaction densities and moisture contents to lines and grades shown on the drawings.

- R. *Subgrade*: Surface over which GCL is placed in Ash Monofill. Also refers to bottom of utility trench. See also Stabilized Subgrade.
- S. *Subgrade Soil Fill*: Also referred to as Embankment Fill. Soil fill that meets the characteristics in Article 2.01 and is placed to specified relative compaction densities and moisture contents to lines and grades shown on the Drawings to raise elevation to Subgrade. GCL is placed on Subgrade.
- T. *Trench Gravel*: Soil fill that meets the characteristics in Article 2.06 and is placed over the liner in the leachate trench to lines and grades shown as Trench Gravel on the drawings.

PART 2 PRODUCTS

2.01 SUBGRADE SOIL FILL

- A. The Contractor shall certify that Subgrade Soils meet the requirements listed in Table 3 and this Article. Unsuitable Subgrade soils shall be excavated to 1 foot below and around bottom liner or structure grades as shown on the Drawings.
- B. Subgrade Soils shall be non-organic, free of debris, sticks, roots, and stones larger than 3 inches in any dimension.
- C. Subgrade soils must be compatible with GCL (see Section 02072, Geosynthetic Clay Liner).
- D. Unsuitable Subgrade Soils:
 - 1. ASTM D2487 Soil Classification Groups: CH, MH, OH, OL, and PT.
 - 2. Soils not meeting requirements listed in Table 3.
 - 3. Unsuitable soils also include satisfactory soils not maintained within 3% of optimum moisture content at time of compaction. The Contractor shall rework such unsuitable soil.
 - 4. Unsuitable soils may also be identified by the Engineer as soil to be removed and replaced.

Table 3 Subgrade Soil and Embankment Fill Requirements				
Classification (USCS)	Maximum Allowable Fines (%)	Other Requirements	Maximum Allowable Carbonate Content (%)	Maximum Allowable Organic Content (%)
CL, ML	50	PI<20, LL<50 Max Size = 3 inches	< 30	< 5
GP-SC, GP-SM, GW-SC, GW-SM, SW-SC, SW-SM, SP-SC, SP-SM	12	PI<20, LL<50 Max Size = 3 inches		
GW, GP, SW, SP	5	Max Size = 3 inches		

2.02 STRUCTURAL FILL

- A. The Contractor shall certify that Structural Fill meets the requirements listed in Table 4 and this Article. Structural Fill may be obtained from site excavation or an approved borrow source if the material meets these requirements. Structural Fill shall be placed below and around structures and compacted to lines and grades shown on the Drawings.
- B. Satisfactory Structural Fill shall be non-carbonate, non-organic, free of debris, sticks, roots, and stones larger than 1 inch in any dimension.
- C. Unsuitable Structural Fill:
 1. ASTM D2487 Soil Classification Groups GW, GP, GC, GM, SC, CL, CH, SM, ML, MH, OH, OL, and PT.
 2. Soils not meeting requirements listed in Table 4.
 3. Unsuitable soils also include satisfactory soils not maintained within 2% of optimum moisture content at time of compaction
- D. Structural Fill is used under footings and other concrete structures.

Table 4 Structural Fill and Anchor Trench Fill Requirements			
Classification (USCS)	Maximum Allowable Fines (%)	Maximum Allowable Carbonate Content (%)	Maximum Allowable Organic Content (%)
SW, SP	5	< 10	< 5
SP-SC, SP-SM, SW-SC, SW-SM	12		

2.03 ANCHOR TRENCH FILL

- A. The Contractor shall certify that the Anchor Trench Fill meets the requirements listed in Table 4 and this Article. Anchor Trench Fill may be obtained from site excavation or an approved borrow source if the material meets these requirements. Anchor Trench Fill shall be placed over the liner in the anchor trench and compacted to lines and grades shown on the Drawings.
- B. Satisfactory Anchor Trench Fill shall be non-carbonate, non-organic, free of debris, sticks, roots, and stones larger than 1 inch in any dimension. Anchor Trench Fill shall be chemically compatible with GCL in accordance with ASTM D6141.
- C. Unsuitable Anchor Trench Fill:
 - 1. ASTM D2487 Soil Classification Groups GW, GP, GC, GM, SC, CL, CH, SM, ML, MH, OH, OL, and PT.
 - 2. Soils not meeting requirements listed in Table 4.
 - 3. Unsuitable soils also include satisfactory soils not maintained within 3% of optimum moisture content at time of compaction

2.04 DRAINAGE SOIL

- A. The Contractor shall certify that Drainage Soil meets the requirements listed in Table 5 and this Article. Drainage Soil may be obtained from site excavation or an approved borrow source if it meets these requirements. Drainage Soil shall be placed to 12 inches above the upper geocomposite of the bottom liner system to lines and grades shown on the Drawings.
- B. Satisfactory Drainage Soils:
 - 1. Drainage Soil shall be non-carbonate, non-organic, free of debris, waste, vegetation, sticks, roots, organic, or other deleterious material and stones larger than 1/4 inch in any dimension.
 - 2. Drainage Soil shall meet requirements of ASTM D2487 Soil Classification Groups SW or SP. See Table 5 for Satisfactory Soil Requirements.
 - 3. Drainage Soil shall have a hydraulic conductivity of greater than or equal to 0.001 cm/sec when placed in accordance with this Section. The laboratory hydraulic conductivity test shall be performed in accordance

with ASTM D2434 on a sample compacted to 90% Modified Proctor dry density in the laboratory.

4. Drainage Soil shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Maximum Percent Passing</u>
No. 4	95

C. Unsuitable Drainage Soil:

1. ASTM D2487 Soil Classification Groups GW, GP, GC, GM, SC, CL, CH, SM, ML, MH, OH, OL, and PT.
2. Soils not meeting requirements listed in Table 5.

Table 5 Drainage Soil Requirements				
Classification (USCS)	Maximum Allowable Fines (%)	Other Requirements	Maximum Allowable Carbonate Content (%)	Maximum Allowable Organic Content (%)
SW, SP	5	Max Size = ¼ inch Hydraulic Conductivity ≥ 0.001 cm/sec	< 5	< 5

2.05 PROTECTIVE SOIL

- A. The Contractor shall certify that Protective Soil meets the requirements listed in Table 6 and this Article. Protective Soil may be obtained from site excavation or an approved borrow source if it meets these requirements. Protective Soil shall be placed to 12 inches over the Drainage Soil to lines and grades shown on the Drawings.
- B. Satisfactory Protective Soils:
1. Protective Soil shall be non-carbonate, non-organic, free of debris, waste, vegetation, sticks, roots, organic or other deleterious material, and stones larger than 1/2 inch in any dimension.
 2. Protective Soil shall meet requirements of ASTM D2487 Soil Classification Groups GW, GP, SW, or SP. See Table 6 for requirements.

3. Protective Soil shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Maximum Percent Passing</u>
½ inch	100
No. 200	12

4. Crushed glass provided by the Owner shall be used in the Protective Soil layer.

C. Unsuitable Protective Soils:

1. ASTM D2487 Soil Classification Groups GC, GM, SC, CL, CH, SM, ML, MH, OH, OL, and PT.
2. Soils not meeting requirements listed in Table 6.

Table 6 Protective Soil Requirements				
Classification (USCS)	Maximum Allowable Fines (%)	Other Requirements	Maximum Allowable Carbonate Content (%)	Maximum Allowable Organic Content (%)
GW, GP, SW, SP	5	Max Size = 1/2 inch	< 5	< 5
GW-GM, GW-GC GP-GM, GP-GC SW-SM, SW-SC SP-SC, SP-SM	12	Max Size = 1/2 inch, PI<20, LL<50		

- D. The Contractor shall use all available on-site crushed glass in the Protective Soil layer before using soil.

2.06 TRENCH GRAVEL

- A. The Contractor shall certify that the Trench Gravel meets the requirements of this Article. Trench Gravel must be obtained from an off-site borrow source. Trench Gravel shall be placed over the bottom liner in the leachate collection trench and wrapped in geotextile to lines and grades shown on the Drawings. The Owner has 300 cubic yards of gravel available onsite that shall be used.
- B. Satisfactory Trench Gravel:
 1. Trench Gravel shall be non-carbonate (< 5%), non-organic (< 5%), free of debris, waste, vegetation, sticks, roots, organic or other deleterious material, and stones larger than 2 inches in any dimension.
 2. Trench Gravel shall be rounded to well-rounded quartz or granite gravel.

3. Trench gravel shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Maximum Percent Passing</u>
2 inches	100
1 inch	20 to 50
½ inch	10 to 30
No. 4	0 to 5

C. Unsuitable Trench Gravel:

1. ASTM D2487 Soil Classification Groups GC, GM, SW, SP, SC, CL, CH, SM, ML, MH, OH, OL, and PT.
2. Soils not meeting requirements listed in Paragraph 2.07B.

2.07 BEDDING

- A. Shall meet the requirements for Drainage Soil other than permeability.
- B. Bedding shall be used below pipes as Haunching.

PART 3 EXECUTION

3.01 PROTECTION

- A. Protect vegetation and any features designated to remain.
- B. Locate, identify, and protect utilities from damage.
- C. Protect benchmarks, wells, and existing structures from damage or displacement, unless scheduled to be removed or relocated.
- D. Protect and maintain erosion and sedimentation controls (see Section 01350, Environmental Protection Procedures).

3.02 CLEARING, GRUBBING, AND STRIPPING

- A. Clear areas required for access to site and execution of work. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be completely removed except such trees and vegetation as may be indicated or directed to be left standing by the Owner.

- B. The Contractor shall adhere to the site-clearing activities and proposed disposal methods presented in the Soils Management Plan.
- C. Site-clearing activities shall be conducted to ensure minimum interference with roads, streets, walks, and other adjacent in-service facilities. The Contractor shall not obstruct access or interfere with the operations of the landfill or other contractors working on-site without coordinating with the Owner.
- D. The Contractor shall provide protection as required to prevent damage to existing improvements indicated to remain in place.
- E. Grub logs, boulder, stumps, debris, and other material protruding through the ground surface. This material shall be excavated and removed to a depth of not less than 18 inches below the original ground surface.
- F. Place cleared and grubbed material in stockpile area identified by the Owner.
- G. Unsatisfactory soil materials shall be removed. A 1-foot-thick layer of soil over the ash monofill and immediately under soil footings are anticipated to be unsatisfactory.
- H. Site-clearing material shall be disposed of in accordance with the following:
 - 1. Materials shall be incorporated into the project or transported and disposed of as directed by the Engineer.
 - 2. On-site stockpile areas will be provided for the Contractor's use. Materials not incorporated into the project shall be segregated according to material type and stockpiled at the designated on-site stockpile area as directed by the Engineer.
 - 3. The Contractor shall have the option to grind or burn the materials (i.e., stumps, logs, etc.) as needed. The Contractor shall be responsible for all permitting, safety, and equipment necessary to perform work under this Section.
 - 4. The Owner retains all rights and title of ownership to all excavated soil materials from onsite sources regardless of whether it is used for the work described in these Specifications.

3.03 PREPARATION

- A. Before beginning any excavation or grading, the Contractor shall survey the project area to determine the soil excavation volume available for backfill and the

volume of borrow required (see Article 1.03, Soil Management Plan). Should the Contractor discover any inaccuracies, errors, or omissions in the survey data, the Contractor shall immediately notify the Engineer of the differences and the impact to the bid. If the Contractor begins any excavation or grading, this shall be held as an acceptance of the survey data by him, after which time the Contractor has no claim against the Owner resulting from alleged errors, omissions, or inaccuracies of the survey data.

- B. Ensure that the foundation surface is clean and free of loose material of any kind when placing fill material.
- C. Ensure that all material limits shall be excavated or constructed within a tolerance of 0.1 foot except where dimensions or grades are shown or specified as minimum. All grading shall be performed to strictly maintain slopes and drainage as shown on the Drawings.
- D. Perform all Material Source Certification and in-place CQC testing for the materials and fill in accordance with Table 1, Table 2, and Part 2. Rework areas that do not meet specified in-place density and moisture requirements.
- E. Set required lines, levels, contours, and datum by construction staking.
- F. Locate, identify, and protect utilities, benchmarks, existing structures, monitoring wells, piezometers, and paving from damage.
- G. Notify utility company to locate utilities, if applicable.
- H. Provide fencing or other safety barrier along the entrance road to separate the excavation area from traffic areas.
- I. Coordinate excavation operations with landfill operations.

3.04 REMOVAL OF WATER

- A. The Contractor shall be responsible for the control and maintenance of groundwater and stormwater through all phases of construction. Under no circumstances shall stormwater be allowed to run into the excavation or pond therein. The Contractor shall provide temporary stormwater control methods including berms, swales, ponds, and pumps, to prevent stormwater runoff from outside the construction area from entering the construction area.
- B. Dewatering necessary to allow for excavation is the responsibility of the Contractor. The Contractor shall submit a Dewatering Plan in accordance with

Specification Section 02240, Dewatering, to the Engineer. The Contractor is responsible for Water Management District, County, and local agency permits.

3.05 TEMPORARY EROSION CONTROL

- A. It is the Contractor's responsibility to provide temporary erosion control to protect slopes and other areas from erosion as indicated in the Plan (see Article 1.03) and in accordance with Specification Section 01350, Environmental Protection Procedures. Measures such as toe-in silt fence, temporary slope flumes, and erosion control matting shall be used to protect completed work. Damage to facilities under construction shall be repaired at the Contractor's sole expense. Any conditions which the Contractor believes endangers the site and cannot be addressed by taking reasonable measures should be immediately brought to the attention of the Engineer in writing.

3.06 EXCAVATION

- A. The Contractor shall excavate soil as required to the lines, grades, and elevations shown on the Drawings as needed to construct the subgrade. Excavate unsuitable Subgrade Soils to 1 foot vertically and horizontally from lines and grades shown on the Drawings. Backfill excavated unsuitable subgrades soil with Subgrade Soil Fill. Unsuitable soils beneath footings shall be excavated to a minimum depth of 2 feet and replaced with Structural Fill.
- B. Machine grade slopes and base to design grades.
- C. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- D. Notify the Engineer of unexpected subsurface conditions and discontinue affected work in the area until notified to resume work.
- E. Correct areas over-excavated by placing soil to meet required grade and requirements as in Article 3.08. Correction of all overexcavated areas shall be at the Contractor's sole expense unless over-excavated area was directed and authorized in writing by the Engineer.
- F. Excavated material shall be stockpiled in a location identified by the Owner or used for Subgrade or Embankment Fill if the excavated material meets the requirements of Part 2.

3.07 SOIL STOCKPILING

- A. Coordinate selective soil and debris stockpiling in accordance with the Soil Management Plan and the Engineer.
- B. Excavate, load, haul, and stockpile excavated soil and debris so that stockpiles have maximum slopes of 3 horizontal to 1 vertical (3:1).
- C. Stabilize the stockpiles and provide erosion and sedimentation controls in accordance with Specification Section 01350, Environmental Protection Procedures. The erosion and sedimentation control measures to be used shall be detailed in the Stormwater and Pollution Prevention Plan and the Excavation and Fill Plan.
- D. The Owner retains all rights and title of ownership to all excavated soil materials from onsite sources regardless of whether it is used for the work described in these Specifications.

3.08 PREPARATION FOR SUBGRADE AND EMBANKMENT SOIL FILL

- A. Moisture condition and compact existing satisfactory subgrade soil to a minimum of 90% relative compaction at a moisture content within 3% of optimum as determined by ASTM D1557.
- B. Proof-roll a minimum of four passes the finished Subgrade Soil surface before installing soil fill using a vibratory steel drum roller with vibrator on.
- C. Areas that pump or rut shall be reworked.
- D. Before placing soil fill, verify that no loose or poorly compacted soil is present in the fill area.
- E. The Contractor shall maintain the groundwater level during construction as required in Section 02240, Dewatering.

3.09 SUBGRADE AND EMBANKMENT SOIL FILL PLACEMENT AND COMPACTION

- A. Load and haul Soil Fill from the excavation, stockpile, or borrow site and place to the lines and grades shown on the Drawings. The Contractor shall not damage liner materials or previously completed courses, including Geosynthetics, during placement and compaction of Soil Fill.
- B. Place in loose lift thickness not exceeding 12 inches.

- C. Each lift of Soil Fill shall be compacted until moisture contents and densities have been achieved.
 - 1. Subgrade Fill: Compact each lift to a minimum of 90% relative compaction at a moisture content within 3% of optimum as determined by ASTM D1557.
 - 2. Structural Fill: Compact each lift to a minimum of 95% relative compaction at a moisture content within 2% of optimum as determined by ASTM D1557.
- D. Completed lifts of Soil Fill cannot yield under equipment loads. Compaction equipment used is at the discretion of the Contractor. Compaction equipment shall be operated in strict accordance with the manufacturer's instructions and recommendations and be maintained in such condition that it will deliver the manufacturer's rated compactive effort.
- E. Areas that pump or rut shall be reworked by the Contractor, at the Contractor's expense. The groundwater level shall be maintained at least 2 feet below top of subgrade.
- F. Maintain moisture content within the specified range until covered with subsequent lifts.
- G. Grade final surface to a vertical tolerance of 0.1 foot unless preparing surface for geosynthetic materials. See Article 3.10 for preparing Soil Fill for Geosynthetics Materials.

3.10 PREPARING SOIL FILL FOR GEOSYNTHETIC MATERIAL

- A. Remove any angular or sharp rocks, debris, ruts, or protrusions from the surface greater than 1/2-inch. Smooth surface to remove rutting and tire marks. The Contractor shall avoid sharp turns, sudden starts or stops, spinning and digging of tracks, or any other operation that could damage the surface.
- B. Grade to a tolerance of plus or minus 0.10-foot of straight line grade between any two points 10 feet apart. Areas of grading include all areas requiring placement of a geosynthetic.
- C. Maintain soil moisture at least 2 feet below top of subgrade until covered by GCL and liner materials. The groundwater level shall be maintained during construction.

- D. The Contractor shall verify in writing to the Owner and Engineer with standard subgrade acceptance forms (see Specification Section 02072, Geosynthetic Clay Liner, Article 1.03) signed by the Contractor and the GCL Installer's representative that the surface on which the GCL will be installed meets these Specification requirements.
- E. Submit Record Drawings of subgrade surface before placement of GCL and geosynthetic materials.

3.11 DRAINAGE SOIL, PROTECTIVE SOIL, AND TRENCH GRAVEL PLACEMENT

- A. The Contractor shall submit a Drainage Material Installation Plan to the Engineer for approval in accordance with Article 1.03. Placement of Drainage Soil, Protective Soil, and Trench Gravel shall begin by placing material from outside of cell limits to create a path by which to enter the cell in accordance with the Drainage Material Installation Plan.
- B. Load and haul Drainage Soil, Protective Soil, and Trench Gravel from the excavation, stockpile, or borrow site and place only when underlying geosynthetic installations are complete and approved in accordance with these Specifications. Placement of Drainage Soil, Protective Soil, and Trench Gravel shall be in accordance with the Drainage Material Installation Plan signed by the Contractor.
- C. Drainage Soil shall be placed in one lift with a minimum thickness as specified in this Section and as shown on the Drawings. The Contractor shall provide sufficient thickness of Drainage Soil to maintain the minimum specified thickness and to maintain the surface grades shown.
- D. Track-mounted equipment with low ground pressure treads (less than 6 psi) no larger than a Caterpillar Model D-6 or equal shall be used for spreading Drainage Soil and Protective Soil. Equipment shall not be allowed to operate on less than 12 inches of cover over the geomembrane liner system. No other equipment, including dump trucks or scrapers, will be permitted to travel on the liner, Drainage Soil, and Protective Soil. The Contractor shall avoid sharp turns, sudden starts or stops, spinning and digging of tracks, or any other operation that could damage the liner system.
- E. Maximum equipment speed over the Drainage Soil and Protective Soil shall be 5 miles per hour.
- F. Drainage Soil shall be placed in such a manner that no air is trapped underneath the geosynthetic liner. The Contractor shall exercise extreme caution in spreading sand to prevent puckering of geocomposite and geotextile damage.

- G. Take precautions necessary to preclude any damage to the liner system due to thermal expansion or contraction during all phases of liner construction and especially during placement of the Drainage Soil.
- H. The Contractor shall provide and maintain a means of continuously observing the depth of the Drainage Soil, Protective Soil, and Trench Gravel, such as by freestanding markers at intervals of 50 feet maximum each way as described in the Drainage Material Installation Plan (see Article 1.03). Sharpened stakes or other rigid items which may damage the underlying liner system if they were contacted by on-site equipment shall not be allowed. If possible, markers shall be removed after use and shall not be abandoned in-place unless removal will disturb the in-place material. A sample of the proposed marker shall be submitted to the Engineer with the Drainage Soil Installation Plan (see Article 1.03).
- I. Trench Gravel shall be placed around leachate collection pipes as shown on the Drawings. Trench Gravel shall be worked in and provide contact with and support to the pipe. Pipe shall not be damaged during Trench Gravel placement.

3.12 ANCHOR TRENCH FILL PLACEMENT

- A. The Contractor shall load and haul Anchor Trench Fill soil from the excavation, stockpile, or borrow site and place only when underlying geosynthetic installations have been completed in accordance with deployment and seaming requirements in Specification Section 02074, Geotextile.
- B. Place fill to the lines, grades, and dimensions shown on the Drawings.
- C. Place in loose lift thickness not exceeding 12 inches.
- D. Compact bottom lifts with a vibratory plate compactor and upper lift by tracking in with rubber tracked skid steer or wheel rolling with a rubber tired loader.
- E. Do not damage underlying geosynthetic installation.

3.13 EXCAVATION FOR STRUCTURES

- A. The Contractor shall excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.10 foot. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb the bottom of the excavation. Excavate by hand to final grade just before placing

concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 0.10 foot. Do not disturb the bottom of excavations intended as bearing surfaces.

3.14 EXCAVATION FOR UTILITY TRENCHES

- A. The Contractor shall excavate trenches to indicated gradients, lines, depths, and elevations.
- B. The Contractor shall excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
 1. Clearance: 12 inches on each side of pipe or conduit.
- C. Trench Bottoms: The Contractor shall excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed multiple-duct conduit units, hand excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 2. For pipes and conduit 6 inches or larger in nominal diameter, shape the bottom of trench to support the bottom 90° of pipe circumference. Fill depressions with tamped sand backfill.
 3. Alternately, excavate trenches 4 inches deeper than the bottom of pipe elevation to allow for the Bedding. Hand excavate for bell of pipe.

3.15 UTILITY TRENCH BACKFILL

- A. The Contractor shall place backfill on subgrades free of mud.
- B. The Contractor shall place and compact the Bedding on trench bottoms and where indicated. Shape the Bedding to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

- C. The Contractor shall backfill trenches excavated under footings and within 18 inches of bottom of footings with suitable soil.
- D. The Contractor shall place and compact Initial Backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
 - 1. Carefully compact Initial Backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- E. The Contractor shall backfill voids with satisfactory soil while installing and removing shoring and bracing.
- F. The Contractor shall place and compact Final Backfill of satisfactory soil to final subgrade elevation.

END OF SECTION

SECTION 02370
EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall take every reasonable precaution throughout construction to prevent the erosion of soil and the sedimentation of streams, bays, storm systems, or other water impoundments, ground surfaces, or other property as required by federal, state, and local regulations.
- B. The Contractor shall provide protective covering for disturbed areas upon suspension or completion of land-disturbing activities. Permanent vegetation shall be established at the earliest practicable time. Temporary and permanent erosion-control measures shall be coordinated to ensure economical, effective, and continuous erosion and siltation control throughout the construction and post-construction period.

1.02 RELATED WORK

- A. Section 02920, Seeding and Sodding.

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. Florida Department of Transportation (FDOT)
 - 1. FDOT Section 103—Temporary Work Structures.
 - 2. FDOT Section 104—Prevention, Control, and Abatement of Erosion and Water Pollution.
 - 3. FDOT Section 530—Riprap.

4. FDOT Section 982—Fertilizer.
5. FDOT Section 985—Geotextile Fabrics.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 RECORD DRAWINGS (NOT USED)

1.13 REGULATORY REQUIREMENTS

- A. The Contractor shall prevent damage to properties outside the construction limits from siltation due to construction of the project and assume all responsibilities to the affected property owners for correction of damages which may occur. Erosion-control measures shall be performed conforming to the requirements of and in accordance with plans approved by applicable state and local agencies and as specified by the erosion-control portion shown on the Drawings and as required by these Specifications. The Contractor shall not allow mud and debris to accumulate in the streets or enter drainage ditches, canals, or waterways. Should the Contractor pump water from excavations during construction, appropriate siltation preventative measures shall be taken before the pumped water is discharged into any drainage ditch, canal, or waterway.

1.14 PRACTICES

The Contractor shall adhere to the following:

- A. Avoid dumping soil or sediment into any stream bed, pond, ditch, or watercourse.

- B. Maintain an undisturbed vegetative buffer where possible between a natural watercourse and trenching and grading operations.
- C. Avoid equipment crossings of streams, creeks, and ditches where practicable.

1.15 EROSION AND SEDIMENT-CONTROL DEVICES AND FEATURES

- A. The Contractor shall construct all devices (silt fences, retention areas, etc.) for sediment control at the locations required to protect federal, state, and local water bodies and water courses and drainage systems before beginning to excavate the site. All devices shall be properly maintained in place until a structure or paving makes the device unnecessary or until directed to permanently remove the device.
- B. The Contractor shall use mulch to temporarily stabilize areas subject to excessive erosion and to protect seed beds after planting where required.
- C. Filter fabric, hay bales, or other approved methods shall be placed and secured over the grates of each existing inlet, grating, or storm pipe opening near the area of excavation to prevent silt and debris from entering the storm systems.
- D. The Contractor shall use silt fences, hay bales, and floating turbidity barriers as shown on the plans or as directed by the Owner or Owner's Representative to restrict movement of sediment from the site.
- E. The Contractor shall establish vegetative cover on all unpaved areas disturbed by the work.

PART 2 PRODUCTS

2.01 GENERAL

- A. Open-mesh biodegradable mulching cloth.
- B. Fertilizer shall be 10-10-10 grade or equivalent.
- C. Lime shall be Dolomitic Agricultural Ground limestone, in accordance with FDOT Section 982.
- D. Grass shall be in accordance with Section 02920, Seeding and Sodding.
- E. Silt fence shall consist of non-biodegradable filter fabric (Trevira, Mirafi, etc.), in accordance with FDOT Section 985, wired to galvanized wire mesh fencing and supported by wood or metal posts.

- F. Floating or staked turbidity barriers as specified in FDOT Section 985 and FDOT Standard Index 103.
- G. Erosion Stone: FDOT Section 530.
 - 1. Sand-Cement Riprap
 - 2. Concrete Block
 - 3. Rubble 20 to 300 pounds each
- H. Filter Fabric for placing under Riprap shall meet the requirements of FDOT Section 985.
- I. Baled hay or straw in accordance with FDOT Section 104.

PART 3 EXECUTION

3.01 CLEARING

- A. The Contractor shall schedule and perform clearing and grubbing so that subsequent grading operation and erosion-control practices can follow immediately after. Excavation, borrow, and embankment operations will be conducted as a continuous operation. All construction areas not otherwise protected shall be planted with permanent vegetative cover within 30 working days after completing active construction.

3.02 STABILIZING

- A. The angle for graded slopes and fills shall be no greater than the angle that can be retained by vegetative cover or other adequate erosion-control devices or structures. All disturbed areas outside of embankment left exposed will, within 30 working days of completion of any phase of grading, be planted or otherwise provided with either temporary or permanent ground cover, devices, or structures sufficient to restrain erosion.

3.03 REGULATORY REQUIREMENTS

- A. If any earthwork is to be suspended for any reason for longer than 30 calendar days, the areas involved shall be seeded with vegetative cover or otherwise protected against excessive erosion during the suspension period. Suspension of work in any area of operation does not relieve the Contractor of the responsibility to control erosion in that area.

3.04 VEGETATIVE COVER

- A. Preparation of Seedbed. Areas to be seeded shall be scarified a depth of 4 inches until a firm, well-pulverized, uniform seedbed is prepared. Fertilizer shall be applied during the scarification process in accordance with the following rates:
 - 1. Fertilizer—10 to 15 pounds per 1,000 square feet.
- B. Seeding. Disturbed areas along embankments shall be permanently seeded with mix specified in Section 02920, Seeding and Sodding.
- C. The Contractor shall mulch all areas immediately after seeding. Mulch shall be applied and anchored as specified previously in this Section.

3.05 MAINTENANCE

- A. The Contractor shall maintain all temporary and permanent erosion-control measures in functioning order. Temporary structures shall be maintained until such time as vegetation is firmly established and grassed areas shall be maintained until completion of the project. Areas which fail to show a suitable stand of grass or which are damaged by erosion shall be immediately repaired. No additional payment will be made to the Contractor for re-establishing erosion-control devices, which may become damaged, destroyed, or otherwise rendered unsuitable for their intended function during the construction of the project.
- B. The Contractor shall remove all silt, sediment, and debris buildup regularly to maintain functioning storm systems and erosion-control devices.

3.06 REMOVAL OF SEDIMENT CONTROL DEVICES

- A. Near completion of the project, when directed by the Engineer, the Contractor shall dismantle and remove the temporary devices used for sediment control during construction. All erosion-control devices in seeded areas shall be left in place until the grass is established. The Contractor shall seed areas around devices and mulch after removing or filling temporary control devices.
- B. The Contractor shall clean up all areas at the completion of the project.

END OF SECTION

SECTION 02526
GROUNDWATER MONITORING WELL CONSTRUCTION AND WELL ABANDONMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section details the installation and abandonment requirements for monitoring wells/piezometers, the correct methods for sediment sample collection, and boring log sample description.

1.02 RELATED WORK (NOT USED)

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. The Contractor will acquire all necessary permits from the appropriate agencies, including the State of Florida Permit Application to Construction, Repair, Modify, or Abandon a Well.
- B. The Contractor will provide the completed Well Completion Form attached to this Section.

1.04 WORK SEQUENCE

- A. The Contractor shall have all materials necessary to complete the specified work on site at the time of drilling, including a local source for potable water.
- B. The Contractor should be prepared and make provisions for difficult drilling conditions, including loss of circulation, voids or cavities, collapsing or running sands, consolidated rock (possibly requiring a coring bit), stiff or swelling clays, or other conditions.
- C. The Engineer will maintain a log recording the boring number, date, sample data, including blow counts and percent sample recovery, general comments on progress of drilling, lost circulation zones and approximate percent loss of circulation, depth to any water levels encountered, and general lithology encountered. The boring log should include descriptions of minerals, mineral coatings, matrix description, color, moisture, fossil description, grain size, roundness, surface texture, organics, and USCS letter symbol. At the time of well installation the Engineer will record depths of the borehole and well; depth to

water; lengths, amounts, and depths of emplacement of material used; and general comments on progress of installation. The boring log format shall be similar to the sample log attached at the end of this Specification.

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A53—Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 2. ASTM D1586—Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.
 - 3. ASTM D1587—Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes.
 - 4. ASTM D5092—Standard Practice for Design and Installation of Ground Water Monitoring Wells.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS

- A. All drilling and well installation shall be performed by an experienced environmental driller approved by the Engineer. No portion of these Specifications may be waived or altered without the expressed consent of the Engineer.
- B. The Contractor or Contractor's subcontractor will maintain a current license for all work performed as may be required by all local, regional, or state agencies.

The Contractor shall obtain all permits and file all necessary completion forms as required by the regulating agency.

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 RECORD DRAWINGS

- A. The Engineer will provide the locations of wells or borings to the Contractor.

1.13 DEFINITIONS

- A. *Monitoring well*: well constructed with a surface seal and a sand filter pack in accordance with accepted design practices to collect a representative groundwater sample.
- B. *Piezometer*: permanent or temporary well that may be designed and constructed without the surface sealing or sand filter pack requirements of a monitoring well.

PART 2 PRODUCTS

2.01 GENERAL

- A. The Contractor will use clean silica sand size 20/30 for the filter pack unless site-specific conditions require use of an alternate sand size. The Contractor will submit alternative material to the Engineer for review and approval.
- B. The Contractor shall use 2-inch diameter Schedule 40 or greater, flush joint, PVC. Solvents or PVC glues are not allowed.
- C. The Contractor will use cement grout as specified in Section 03600, Grout.

PART 3 EXECUTION

3.01 DRILLING PROCEDURES AND BORING REQUIREMENTS

- A. Before any drilling at a test boring or monitoring well location, all equipment shall be decontaminated by steam cleaning and rinsed with clean potable water.
- B. The Contractor is responsible for appropriate handling and disposal of Investigative Derived Waste (IDW), which includes drilling cuttings, fluids, water, and other materials and substances resulting from the Contractor's work. When drilling at possibly contaminated sites the Contractor will supply drums

with sealable lids for IDW. All IDW drums will be labeled with the name of the project manager, the company, the company's address and phone number, and labeled as nonhazardous or hazardous, whichever is correct.

- C. The drill rig shall be free from leaks of fuel, hydraulic fluid, and oil that may contaminate the borehole, ground surface, or drilling tools.
- D. Wells shall be installed using mud rotary, hollow stem auger, solid stem auger, or hand auger drilling methods as appropriate. Mud rotary drilling is the preferred method when drilling in karst environments where hard rock will likely be encountered. Hollow Stem Auger drilling is used mostly in sands, clays, and light rock. Limited use of solid stem auger or hand auger may be appropriate in areas with clayey sands and shallow total depths. The driller will use clean, clear, potable water during drilling. Drilling fluid additives or lubricants must be inert.
- E. Borings will be of sufficient diameter to allow at least 2 inches of annular space between the boring wall and the outer diameter of the monitoring well screen and riser pipe to allow sufficient space for installing a sand pack around the well screen.
- F. Total borehole depth will be as shown in the Drawings or as determined by the Engineer.

3.02 TEST BORING PROCEDURES

- A. The Contractor shall sample soil or sediment in substantial accordance with ASTM D1586. Samples shall be extracted with a stainless steel split tube (spoon) sampler on intervals of 5 feet or less. The Contractor will decontaminate samplers with clean potable water between sample intervals. The Contractor will decontaminate all downhole tools by steam decontamination between boring locations. The Engineer will collect representative portions of the spoon samples in clean, unused, sample containers labeled with the project name, boring number, depth interval of sample, collector's initials, and date.
- B. Thin-wall tube sampling (Shelby tubes) may be required as needed by the Engineer. The sampler is attached to the drill rods and pushed without rotation into the bottom of the borehole in one continuous motion. The sampler is then withdrawn and sealed according to ASTM D1587 Standards for laboratory analysis. The Engineer is responsible for the labeling and delivery of the Shelby tube sample. The label should include the project name, boring number, depth interval of sample, collector's initials, date, and indicate the top and bottom of sample. The sample should be transported upright.

- C. Any exploratory borehole that is more than 5 feet deeper than the planned monitoring well should be grouted and the monitoring well should be placed in a new boring to the specified well depth. If the overdrilled depth is less than 5 feet, the borehole should be back filled with sediment to within 1 foot of the bottom of the well screen. Monitoring wells installed in clusters—within 10 feet of each other—with a contemporary exploratory boring that has a complete field log, may be installed without the requisite spoon sampling. This allowance may be adjusted if specific lithological information is being sought by the Engineer.
- D. Any borehole that is not to be finished with a monitoring well or piezometer must be properly abandoned in accordance with Water Management District requirements (grouting from bottom up).

3.03 WELL INSTALLATION

- A. Monitoring wells construction consists of 2-inch Schedule-40 polyvinyl chloride (PVC) solid riser pipe.
- B. Do not use solvents, glues, or other adhesives at any time during well installation. Casing sections, screens, and tremie pipes must be physically joined and made watertight by flush-joint threading or force-fittings. Clean disposable gloves should be worn during well installation.
- C. Typical monitoring wells screen shall be constructed of flush joint PVC with 0.010-inch slot size. If the sections cannot be connected with threaded joints, mechanically fasten joints with slip couplers that are permanently fastened with stainless steel screws. Do not use glued or welded joints.
- D. The Engineer shall provide approximate well depths and screen lengths for each location. Actual depths may vary based on field conditions. The Engineer may adjust the slot-size based on the lithology of the screened section.
- E. The annular space between the drilled hole and the monitoring well screen shall be packed with filter material to a height of at least 2 feet above the top of the well screen, or as specified. For wells that have the top of the well screen beginning at depths less than 5 feet, the amount of sand above the screen should be decreased to obtain a proper filter pack seal and a surface seal for the well. The filter pack shall consist of clean-washed 20/30 silica sand. The Engineer may adjust the filter pack grain-size based on the lithology of the screened section. A tremie pipe must be used for filter pack placement in monitoring wells. No PVC glue shall be used on the tremie pipe. A cap must be placed on the top of the riser before placing the filter pack to prevent sand from entering. The filter pack sand may be poured through the tremie pipe or directly into the annular space of the borehole provided that a PVC pipe is used as a tamping device to prevent

bridging of the filter pack and that the amount of filter pack sand is continuously tagged during emplacement by the Contractor.

- F. An annular fine clean washed sand (30/65 silica sand) seal with minimum thickness of 1 foot shall be placed directly above the filter pack. A bentonite pellet/chip seal with a minimum thickness of 1 foot shall be placed above the fine sand seal. Fine, clean washed sand (30/65 silica sand) seal with a minimum thickness of 1 foot shall be placed above the bentonite seal.
- G. The annular space between the drilled hole and the monitoring well casing shall be grouted with cement/bentonite grout (maximum 4% bentonite) from the top of the annular seal to ground surface. The water/cement ratio shall be 6.5 gallons of water per sack (94 pounds) of cement. The tremie pipe method must be used to install the grout seal; all other methods will not be acceptable except in cases where the depth of the grout seal is sufficiently shallow to allow visual confirmation of grout placement. Following the initial grouting of the hole, the grout shall be allowed to set, and the hole shall be topped off with grout if significant settling has occurred.
- H. Well Completion
 - 1. The riser pipe shall extend from the well screen to 36 inches above the ground surface. The top of the monitoring well casing shall be neatly cut with a pipe cutter at a right angle to the riser pipe. The monitoring wells will be completed by placing a 4-inch-by-4-inch aluminum or steel protective casing with locking cap set in a 2-foot-by-2-foot-by-4-inch concrete pad. The Contractor will label the monitoring well with the designated well number written in the concrete pad.
 - 2. The well may be completed flush mount—below ground surface—if it is in an area of very heavy traffic. Flush mount wells will be completed with 8-inch or 12-inch bolt-down manhole covers.
- I. If the well is installed in an area that will receive traffic, including construction traffic, at least three protective bollards must be installed around the well. Bollards shall be a minimum 4-inch diameter, ASTM A53 galvanized steel pipe, filled with concrete, and extend 36 inches above ground surface.
- J. The Contractor shall be responsible for the effective development of all monitoring wells installed. Wells shall be developed to produce clean, sediment-free groundwater to an NTU below 20. The Engineer will determine the adequacy of development procedures. The preferred method of well development is the pump-and-surge technique.

3.04 WELL ABANDONMENT

- A. Monitoring wells will be abandoned according to Rule 62-532.440, FAC, and applicable rules of the governing Water Management District.
- B. Typical Well Abandonment Procedures
 - 1. Fill well screen interval with clean silica sand to at least 1 foot above the screen interval.
 - 2. Seal the well to be abandoned by grouting from the bottom—top of the sand filling the screen interval—to ground surface. This will be done by placing a tremie pipe to the bottom of the well and pumping grout through the pipe until undiluted grout flows from the boring at ground surface.
 - 3. Remove well protective casing and concrete pad. Properly dispose of well protective casing and concrete.
 - 4. After 24 hours, the site representative should check the abandonment site for grout settlement. Any settlement will be filled with grout back up to ground surface. Additional grout will be installed using a tremie pipe inserted to the top of the firm grout in the well. If the top of firm grout in the well is fewer than 5 feet below land surface, using a tremie pipe is not required. This process should be repeated until firm grout remains at ground surface.
 - 5. Cover and level the surface expression of abandoned well with soil or concrete depending upon the composition of the original surface.



STATE OF FLORIDA PERMIT APPLICATION TO CONSTRUCT,
REPAIR, MODIFY, OR ABANDON A WELL

- ☐ Southwest
☐ Northwest
☒ St. Johns River
☐ South Florida
☐ Suwannee River

THIS FORM MUST BE FILLED OUT COMPLETELY.

The water well contractor is responsible for completing
this form and forwarding the permit to the appropriate
designated county where applicable.

CHECK BOX FOR APPROPRIATE DISTRICT ADDRESS ON BACK OF PERMIT FORM

Permit No. **782151**

Florida Unique I.D.

Permit Stipulations Required (See attached)

39, 55, 23

62-524 Quad # **Q4116** Delineation #

CUP/WUP Application No.

ABOVE THIS LINE FOR OFFICIAL USE ONLY

Field at this line to order that address
is shown through a separate window

1. MARION COUNTY		601 SE 25TH Ave		OCALA FL	34471-0000		
Owner, Legal Name of Entity if Corporation		Address		City	Zip	Telephone Number	
2. 13000 SE 115TH AVE, N/A							
Well Location Address, Road Name or number, City							
Parcel # (Pin) 45006-000-00							
3. STEPHANIE S STALLSMITH		9342		(352) 567-9500			
Well Drilling Contractor		License No.		Telephone No.			
35920 STATE ROAD 52		4. 1/4 of 1/4 of Section 1				NW NE	
Address		5. Township 17		Range 23		(Indicate Well on Chart)	
DADE CITY FL 33525						SW SE	
City State Zip							
6. MARION							
County		Subdivision Name		Lot		Block	
				Unit			
7. Number of proposed wells 2 Check the use of well: (See back of permit for additional options) Domestic Monitor (type) ☒							
(Irrigation Type) Public Water Supply (type) List Other							
Distance from septic system 0 ft. Description of facility Estimated start of construction date 2/23/2009							
8. Application for: ☒ Now Construction ☐ Repair/Modify ☐ Abandonment (Reason for Abandonment)							
9. Estimated: Well Depth 180 Casing Depth 170 Screen Interval from 170 to 180							
Casing Material: EXXON / GMI / PVC Casing Diameter 2 smallest Seal Material Cement							
10. If applicable: Proposed From 0 to 166 Seal Material Cement Received: Monday, February 23, 2009							
Grouting Interval From to Seal Material							
From to Seal Material							
11. Telescope Casing or Liner (check one) Diameter							
Blk-Steel / Galvanized / PVC Other (specify):							
12. Method of Construction: ☒ Rotary ☐ Cable Tool ☐ Combination							
Auger Other (specify):							
13. Indicate total No. of wells on site 76 . List number of unused wells on site 0							
14. Is this well or any other well or water withdrawal on the owner's contiguous property covered under a Consumptive Water Use Permit (CUP/WUP) or CUP/WUP Application? ☒ No ☐ Yes							
(IF YES, COMPLETE THE FOLLOWING) CUP/WUP No.							
District well I.D. No.							
Latitude 29° 02' 04.35" Longitude 81° 57' 48.09"							
Data obtained from GPS or map or survey (map datum NAD 27, NAD 83)							
15. I hereby certify that I will comply with the applicable rules of Title 40, Florida Administrative Code and that a water use permit or artificial recharge permit, if needed, has been or will be obtained prior to commencement of well construction. I further certify that all information provided on this application is accurate and that I will obtain necessary approval from other federal, state, or local governments, if applicable. I agree to provide a well completion report to the District within 90 days after drilling or the permit expiration, whichever occurs first.							
I certify that I am the owner of the property, that the information provided is accurate, and that I am aware of my responsibilities under Chapter 379, Florida Statutes, to maintain or properly abandon this well, or, I certify that I am the agent for the owner, that the information provided is accurate, and that I have informed the owner of his responsibilities as stated above. Owner consents to placement of the WMD or a representative access to the well site.							
Digitally Signed		9342		Digitally Signed		Date	
Signature of Contractor		License No.		Owner's or Agent's Signature			

DO NOT WRITE BELOW THIS LINE - FOR OFFICIAL USE ONLY

Approval Granted By: **CYNDI BELLINGAR** STATUS: **ISSUED** Issue Date: **2/24/2009** Hydrologist Approval Initials

Owner Number: Fee Received: \$ **25.00** Receipt No.: **IN093855905** Check No.:

THIS PERMIT NOT VALID UNTIL PROPERLY SIGNED BY AN AUTHORIZED OFFICER OR REPRESENTATIVE OF THE WMD. IT SHALL BE AVAILABLE AT THE WELL SITE DURING ALL DRILLING OPERATIONS. This permit is valid for 90 days from the date of issue.

FORM 41.10 - 410 (1) REV. 12/04

WHITE: ORIGINAL FILE
YELLOW: DRILLING CONTRACTOR
PINK: OWNER

END OF SECTION

WELL COMPLETION REPORT (Please complete in black ink or type.)

PERMIT #: 782151.1 CUP/WUP#: _____ DID#: _____

Indicate the number of wells drilled/abandoned for this report: 1

Indicate the number of wells permitted but not drilled/abandoned that are being cancelled: _____

WATER WELL CONTRACTOR'S

SIGNATURE Digitally Signed License # 9342

I certify that the information provided in this report is accurate and true.

Grout	No. of Bags	From (ft.)	To (ft.)
Neat Cement:	33	0	170
Bentonite:	0	170	180
(Other)			

WELL LOCATION: County Marion
1/4 of _____ 1/4 of Section 1, Township 17, Range 23
Latitude: 29° 2' 4.35", Longitude: -81° 57' 48.09"

DATE STAMP
Mar 03 2009

Official Use Only

Sketch of well location on property

Give distances from septic tank and house, or other reference points

CHEMICAL ANALYSIS WHEN REQUIRED
Iron: _____ ppm Sulfate: _____ ppm
Chlorides: _____ ppm TDS _____ mg/l

Conductivity _____ umhos/cm
[] Lab Test [] Field Test Kit

Pump Type

[] Centrifugal [] Jet [] Submersible [] Turbine

Horsepower: _____ Capacity: _____ GPM: _____

Pump Depth: _____ ft. Intake Depth: _____ ft.

Form LEG-R.005.00(10/05)

OWNER'S NAME: MARION COUNTY

COMPLETION DATE: 02/27/2009 Florida Unique I.D.: _____

Parcel # (Pin): 45006-000-00

WELL USE:

[] Public Supply [] Irrigation [] Domestic ☒ Monitor
[] Injection [] Other

DRILL METHOD:

☒ Rotary [] Cable Tool [] Combination
[] Jet [] Auger [] Other

Measured Static Water Level: _____		Measured Pumping Water Level: _____	
After _____ Hours at _____ GPM.		Measuring Pt. (Description): _____	
Which is _____ ft. [] above ☒ below land surface			
Casing: [] Black Steel [] Galvanized ☒ PVC [] Other: _____			
Casing Diameter and Depth (ft.)	From	To	DRILL CUTTINGS LOG Examine cuttings every 20 ft. or at formation changes. Note cavities, depth to producing zones. Color Grain Size Type of Material
Diameter: <u>2</u>	0 - 20 tan fine sand		
From: <u>0</u>	20 - 80 orange not applicable sandy clay		
To: <u>170</u>	80 - 180 white not applicable limestone		
Diameter: <u>2</u>			
From: <u>170</u>			
To: <u>180</u>			
Liner [] or Casing []			
Diameter: _____			
From: _____			
To: _____			

Driller's Name (print or type): Eddie Palmer

SECTION 02530
PIPEWORK, GRAVITY SEWERS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall provide all work necessary for constructing a gravity sewer system. This work shall include the installation of all gravity sewer lines, services, fittings, and appurtenances as may be required to complete the work as indicated in the plans.

1.02 RELATED WORK

- A. The General Conditions and Special Conditions of these Specifications are a part of this Section as if incorporated in this Section.
- B. Other related Specifications are listed below:
 - 1. Section 03300, Cast-in-Place Concrete.

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. Shop Drawings: The Contractor shall submit catalog cut sheets, manufacturer's descriptive literature, and other necessary information to the Engineer for approval before installing pipe.
- C. Certifications: The Contractor shall submit a certification from the pipe manufacturer that the pipe and fittings supplied are new, have been manufactured for this project, and have been inspected at the plant.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

- A. Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

B. The latest edition of the Ten States Standards and applicable Standard Details and Specifications (latest edition) shall be referred to for both specific and general standards for materials, construction, workmanship, and quality control as specified in this Section, with exceptions as noted.

1. American Society of Testing and Materials (ASTM):

- a. ASTM A48—Standard Specification for Gray Iron Castings.
- b. ASTM A536—Standard Specification for Ductile Iron Castings.
- c. ASTM A746—Standard Specification for Ductile Iron Gravity Sewer Pipe.
- d. ASTM C32—Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).
- e. ASTM C144—Standard Specification for Aggregate for Masonry Mortar.
- f. ASTM C150—Standard Specification for Portland Cement.
- g. ASTM C443—Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
- h. ASTM D1248—Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
- i. ASTM D1557—Standard Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
- j. ASTM D1748—Standard Standard Test Method for Rust Protection by Metal Preservatives in the Humidity Cabinet.
- k. ASTM D1784—Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- l. ASTM D2241—Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- m. ASTM D2321—Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- n. ASTM D3034—Standard Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.
- o. ASTM D3212—Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
- p. ASTM F477—Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- q. ASTM F679—Standard Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings.
- r. ASTM F794—Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

- s. ASTM F1417—Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
- 2. American National Standards Institute (ANSI) Standards:
 - a. ANSI A21.5/AWWA C105—Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - b. ANSI A21.10/AWWA C110—Ductile-Iron and Gray-Iron Fittings for Water.
 - c. ANSI A21.11/AWWA C111—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - d. ANSI A21.51/AWWA C151—Ductile-Iron Pipe, Centrifugally Cast.
 - e. ANSI/AWWA-C900—Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-Inch through 12-Inch (100 mm through 300 mm), for Water Transmission and Distribution.
- 3. Federal Specifications and Standards (FSS):
 - a. A-A-60005—Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storage and protection of the items specified in this Section.
- B. Delivery, storage, and handling shall be in accordance with the manufacturer's recommendations.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 RECORD DRAWINGS (NOT USED)

PART 2 PRODUCTS

2.01 GENERAL

- A. The Contractor shall provide all new materials free from defects impairing strength and durability and of the best commercial quality for the purpose specified. All material supplied shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail.

2.02 PIPE

- A. Polyvinyl Chloride (PVC): Manufacture in accordance with ASTM D3034, minimum SDR 35, for pipe depths up to 12 feet deep only. PVC pipe shall have a cell classification of 12454B or 12364C as defined under ASTM D1748. PVC pipe shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in a sanitary sewer. No solvent-cement weld pipe will be accepted. The color must be green.
 - 1. Fittings and Joints: Bell and spigot type with elastomeric gasket installed in accordance with ASTM D3212 and ASTM D3034. Gaskets shall conform to ASTM F477 for joining plastic pipe.
 - 2. Nonmetallic Marking Tape: Install continuous marking tape approximately 1 foot above and on line with all nonmetallic pressure piping. Marking tape shall be "Extra-Stretch" marking tape equal to Allen Marking Tape, Allen Systems; Terra Tape, Division Reef Industries, for sanitary sewer, colored green. Extra-Stretch marking tape shall consist of 6-ply copolymer film bonded together without the use of adhesives, specifically formulated for prolonged use underground. It shall be highly resistant to alkalis, acids, and other destructive agents found in the soil. Extra Stretch tape shall have a minimum thickness of 6 mils, minimum tensile strength of 80 lb per 3-inch-wide strip, and a minimum elongation of 600%. Tape shall bear a continuous printed message repeated every 16 to 36 inches warning of the installation buried below. Installation instructions for the tape shall be printed with each message along the entire length.
 - 3. Tracer Wire: Install two strands of minimum #14 gauge stranded THWN wire with green insulation. Insulation shall be polyvinylchloride (PVC) or low-density, high-molecular-weight polyethylene for applications up to 600 volts. Wire shall run continuously through test stations for the entire

length of the pipe line. Leave enough slack in the wire so it can be extended 12 inches above the valve box at the test station. Attach wire along the sides of pipe line 5 feet 0 inch on center, using duct tape or approved equal. Wire shall meet National Electric Codes and Underwriter Laboratories, Inc. requirements.

2.03 SERVICE LATERAL PIPE

- A. Polyvinyl Chloride (PVC): Pipe, joints, and fittings shall conform to ASTM D3034, Type PSM, with a minimum SDR of 35.
- B. PVC Drain Waste Vent (PVC-DWV): 4-inch DWV sewer service pipe shall be PVC-DWV, Schedule 40 pipe and fittings.
- C. Adapters and Flexible Couplings: Prefabricated polyvinyl joint sealer adapters and sewer pipe couplings shall be similar to those manufactured by Fernco Joint Sealer Company, pipe manufacturer, or equal. Flexible couplings shall be installed with stainless steel bands and adjusting screws.

2.04 MANHOLES (NOT USED)

2.05 FLEXIBLE MANHOLE-TO-PIPE CONNECTOR (NOT USED)

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: The Contractor shall install all pipework meeting the requirements of AWWA for installing polyvinyl chloride for the various types and classes of pipe. Lay all gravity sewers using laser beam methods. Obtain exact grade and alignment for each pipe by measuring to the invert of the pipe. Lay pipe upgrade, beginning at the lower end of the sewer, with pipe bell ends up-grade. Exercise extreme care to keep the pipe in exact alignment and elevation. It is the Contractor's responsibility to make exploratory excavations and/or use other methods available to locate existing utilities before constructing any gravity sewers. If necessary, the Contractor shall adjust the new sewers and/or laterals, subject to approval by the Engineer, to avoid conflicts with existing piping.. In no case shall the pipe be walked on either before or after the joints have been made. Securely close all openings such as stubs, wyes, or other services along the lines with approved stoppers that fit into the bells of the pipe and are recommended by the pipe manufacturer. Install stoppers in such a manner that they may be removed at some future time without injury to the pipe bells. No bricking or grouting plugs in lines will be permitted.

- B. **Laying Pipe:** Take all necessary precautions to prevent mud, sand, or other obstructing matter entering the pipelines. Lay pipe on bedding prepared in accordance with ASTM D1557 and a minimum of 90% density bedding for the pipe installed, in accordance with the plans and Earthwork section of these Specifications; provide uniform bearing under the full length of the pipe barrel. Excavate for pipe bells and carefully lay pipe true to line and grade. Make adjustments to line and grade by scraping away or filling in and tamping under the pipe barrel and not by wedging or blocking up any portion of the pipe. Abut the spigot end of each pipe against the base of the socket of the adjacent pipe in such a manner that there will be no unevenness of any kind along the bottom halves of the pipes. Immediately after the pipe has been jointed and inspected, compact sufficient backfill to protect the pipe adequately from injury and movement. At the close of each day's work and at other times when pipe is not being laid, protect the end of the pipe with a close-fitting stopper approved by the Engineer. Replace with sound pipe any defective pipe which may have been laid. Upon completion, installed pipe lines shall show a full circle of light when lamped between pipe ends.
- C. **Joints:** The Contractor shall submit the specific type of joint to be used on all pipe, including complete data on all material to be used, to the Engineer for approval before beginning any pipework. Make all joints conform to the requirements of the manufacturer's printed instructions as approved for the type of joint installed.
- D. **Cleanouts:** Construct as detailed using pipe and fittings as specified in this Section. Applicable portions of these Specifications shall apply to the construction of this item.

3.02 INSPECTION AND TESTING

A. **General:**

1. The Contractor shall inspect all work constructed for faults or defects and any deviation from these documents or omissions shall be corrected at once. The Contractor shall conduct all tests and shall provide necessary equipment and personnel for lamping the system in the presence of the Engineer. The Contractor shall bear all costs for these tests and inspections.
2. Sewers shall be tested by a low-pressure air test.
3. Pipe testing shall closely follow pipe laying. No more than 1,000 feet of pipe shall remain untested at any time.

B. Gravity Piping

1. The Contractor shall submit the proposed method of testing to the Engineer for approval. Air testing shall be performed in accordance with the procedures described in ASTM F1417. The equipment shall be specifically designed and manufactured for testing pipelines with low-pressure air and shall be provided with an air regulator valve or air safety valve set to prevent the air pressure in the pipeline from exceeding 8 psig. If the results of the air test are unsatisfactory, perform the exfiltration test as outlined above.
2. The following low-pressure air testing procedures may be used. The sewer line shall have an orifice through which to pass air into the pipe. An air supply shall be connected to the orifice at one end of the line. The air supply line will contain an on/off gas valve and a pressure gauge with a range of 0 to 5 psi. The gauge shall have minimum divisions of 0.10 psi and shall have an accuracy of ± 0.04 psi. The seals at each manhole shall be properly blocked to prevent displacement while the line is under pressure. The pipe line under test shall be pressurized to 4 psig. The line will be allowed to stabilize between 4 psig and 3.5 psig for no less than 5 minutes. If necessary, air shall be added to the line to maintain the pressure above 3.5 psig. After the stabilization period, the gas valve shall be closed. When the line pressure drops to 3.5 psig, timing will begin with a stop watch. The stop watch shall be allowed to run until the line pressure drops to 2.5 psig. The watch shall then be stopped and the time lapse shall be compared to the allowable time lapse in these Specifications. If the time lapse is greater than that specified, the section undergoing the test shall have passed the low-pressure air test and the test will be discontinued at that time. If the time is less than that specified, the line has not passed the test (see Table 1 for test times).

Table 1 Air Test Table									
Length (feet)	4	6	8	10	12	15	18	21	24
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30	--	--
175	0:31	1:09	2:03	3:13	4:37	7:05	--	--	--
200	0:35	1:19	2:21	3:40	5:17	--	--	--	12:06
225	0:40	1:29	2:38	4:08	5:40	--	--	10:25	13:36
250	0:44	1:39	2:56	4:35	--	--	8:31	11:35	15:07
275	0:48	1:49	3:14	4:43	--	--	9:21	12:44	16:38
300	0:53	1:59	3:31	--	--	--	10:12	13:53	18:09

Table 1 Air Test Table									
Length (feet)	4	6	8	10	12	15	18	21	24
350	1:02	2:19	3:47	--	--	8:16	11:54	16:12	21:10
400	1:10	2:38	--	--	6:03	9:27	13:36	18:31	24:12
450	1:19	2:50	--	--	6:48	10:38	15:19	20:50	27:13
500	1:28	--	--	5:14	7:34	11:49	17:01	23:09	30:14

- C. Infiltration: After the work is complete, the sewers or sections shall be tested for infiltration. Any section in which the infiltration of water is detected will be rejected until corrective work has been performed. No infiltration will be allowed for any one trunk, main, or lateral.
- D. Exfiltration: The Engineer may require tests for exfiltration. Exfiltration shall be in accordance with the requirements of ASTM requirements as modified by the Engineer. An allowance of 10 % of exfiltration gallonage shall be permitted for each additional 10-foot head over the basic top-of-manhole head.
- E. Television Inspection: All new sewer mains shall be inspected by internal television inspection, providing accurate distances to all services, with logs and video record of inspection. The Contractor shall provide all equipment and labor for such inspection. Any Sub-Contractor must be approved by the Owner before work. Acceptable procedures for televising and video recording are available at the Public Works Department. Digital video recordings shall be taken of all inspection. The Contractor shall prepare the DVD and after review by the Engineer it shall be delivered to the Owner. The Engineer or Owner's representative shall observe the television inspection.
- F. Alignment and Deflection: Lines shall show full circle of light when lamped between pipe ends for line sections with complete pipe replacement.
1. A nine-point mandrel shall be passed through each new flexible pipe section installed after full backfill has been placed. The maximum pipe diameter deflection shall not exceed 5%.
- G. Warranty Test: To ensure the adequacy of the pipe described above, the Contractor shall remobilize to the work site 10 months after final approval-acceptance of the complete project, such time being within the 1-year warranty period, as stated in the General Conditions. The date for such remobilization will be stated in the Final Approval issued by the Engineer.
1. The Contractor, together with representatives of the Engineer and the Owner, shall visually inspect every new line section installed in the project area for cracks, damaged lining, leaks, or abnormal conditions. The line sections will be chosen by the Engineer/Owner at random.

2. The Contractor shall appropriately correct any deficiencies that are found by such visual inspection, as approved by the Engineer. To adequately locate certain deficiencies, the Contractor shall be required to use closed-circuit television inspection and other methods.
 3. All costs involved in remobilizing, inspecting, or correcting deficiencies will be considered incidental to the project and shall be the responsibility of the Contractor at no additional cost to the Owner.
- H. Repair of PVC Piping: At the option of the Engineer, if PVC piping is found to be defective during the warranty test period and if the Engineer does not approve a method of pipe repair by the Contractor, the Contractor shall remove and replace the faulty pipe in an approved manner at no additional cost to the Owner.

END OF SECTION

SECTION 02630
STORM DRAINAGE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers the work necessary to provide for the construction of a stormwater collection system. This work shall include installing the pipe, catch basins, inlets, manholes, mitered end section, etc., as may be required to complete the work as indicated in the plans.

1.02 RELATED WORK (NOT USED)

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Shop Drawings: The Contractor shall submit catalog cut sheets, manufacturer's descriptive literature, and other information as necessary to the Engineer for approval before installing pipes and structures.
- B. Certifications: The Contractor shall submit a notarized certification from the pipe manufacturer that the pipe and fittings supplied are new, have been manufactured for this project, have been inspected at the plant, and meet the requirements of these Specifications.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. The most current edition of the Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction (Standard Specifications) and the most current edition of the Roadway and Traffic Design Standards shall be referred to for construction, workmanship, and quality control as specified in this Section with exceptions as noted. Note that any reference in

the Standard Specifications to the terms "Department" or "District Materials Engineer" shall be replaced by the term "Engineer."

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES (NOT USED)

1.08 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 RECORD DRAWINGS (NOT USED)

PART 2 PRODUCTS

Except as specifically noted below, the Contractor shall provide all new materials free from defects impairing strength and durability and of the best commercial quality for the purpose specified. All materials shall have structural properties sufficient to safely sustain or withstand strains and stresses which they will be normally subjected to and be true to detail.

- A. The Owner has the following pipe culverts available onsite that shall be used before ordering additional materials.
 - 1. 53 lengths of 8-foot 36-inch diameter RCP
- B. If the Owner-provided materials are damaged or defective, the Contractor shall notify the Owner.
- C. Contractor shall provide seals and mitered end sections for culvert construction.

2.01 PIPE CULVERTS

- A. The following section of the FDOT Standard Specifications shall apply:
Section 430.

2.02 INLETS, MANHOLES, AND JUNCTION BOXES

- A. The following section of the FDOT Standard Specifications shall apply:
Section 425.

2.03 MITERED END SECTIONS

- A. The following section of the FDOT Standard Specifications shall apply:
Section 430.

2.04 FILTER POINT MAT (SLOPE PAVING-PUMPED CONCRETE MATS)

- A. The following section of the FDOT Standard Specifications shall apply:
Section 524.

2.05 BEDDING MATERIAL

- A. The following section of the FDOT Standard Specifications shall apply:
Section 530.

2.06 PRECAST CONCRETE DRAINAGE PRODUCTS

- A. The following sections of the FDOT Standard Specifications shall apply:

1. Section 449-1, Description
2. Section 449-2, Materials
3. Section 449-3, Construction Requirements
4. Section 449-4, Concrete Pipe
5. Section 449-5, Fiber Reinforced Concrete Pipe
6. Section 449-6, Requirement for Pipe Joints When Rubber Gaskets Are To Be Used

- B. Exceptions:

1. Section 449-1: References to Quality Control Plan are not applicable.

2.07 CONCRETE DITCH AND SLOPE PAVEMENT

- A. The following section of the FDOT Standard Specifications shall apply:
Section 524.

2.08 FLOWABLE FILL

- A. The following section of the FDOT Standard Specifications shall apply:
Section 121.

2.09 RUBBLE RIP RAP (DITCH LINING)

- A. The following section of the FDOT Standard Specifications shall apply:
Section 530.

PART 3 EXECUTION

3.01 EXCAVATION FOR STRUCTURES AND PIPE

- A. The following sections of the FDOT Standard Specifications shall apply:
 - 1. Section 125-1, Description
 - 2. Section 125-2, Classification
 - 3. Section 125-3, Cofferdams
 - 4. Section 125-4, Excavation
 - 5. Section 125-8, Backfilling
 - 6. Section 125-11, Site Restoration
 - 7. Section 125-12, Cleaning Up

3.02 PIPE CULVERTS

- A. The following section of the FDOT Standard Specifications shall apply:
Section 430.

3.03 INLETS, MANHOLES, AND JUNCTION BOXES

- A. The following section of the FDOT Standard Specifications shall apply:
Section 425.

3.04 MITERED END SECTIONS

- A. The following section of the FDOT Standard Specifications shall apply:
Section 430.

3.05 FILTER POINT MAT (SLOPE PAVING-PUMPED CONCRETE MATS)

- A. The following section of the FDOT Standard Specifications shall apply:
Section 524.

3.06 CONCRETE DITCH AND SLOPE PAVEMENT

- A. The following section of the FDOT Standard Specifications shall apply:
Section 524.

3.07 PLUGGING PIPE WITH FLOWABLE FILL

- A. The following section of the FDOT Standard Specifications shall apply:
Section 430-4.5.

3.08 RUBBLE RIP RAP (DITCH LINING)

- A. The following section of the FDOT Standard Specifications shall apply:
Section 530.
- B. Exceptions: Basis of payment for all sections.

END OF SECTION

SECTION 02700
PAVING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers the work necessary to provide for the construction of all pavement and limerock surfaced roads where indicated on the Drawings.
- B. The Contractor shall obtain crushed glass from the Lee County Resource Recovery Facility in Fort Myers, Florida to incorporate into asphalt paving for use in the Composting Facility Expansion in accordance with Paragraph 2.05B.

1.02 RELATED WORK

- A. Section 01350, Environmental Protection Procedures.
- B. Section 02300, Earthwork.

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Limerock material submittal is to be made to include liquid limit, plastic index, gradation, certification regarding deleterious material, limerock bearing ratio (LBR), Florida Department of Transportation (FDOT) pit number, and other information as required to indicate performance in accordance with the specifications.
- B. Information regarding asphaltic and Portland cement concrete materials and mix shall be submitted as required by the referenced FDOT specifications.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. The latest edition of the FDOT Standard Specifications for Road and Bridge Construction (Standard Specifications) and Roadway and Traffic Design Standards shall be referred to for construction, workmanship, and quality control as specified with exceptions as noted in this Section.
 - 1. Where the referenced FDOT Specifications cite "the Department," this shall be modified to "the Owner and/or Engineer" by this contract.
 - 2. The Contractor shall retain an independent testing agency, as approved by the Engineer, to perform all tests, including tests referenced to be performed by the Engineer.
 - 3. Payment for this project is on a Lump-Sum Basis if defined as Lump Sum on the Bid Form. The FDOT sections defining the Basis of Payment shall be applied only when unit price work is defined on the Bid Form.
- B. American Society of Testing and Materials (ASTM)
 - 1. ASTM D1556—Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 - 2. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 3. ASTM D2167—Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 4. ASTM D6938—Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.06 QUALITY ASSURANCE

- A. The Contractor shall perform field-density tests along the centerline of construction or as directed by the Engineer and in accordance with the FDOT's *Standard Specifications for Road and Bridge Construction*, latest edition.
- B. The Contractor shall field check the depth of stabilization and/or limerock at each road crossing with a pipeline.
- C. The Engineer may require additional testing as deemed necessary. The Engineer shall interpret test results and the Contractor shall perform remedial work as directed by the Engineer at no additional cost to the Owner. The Contractor shall provide labor to the Engineer for help in performing tests and/or checking line and grade at no additional cost to the Owner.

- D. Laboratory maximum dry density of soil mixtures at optimum moisture shall be determined by ASTM D1557 for subgrade, stabilized subgrade, and limerock base course.
- E. Field density of stabilized subgrade and soils or soil mixtures in fill or backfill shall be determined by ASTM D1556, D2167, or D6938 for limerock base course.
- F. Bearing value of stabilized subgrade shall be determined by the methods required for determining limerock bearing ratio (LBR) according to the FDOT, Standard Specification FM 5-515.
- G. Field density of stabilized subbase shall be 98% or greater of the Modified Proctor maximum dry density, ASTM D1557.
- H. The Owner shall retain an independent testing agency, as approved by the Engineer, to perform all tests. The Engineer shall have sole responsibility for interpreting all test results. The Contractor shall bear the cost of all retests due to failure to achieve specified requirements.

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.
- B. The Owner waives the warranty requirements for the finished asphalt pavement using recycled crushed glass material installed according to the specifications herein.

1.08 DELIVERY, STORAGE, AND HANDLING (NOT USED)

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 RECORD DRAWINGS (NOT USED)

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 ROCK BASE

A. The following sections of the Standard Specifications shall apply:

1. Section 200-1, Description.
2. Section 200-2, Materials

2.03 STABILIZING

A. The following sections of the Standard Specifications shall apply:

1. Section 160-1, Description
2. Section 160-2, Materials

2.04 PRIME AND TACK COATS FOR BASE COURSES

A. The following sections of the Standard Specifications shall apply:

1. Section 300-1, Description
2. Section 300-2, Materials
3. Section 300-3, Equipment

2.05 SUPERPAVE ASPHALT

A. The following sections of the Standard Specifications shall apply:

1. Section 334-1, Description
2. Section 334-2, Materials
3. Section 334-3, General Composition of Mixture
4. Section 334-5, Acceptance of the Mixture

B. Exceptions

1. Section 334-2.4, Recycled Crushed Glass: The Contractor shall use recycled crushed glass, which shall be obtained from the County. The gradation of recycled crushed glass may vary from the gradation requirements of Section 902-6 Local Materials. Recycled crushed glass may be used in the final wearing surface.

2.06 CEMENT CONCRETE PAVEMENT (NOT USED)

2.07 TRAFFIC STRIPES AND MARKINGS (NOT USED)

PART 3 EXECUTION

3.01 EXCAVATION AND EMBANKMENT

A. The following sections of the Standard Specifications shall apply:

1. Section 120-1, Description
2. Section 120-2, Classifications of Excavation
3. Section 120-3, Preliminary Soils Investigation
4. Section 120-4, Removal of Unsuitable Materials and Existing Roads
5. Section 120-5, Disposal of Surplus and Unsuitable Material
6. Section 120-6.1, Materials for Borrow
7. Section 120-7, Materials for Embankment
8. Section 120-8, Embankment Construction
9. Section 120-9, Compaction Requirements
10. Section 120-10, Acceptance Program
11. Section 120-11, Maintenance and Protection of Work
12. Section 120-12, Construction

B. Exceptions

1. Section 120-4.1, Subsoil Excavation: Unsuitable soils shall be those in Classifications A-6, A-7, or A-8 in the American Association of State Highway and Transportation Officials (AASHTO) System.
2. Section 120-4.2, Removal of Existing Old Road: Where removal of existing pavement is called for, it shall be removed to the full depth as indicated in the cross-sections and replaced with new limerock and paving or other treatment in accordance with the Drawings and details.
3. Section 120-5.2, Disposal of Paving Materials: Disposing of muck on side slopes shall not apply.
4. Section 120-9.2.1, General: Laboratory maximum dry density shall be determined by Modified Proctor, ASTM D1557. Field densities shall be determined by ASTM D1556, D2167, or D6938. All embankments shall be compacted to not less than 95% of the maximum dry density, as determined by modified Proctor, ASTM D1557.

5. Section 120-12.1, Construction Tolerances: No tolerance greater than 0.1-foot above or below the plan cross-section will be allowed.

3.02 STABILIZING

- A. The following sections of the Standard Specifications shall apply:

1. Section 160-1, Description
2. Section 160-2, Materials
3. Section 160-3, Construction Methods
4. Section 160-4, Acceptance Program

- B. Exceptions

1. The Contractor shall stabilize the road bed to a minimum depth of 12 inches as shown on the Drawings.
2. Section 160-4.2.1.2, Undertolerance in Bearing Value Requirements: no undertolerance will be acceptable.

3.03 LIMEROCK BEARING RATIO AND DENSITIES

- A. Stabilized finish grade and stabilized shoulders shall have a minimum Limerock Bearing Ratio (LBR) value of 40.
- B. Field density of stabilized finished grade shall be a minimum of 98% of the Modified Proctor maximum dry density as specified in ASTM D1557 to a minimum depth of 12 inches as shown on the Drawings.

3.04 PRIME AND TACK COATS

- A. The following sections of the Standard Specifications shall apply:

1. Section 300-3, Equipment
2. Section 300-5, Cleaning Base and Protection of Adjacent Work
3. Section 300-6, Weather Limitations
4. Section 300-7, Application of Prime Coat
5. Section 300-8, Application of Tack Coat

3.05 LIMEROCK BASE

A. The following sections of the Standard Specifications shall apply:

1. Section 200-3, Equipment
2. Section 200-4, Transporting Rock
3. Section 200-5, Spreading Rock
4. Section 200-6, Compacting and Finishing Base
5. Section 200-7, Acceptance Program
6. Section 200-8, Priming and Maintaining

B. Exceptions

1. Section 200-7.2.1, Density: The minimum density which will be acceptable for paved areas will be 98% of the maximum dry density as determined by Modified Proctor, ASTM D1557.
2. Section 200-7.3.1.2, Depth and Surface Testing Requirements: Thickness of base shall be measured at intervals not to exceed 200 feet.

3.06 REWORKING LIMEROCK BASE

A. The following sections of the Standard Specifications shall apply:

1. Section 210-5, Trenches and Subgrade
2. Section 210-6, Spreading, Shaping, and Compacting Rock
3. Section 210-7, Priming and Maintaining

3.07 SUPERPAVE ASPHALT

A. The following sections of the Standard Specifications shall apply:

1. Section 320-6, Preparation of the Mixture
2. Section 320-7, Transportation of the Mixture
3. Section 330-1, Description
4. Section 330-2, Quality Control by Contractor
5. Section 330-3, Limitations of Operations
6. Section 330-4, Surface Preparation
7. Section 330-5, Paving Equipment
8. Section 330-6, Placing Mixture
9. Section 330-7, Compacting Mixture
10. Section 330-8, Joints
11. Section 330-9, Surface Requirements
12. Section 330-10, Protection of Finished Surface

- 13. Section 334-3, General Composition of Mixture
- 14. Section 334-5, Acceptance of Mixture

3.08 CEMENT CONCRETE PAVEMENTS (NOT USED)

3.09 PAVEMENT REPAIR

- A. At his own expense the Contractor shall repair all damage to pavement as a result of work under this Contract in a manner satisfactory to the Engineer. Pavement shall be repaired to match the original surface material thickness and original grade. However, the asphalt concrete thickness shall not be less than 2 inches. The repair shall include preparing the subgrade, placing and compacting the applicable base, priming the limerock base, and placing and maintaining the surface treatment as specified in this Section.
- B. The width of all repairs shall extend at least 12 inches beyond the limit of the damage. The edge of the pavement to be left in place shall be cut to a true edge with a saw or other approved method so as to provide a clean edge to abut the repair. The line of the repair shall be reasonably uniform with no unnecessary irregularities.

3.10 JOINTS

- A. General pavement joints within asphalt driveways and roadways and where specified or directed by the Engineer, shall be mechanically sawed butt joints. The edges of asphalt pavement shall be trimmed to straight lines which a roller can follow.

3.11 TRAFFIC STRIPES AND MARKINGS (NOT USED)

END OF SECTION

SECTION 02920
SEEDING AND SODDING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes requirements for the following areas of work:

1. Fine grading
2. Preparation of areas to receive seeding and sodding
3. Fertilizing of areas to receive seeding and sodding
4. Maintenance
5. Seeding
6. Hydroseeding
7. Sodding of new areas to receive seeding and sodding
8. Mulching

1.02 RELATED WORK

A. Section 02370, Erosion and Sedimentation Control.

1.03 SUBMITTALS

A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

B. Certificates:

1. Fertilizer, seed, hydroseed, and sod shall be accompanied by certificate from vendors certifying these items meet the requirements of these Specifications, stating botanical name, percentage by weight, and percentage of purity.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. FS O-F-241—Fertilizers, Mixed, Commercial
- B. American Society for Testing and Materials (ASTM)—Equivalent AASHTO standards may be substituted as approved.
- C. The Florida Department of Transportation (FDOT) Standard Specifications for Road Bridge Construction (Standard Specifications) shall be referred to for both specific and general standards for materials, construction, workmanship, and quality control as specified in this Section with exceptions, as noted herein. Note that any reference in the Standard Specifications to the terms “Department” or “District Materials Engineer” shall be replaced by the term “Owner.”

1.06 QUALITY ASSURANCE

- A. The Contractor shall provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. Deliver, store, protect, and handle products to the site and prevent damage from wetness and weather conditions.
- C. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- D. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of the manufacturer.
- E. No sod that has been cut for more than 72 hours may be used unless specifically authorized. A letter of certification from the grassing Contractor as to when the sod was cut and what type shall be provided to the Engineer upon delivery of the sod to the job site.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE

Maintenance shall be as indicated under Part 3, Execution, of this Specification Section.

1.12 RECORD DRAWINGS (NOT USED)

1.13 DEFINITIONS

- A. *Weeds:* Weeds include but are not limited to Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.14 REGULATORY REQUIREMENTS

- A. The Contractor shall comply with regulatory agencies for fertilizer and herbicide composition.

PART 2 PRODUCTS

2.01 TOPSOIL

- A. The Contractor shall provide topsoil from on-site excavation of the Ash Monofill.

2.02 SEED MIXTURE

- A. Fresh, clean, new-crop seed labeled in accordance with U.S. Department of Agriculture Rules and Regulations and FDOT's Standard Specification under the Federal Seed Act in effect on date of bidding. Provide seed of grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, as specified. Furnish seed in sealed standard containers labeled with producers name and seed mixture and percentage of purity, germination, and weed seed for each grass seed species required. Provide grass seed mixtures in accordance with the following:

Botanical (Common Name)	Percent by Weight	Minimum Percent Germination	Minimum Percent Purity	Maximum Percent of Weed Seed
Bahia Grass (Pensacola)	80	85	85	1.0
Bermuda Grass, Hulled (Cynodon Dactylon)	20	85	85	1.0

2.03 SOD

- A. The Contractor shall provide strongly rooted sod Bahia grass sod or St. Augustine, not less than 2 years old and free of weeds and undesirable native grasses. Provide only sod capable of growth and development when planted (viable, not dormant). Sod shall be provided in rectangles a minimum of 12 inches by 24 inches or in rolls at least 12 inches in width and length consistent with the equipment used to handle the rolls and place the sod.

2.04 FERTILIZER FOR SOD

- A. The Contractor shall provide commercial fertilizer of neutral character, with some elements derived from organic sources, containing not less than 8% phosphoric acid, 8% potassium, and percentage of nitrogen required to provide less than 1.0 lb. of actual nitrogen per 1,000 square feet of area. Provide nitrogen in form that will be available to the seeded and sodded area during initial period of growth. The chemical designation shall be 5-10-10.
- B. The Contractor shall ensure that the fertilizer is delivered to the site in labeled bags or containers.

2.05 FERTILIZER FOR SEED

- A. Fertilizer: FS O-F-241, Type I, Grade A; recommended for grass, with 50% of the elements derived from organic sources, of a proportion necessary to eliminate any deficiencies of topsoil to the following proportions:

Seeded Areas—5% nitrogen, 10% phosphoric acid, 10% soluble potash.
- B. The Contractor may also use compost available from the on-site facility in addition to seed and sod.

2.06 WATER FOR SEEDING AND SODDING

- A. Water shall be free of acid, alkali, or organic materials and shall have a pH of 7.0 to 8.5. The Contractor shall provide all water needed for grassing by providing permanent or temporary piping valves and temporary trucks to convey water from

the source to the point of use. The Contractor shall provide any meters required and pay for water used if the water is taken from a public water system. Water shall be free of petroleum products, pesticides, and any other deleterious impurities.

2.07 EROSION-CONTROL FABRIC

- A. The Contractor shall provide 70% agricultural straw with 30% coconut fiber matrix stitches with degradable nettings designed to degrade within 18 months. Erosion-control anchors shall be as recommended by the manufacturer.

2.08 STRAW MULCH

- A. Straw mulch shall be used on all newly graded and topsoiled areas sloped 3:1 or steeper to protect areas against washouts and erosion. Straw mulch shall consist of threshed straw of oats, wheat, barley, or rye that is free from noxious weeds, mold, or other objectionable material. The straw mulch shall contain at least 50% by weight of material that is 10 inches or longer. Straw shall be in an air-dry condition and suitable for placement with blower equipment.

2.09 TACKIFIER

- A. Latex acrylic copolymer shall be Soil Sealant with coalescing agent as manufactured by Soil Stabilization Products Company, Inc., Merced, CA or equal and shall be used as straw mulch tackifier.

PART 3 EXECUTION

3.01 COORDINATION OF WORK

- A. The Contractor shall coordinate all work activities to provide for establishing grass cover at the earliest possible time in the construction schedule to minimize erosion of topsoil.

3.02 SOIL PREPARATION

Concerning soil preparation, the Contractor shall do the following:

- A. Dispose of any existing sod, growth, rocks, or other obstructions which might interfere with tilling, seeding, sodding, or later maintenance operations. Remove stones over 2 inches in any dimensions and sticks, roots, rubbish, and other extraneous matter.

- B. Grade areas to be seeded and sodded to a smooth, even surface with loose, uniformly firm texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas which can be planted in the immediate future.
- C. Moisten prepared areas to be seeded and sodded before planting if the soil is dry. Water thoroughly and allow the surface to dry off before seeding and sodding. Do not create a muddy soil condition.
- D. Restore prepared areas to specified condition if eroded or otherwise disturbed after the fine grading and before planting.
- E. Spread the planting soil mixture to depth required to meet thickness, grades, and elevations indicated after light rolling and natural settlement. Do not spread if the material is frozen or if the subgrade is frozen.
- F. Preparing Unchanged Grades:
 - 1. Where seeding and sodding in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil as follows:
 - a. Apply soil amendments and initial fertilizers.
 - b. Remove high areas and fill in depressions.
 - c. Till soil to a homogeneous mixture of fine texture, free of lumps, clods, stones, roots, and other extraneous matter.
- G. Allow for a 3-inch sod thickness in areas to be added next to paving. Sod shall not block stormwater run-off from paved areas.
- H. Before preparing unchanged areas, remove existing grass, vegetation, and turf. Dispose of such material outside of the Owner's property: do not turn over into soil being prepared for seeding and sodding.
- I. Place approximately one-half of the total amount of planting soil required. Work into the top of the loosened subgrade to create a transition layer and then place the remainder of the planting soil.

3.03 FERTILIZING FOR SEEDING

- A. Seeding: The Contractor shall spread fertilizer uniformly at a rate of 10 pounds per 1,000 square feet.

- B. Apply after smooth raking of topsoil and before roller compaction.
- C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- D. Mix thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.04 SEEDING

- A. Apply seed at the rate designated on the schedule evenly in two intersecting directions. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on the same day.
- C. Do not sow immediately following rain, when ground is too dry, or during windy periods.
- D. Roll seeded area with appropriate equipment to achieve seed embedment and soil compaction.
- E. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.05 HYDRO-SEEDING

- A. Apply seeded slurry with a hydraulic seeder at the rate designated on schedule evenly in two intersecting directions.
- B. Do not hydro-seed area in excess of that which can be mulched on the same day.
- C. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.06 SEED PROTECTION

- A. When seeding is complete, apply straw mulch at a rate of 4,000 lb/acre. Apply tackifier as required.
- B. Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.

- C. Lay fabric smoothly on surface, bury top end of each section in 6-inch-deep excavated topsoil trench. Provide a 2- to 4-inch overlap of adjacent rolls. Backfill the trench and rake smooth, level with the adjacent soil.
- D. Secure outside edges and overlaps in accordance with the manufacturer's recommendations.
- E. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
- F. At the sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges a minimum of 6 inches.

3.07 SODDING NEW AREAS

When sodding new areas, the Contractor shall do the following:

- A. Before laying sod, contact the Engineer to observe soil preparation work. Lay sod within 24 hours of the time of stripping. Do not plant dormant sod or if the ground is frozen.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger to offset joints in adjacent courses. Employ installation methods to avoid damage to subgrade or sod. On slopes install the sod with an overlap that allows water to flow over the adjacent strip and not under it. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering adjacent grass.
- C. Anchor sod on slopes greater than 3:1 with wood pegs as required to prevent slippage.
- D. Water sod thoroughly with a fine spray immediately after planting.

3.08 RECONDITIONING SEEDED AND SODDED AREAS

The Contractor shall ensure that seeded and sodded areas are properly reconditioned by doing the following:

- A. Recondition seeded and sodded areas that are damaged by work operations, including storage of materials or equipment and movement of vehicles. Also recondition seeded and sodded areas where settlement or washouts occur or where minor regrading is required. Recondition other existing seeded and sodded areas where indicated.

- B. Provide fertilizer, topsoil, seed, or sod amendments as specified for new seeded and sodded areas and as required to provide satisfactory reconditioning. Provide new planting soil as required to fill low spots and meet new finish grades.
- C. Cultivate bare and compacted areas thoroughly to provide a good deep planting bed.
- D. Remove diseased or unsatisfactory seeded and sodded areas; do not bury into soil. Remove topsoil containing foreign materials resulting from operations including oil drippings, stone, gravel, and other construction materials. Replace with new topsoil.
- E. Where substantial seeding and sodding remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize, and seed. Remove weeds before seeding or, if extensive, apply selective chemical weed killers as required. Apply seedbed mulch, if required, to maintain moist condition.
- F. Water newly planted areas and keep moist until new grass is established.

3.09 PROTECTION

- A. The Contractor shall erect barricades, warning signs, and fencing to protect newly planted areas from traffic. Maintain barricade fencing and warning signs throughout the maintenance period until project is substantially completed.

3.10 MAINTENANCE

To maintain the seeded and sodded area, the Contractor shall do the following:

- A. Mow sod to a height of 2 inches as soon as there is enough top growth to cut with a mower. Remove no more than 40% of grass leaf growth in initial or subsequent mowing. Do not delay mowing until grass blades bend over and become matted.
- B. The Contractor shall top-dress the seeded and sodded area with ¼- to ½-inch of compost from the Owner's on-site facility.
- C. Remove weeds by pulling or chemical treatment.
- D. Perform maintenance until the date of final completion of project.
- E. Apply the second fertilizer application after the first mowing and when grass is dry. Use fertilizer which will provide not less than 1.0 pound of actual nitrogen per 1,000 square feet of seeded and sodded areas.

- F. Replant bare areas using the same materials specified for seeded and sodded areas.
- G. Watering: Provide and maintain temporary piping, hoses, and watering equipment as required to convey water from water sources and to keep seeded and sodded areas uniformly moist as required for proper growth. Do not apply more than 1 inch (25 mm) of water per week to sustain grass growth.
- H. Lay out temporary watering system and arrange watering schedule to avoid walking over muddy areas. Use equipment and water to prevent puddling and water erosion and displacing seed or mulch (if any).
- I. Apply water in sufficient quantities and as often as seasonal conditions require to keep the grassed areas moist.
- J. Provide supplemental water and irrigation to sod areas when the rainfall is not adequate to maintain soil moisture necessary for growth of the grass. The Contractor is responsible for determining the quantities of water required and when to irrigate. This obligation shall remain in full force and effect until final acceptance of the work by the Owner and shall be provided at no additional cost to the Owner.

The Owner, at its discretion, may relieve the Contractor of this obligation at such time as the Owner is able to provide irrigation if available. This action, however, does not relieve the Contractor of the provisions and guarantees set forth in the Contract Documents.

3.11 ACCEPTANCE OF SEEDED OR SODDED AREAS

- A. When seeding or sodding work, including maintenance, is substantially complete, the Engineer and the Owner will, upon request, observe to determine satisfactory growth and acceptability:
 - 1. The term "Satisfactory Growth" as used in this Section is defined as even plant growth in healthy condition without bare spots larger than 1 square foot in seeded areas and without bare spots in sodded areas. Bare spots in sodded areas shall be resodded. The Contractor shall maintain all grassed and sodded areas until satisfactory growth has been demonstrated at project final completion. If the subsequent stand of grass is found contaminated with weeds or other obnoxious or undesirable growth, the Contractor shall eliminate such undesirable growth at the Contractor's own expense.

- B. The Contractor shall re-plant rejected work and continue specified maintenance until the work is accepted by the Engineer and the Owner and found to be acceptable.
- C. Sodded areas will be acceptable provided requirements, including maintenance, have been complied with and a healthy, well-rooted, even-colored, viable seeded or sodded area is established, free of weeds, open joints, bare areas, and surface irregularities.

3.12 CLEANUP

- A. The Contractor shall promptly remove soil and debris created by seeding and sodding work from paved areas. Clean wheels of vehicles before they leave the site to avoid tracking soil onto surfacing of roads, walks, or other paved areas.

END OF SECTION

DIVISION 3

CONCRETE

SECTION 03100
CONCRETE FORMWORK

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required to design, install, and remove formwork for cast-in-place concrete as shown on the Drawings and as specified in this Section.
- B. Secure to forms as required or set for embedment as required all miscellaneous metal items, sleeves, reglets, anchor bolts, inserts, and other items furnished under other Sections and required to be cast into concrete or approved in advance by the Engineer.

1.02 RELATED WORK

- A. Section 03200, Concrete Reinforcement.
- B. Section 03250, Concrete Joints and Joint Accessories.
- C. Section 03300, Cast-in-Place Concrete.
- D. Section 03600, Grout.

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:
 - 1. Form release agent.
 - 2. Form ties.
- B. Samples
 - 1. Demonstrate to the Engineer on a designated area of the concrete substructure exterior surface that the form release agent will not adversely affect concrete surfaces to be painted, coated, or otherwise finished and will not affect the forming materials.
 - 2. Certify that the form release agent is suitable for use in contact with potable water after 30 days (non-toxic and free of taste and odor).

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Concrete Institute (ACI)
 - 1. ACI 301—Specifications for Structural Concrete.
 - 2. ACI 318—Building Code Requirements for Structural Concrete and Commentary.
 - 3. ACI 347—Guide to Formwork for Concrete.
- B. American Plywood Association (APA)
 - 1. Material grades and designations as specified
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES (NOT USED)

1.08 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 WEATHER CONSTRAINTS (NOT USED)

1.12 SYSTEM DESCRIPTION

- A. General: Architectural Concrete is wall, slab, beam, or column concrete which will have surfaces exposed to view in the finished work. It includes similar exposed surfaces in water-containment structures from the top of walls to 2 feet below the normal water surface in open tanks and basins.
- B. Formwork shall be designed and erected in accordance with the requirements of ACI 301 and ACI 318 and as recommended in ACI 347 and shall comply with all applicable regulations and codes. The design shall consider any special requirements due to the use of plasticized and/or retarded set concrete.

PART 2 PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and model or catalog number is to establish the standard of quality and general configurations desired.

2.02 MATERIALS

- A. Forms for cast-in-place concrete shall be made of wood, metal, or other approved material. Construct wood forms of sound lumber or plywood of suitable dimensions and free from knotholes and loose knots. Where used for exposed surfaces, dress and match boards. Sand plywood smooth and fit adjacent panels with tight joints. Metal forms may be used when approved by the Engineer and shall be of an appropriate type for the class of work involved. All forms shall be designed and constructed to provide a flat, uniform concrete surface requiring minimal finishing or repairs.
- B. Wall Forms
 - 1. Forms for all exposed exterior and interior concrete walls shall be "Plyform" exterior-grade plywood panels manufactured in compliance with the APA and bearing the trademark of that group or an equal acceptable to the Engineer. Provide B grade or better veneer on all faces to be placed against concrete during forming. The class of material and grades of interior plies shall be of sufficient strength and stiffness to provide a flat, uniform concrete surface requiring minimal finishing and grinding.
 - 2. All joints or gaps in forms shall be taped, gasketed, plugged, and/or caulked with an approved material so that the joint will remain watertight and will withstand placing pressures without bulging or creating surface patterns.
- C. Rustication strips shall be at the location and shall conform to the details shown on the Drawings. Moldings for chamfers and rustications shall be milled and planed smooth. Rustications and corner strips shall be of a nonabsorbent material, compatible with the form surface, and fully sealed on all sides to prohibit the loss of paste or water between the two surfaces.

D. Column Forms

1. Rectangular columns shall be formed as specified for wall forms. All corners shall have a $\frac{3}{4}$ -inch chamfer unless otherwise noted on the Drawings.

E. Form Release Agent

1. Coat all forming surfaces in contact with concrete using an effective, non-staining, non-residual, water-based, bond-breaking form coating unless otherwise noted. Form release agents used in potable water containment structures shall be suitable for use in contact with potable water and shall be non toxic and free of taste or odor.

F. Form Ties

1. Form ties encased in concrete other than those specified in the following paragraphs shall be designed so that after removal of the projecting part no metal shall remain within 1-1/2 inches of the face of the concrete. The part of the tie to be removed shall be at least 1/2 inch diameter or be provided with a wood or metal cone at least $\frac{1}{2}$ inch diameter and 1-1/2 inches long. Form ties in concrete exposed to view shall be the cone washer type.
2. Form ties for exposed exterior and interior walls shall be as specified in the preceding paragraph except that the cones shall be of approved wood or plastic.
3. Flat bar ties for panel forms, if used, shall have plastic or rubber inserts having a minimum depth of 1-1/2 inches and sufficient dimensions to permit proper patching of the tie hole.
4. Ties for liquid containment structures shall have an integral waterstop that is tightly welded to the tie.
5. Common wire shall not be used for form ties.
6. Alternate form ties consisting of tapered through bolts at least 1-inch-diameter at the smallest end or through bolts that use a removable tapered sleeve of the same minimum size may be used at the Contractor's option. Obtain the Engineer's acceptance of the system and spacing of ties before ordering or purchase forming. Clean, fill, and seal the form tie hole with non-shrink cement grout. The Contractor shall be responsible for watertightness of the form ties and any repairs needed.

PART 3 EXECUTION

3.01 GENERAL

- A. Forms shall be used for all cast-in-place concrete, including sides of footings. Forms shall be constructed and placed so that the resulting concrete will be of the shape, lines, dimensions, and appearance indicated on the Drawings.
- B. Forms for walls shall have removable panels at the bottom for cleaning, inspection, and joint surface preparation. Forms for walls of considerable height shall have closable intermediate inspection ports. Tremies and hoppers for placing concrete shall be used to allow concrete inspection, prevent segregation, and prevent the accumulation of hardened concrete on the forms above the fresh concrete.
- C. Molding, bevels, or other types of chamfer strips shall be placed to produce blockouts, rustications, or chamfers as shown on the Drawings or as specified in this Section. Chamfer strips shall be provided at horizontal and vertical projecting corners to produce a $\frac{3}{4}$ -inch chamfer. Rectangular or trapezoidal moldings shall be placed in locations requiring sealants where specified or shown on the Drawings. Sizes of moldings shall conform to the sealant manufacturer's recommendations.
- D. Forms shall be sufficiently rigid to withstand construction loads and vibration and to prevent displacement or sagging between supports. Construct forms so that the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for the adequacy of the forming system.
- E. Before form material is reused, all surfaces to be in contact with concrete shall be thoroughly cleaned, all damaged places repaired, all projecting nails withdrawn, and all protrusions smoothed. Reuse of wooden forms for other than rough finish will be permitted only if a "like new" condition of the form is maintained.

3.02 FORM TOLERANCES

- A. Forms shall be surfaced, designed, and constructed in accordance with the recommendations of ACI 347 and shall meet the following additional requirements for the specified finishes:
 - 1. Formed Surface Exposed to View: Edges of all form panels in contact with concrete shall be flush within $\frac{1}{16}$ inch and forms for plane surfaces shall be such that the concrete will be planed within $\frac{3}{16}$ inch in 4 feet. Forms shall be tight to prevent the passage of mortar, water, and grout. The maximum deviation of the finish wall surface at any point shall not

exceed 1/4 inch from the intended surface as shown on the Drawings. Form panels shall be arranged symmetrically and in an orderly manner to minimize the number of seams.

2. Formed surfaces not exposed to view or buried shall meet requirements of Class "C" Surface in ACI 347.
3. Formed rough surfaces including mass concrete, pipe encasement, electrical duct encasement, and other similar installations shall have no minimum requirements for surface smoothness and surface deflections. The overall dimensions of the concrete shall be plus or minus 1 inch.

3.03 FORM PREPARATION

- A. Wood forms in contact with the concrete shall be coated with an effective release agent before the forms are installed.
- B. Steel forms shall be thoroughly cleaned and mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface for all forms, except those used for surfaces receiving a rough finish. All forms shall have the contact surfaces coated with a release agent.

3.04 REMOVAL OF FORMS

- A. The Contractor shall be responsible for all damage resulting from removing the forms. Forms and shoring for structural slabs or beams shall remain in place in accordance with ACI 301 and ACI 347. Form removal shall conform to the requirements specified in Section 03300 and a curing compound applied.

3.05 INSPECTION

- A. The Engineer on site shall be notified when the forms are complete and ready for inspection at least 6 hours before the proposed concrete placement.
- B. Failure of the forms to comply with the requirements specified in this Section or to produce concrete complying with requirements of this Section shall be grounds for rejection of that portion of the concrete work. Rejected work shall be repaired or replaced as directed by the Engineer at no additional cost to the Owner. Such repair or replacement shall be subject to the requirements of this Section and approval of the Engineer.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install all concrete reinforcement complete as shown on the Drawings and as specified in this Section.
- B. Furnish only all deformed steel reinforcement required to be entirely built into concrete masonry unit construction.

1.02 RELATED WORK

- A. Section 03100, Concrete Formwork.
- B. Section 03250, Concrete Joints and Joint Accessories.
- C. Section 03300, Cast-in-Place Concrete.
- D. Section 03600, Grout.

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:
 - 1. Reinforcing steel. Placement drawings shall conform to the recommendations of ACI 315. All reinforcement in a concrete placement shall be included on a single placement drawing or cross referenced to the pertinent main placement drawing. The main drawing shall include the additional reinforcement (around openings, at corners, etc.) shown on the standard detail sheets. Bars to have special coatings and/or to be of special steel or special yield strength are to be clearly identified.
 - 2. Bar bending details. The bars shall be referenced to the same identification marks shown on the placement drawings.
 - 3. Schedule of all placements to contain synthetic reinforcing fibers. The amount of fibers per cubic yard to be used for each of the placements shall be noted on the schedule. The name of the manufacturer of the fibers and the product data shall be included with the submittal.

B. Submit Test Reports, in accordance with Section 01330, of each of the following items:

1. Certified copy of mill test on each steel proposed for use showing the physical properties of the steel and the chemical analysis.
2. Welder's certification. The certification shall be in accordance with AWS D1.4 when welding of reinforcement is required.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM A82—Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. ASTM A184—Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
3. ASTM A185—Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
4. ASTM A496—Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
5. ASTM A497—Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
6. ASTM A615—Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
7. ASTM A704—Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
8. ASTM A706—Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
9. ASTM A767—Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
10. ASTM A775—Standard Specification for Epoxy-Coated Steel Reinforcing Bars
11. ASTM A884—Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
12. ASTM A934—Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.

13. ASTM A996—Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.

B. American Concrete Institute (ACI)

1. ACI 301—Specifications for Structural Concrete.
2. ACI 315—Details and Detailing of Concrete Reinforcement.
3. ACI 318—Building Code Requirements for Reinforced Concrete and Commentary.
4. ACI SP 66—ACI Detailing Manual.

C. Concrete Reinforcing Steel Institute (CRSI)

1. Manual of Standard Practice.

D. American Welding Society (AWS)

1. AWS D1.4—Structural Welding Code-Reinforcing Steel.

1.06 QUALITY ASSURANCE

- A. Provide services of a manufacturer's representative, with at least 2 years experience in the use of the reinforcing fibers for a preconstruction meeting and assistance during the first placement of the material.

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. Reinforcing steel shall be substantially free from mill scale, rust, dirt, grease, or other foreign matter.
- C. Reinforcing steel shall be shipped and stored with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted Placing Drawings.

- D. Reinforcing steel shall be stored off the ground and kept free from dirt, oil, or other injurious contaminants.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 WEATHER CONSTRAINTS (NOT USED)

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials shall be new, of domestic manufacture, and shall comply with the following material specifications.
- B. Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60 deformed bars.
- C. Concrete Reinforcing Bars required on the Drawings to be Welded: ASTM A706.
- D. Welded Steel Wire Fabric: ASTM A185. Provide in flat sheets.
- E. Welded Deformed Steel Wire Fabric: ASTM A497.
- F. Welded Plain Bar Mats: ASTM A704 and ASTM A615 Grade 60 plain bars.
- G. Fabricated Deformed Steel Bar Mats: ASTM A184 and ASTM A615 Grade 60 deformed bars.
- H. The following alternate materials are allowed:
 - 1. ASTM A615 Grade 60 may be used for ASTM A706 provided the following requirements are satisfied:
 - a. The actual yield strength of the reinforcing steel based on mill tests shall not exceed the specified yield strength by more than 18,000 psi. Retests shall not exceed this value by more than an additional 3,000 psi.
 - b. The ratio of the actual ultimate tensile strength to the actual tensile yield strength of the reinforcement shall not be less than 1.25.
 - c. The carbon equivalency (CE) of bars shall be 0.55 or less.

I. Reinforcing Steel Accessories

1. Plastic Protected Bar Supports: CRSI Bar Support Specifications, Class 1 Maximum Protection.
2. Stainless Steel Protected Bar Supports: CRSI Bar Support Specifications, Class 2 Moderate Protection.
3. Precast Concrete Block Bar Supports: CRSI Bar Support Specifications, Precast Blocks. Blocks shall have equal or greater strength than the surrounding concrete.
4. Steel Protected Bar Supports: #4 Steel Chairs with plastic or rubber tips.

J. Tie Wire

1. Tie Wires for Reinforcement shall be 16-gauge or heavier, black annealed wire, or stranded wire.

K. Mechanical reinforcing steel butt splices or embedded mechanical rebar coupler shall be positive connecting taper threaded-type employing a hexagonal coupler such as Lenton rebar splices as manufactured by Erico Products Inc., Solon, OH or equal. They shall meet all ACI 318 Building Code requirements. Bar ends must be taper threaded with coupler manufacturer's bar threader to ensure proper taper and thread engagement. Bar couplers shall be torqued to the manufacturer's recommended value.

1. Unless otherwise noted on the Drawings, mechanical tension splices shall be designed to produce a splice strength in tension or compression of not less than 125% of the ASTM-specified minimum yield strength of the rebar.
2. Compression-type mechanical splices shall provide concentric bearing from one bar to the other bar and shall be capable of developing the ultimate strength of the rebar in compression.

L. Fiber Reinforcement

1. Synthetic reinforcing fiber for concrete shall be 100% polypropylene collated, fibrillated fibers as manufactured by Fibermesh Company of Synthetic Industries Inc., Chattanooga, TN Fibermesh or equal. Fiber length and quantity for the concrete mix shall be in strict compliance with the manufacturer's recommendations as approved by the Engineer.

2.02 FABRICATION

- A. Fabrication of reinforcement shall be in compliance with the *CRSI Manual of Standard Practice*.
- B. Bars shall be cold bent. Bars shall not be straightened or rebent.
- C. Bars shall be bent around a revolving collar having a diameter of not less than that recommended by the ACI 318.
- D. Bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded shall have the applicable end(s) saw cut. Such ends shall terminate in flat surfaces within $1\frac{1}{2}^\circ$ of a right angle to the axis of the bar.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Surface condition, bending, spacing, and tolerances of placement of reinforcement shall comply with the *CRSI Manual of Standard Practice*. The Contractor shall be solely responsible for providing an adequate number of bars and maintaining the spacing and clearances shown on the Drawings.
- B. Except as otherwise indicated on the Drawings, the minimum concrete cover of reinforcement shall be as follows:
 - 1. Concrete cast against and permanently exposed to earth: 3 inches
 - 2. Concrete exposed to soil, water, sewage, sludge and/or weather: 2 inches (including bottom cover of slabs over water or sewage)
 - 3. Concrete not exposed to soil, water, sewage, sludge, and/or weather:
 - a. Slabs (top and bottom cover), walls, joists, shells, and folded plate members: 1 inch.
 - b. Beams and columns (principal reinforcement, ties, spirals, and stirrups): $1\frac{1}{2}$ -inches.
- C. Reinforcement which will be exposed for a considerable length of time after being placed shall be coated with a heavy coat of neat cement slurry.
- D. No reinforcing steel bars shall be welded either during fabrication or erection unless specifically shown on the Drawings or specified in this Section or unless

prior written approval has been obtained from the Engineer. All bars that have been welded, including tack welds, without such approval shall be immediately removed from the work. When welding of reinforcement is approved or called for, it shall comply with AWS D1.4.

- E. Reinforcing steel interfering with the location of other reinforcing steel, conduits, or embedded items may be moved within the specified tolerances or one bar diameter, whichever is greater. Greater displacement of bars to avoid interference shall only be made with the approval of the Engineer. Do not cut reinforcement to install inserts, conduits, mechanical openings, or other items without the prior approval of the Engineer.
- F. Securely support and tie reinforcing steel to prevent movement during concrete placement. Secure dowels in place before placing concrete.
- G. Reinforcing steel bars shall not be field bent except where shown on the Drawings or specifically authorized in writing by the Engineer. If authorized, bars shall be cold bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. If the reinforcing steel is damaged, replace, Cadweld, or otherwise repair as directed by the Engineer. Do not bend reinforcement after it is embedded in concrete unless specifically shown otherwise on the Drawings.

3.02 REINFORCEMENT AROUND OPENINGS

- A. Unless specific additional reinforcement around openings is shown on the Drawings, provide additional reinforcing steel on each side of the opening equivalent to one half of the cross sectional area of the reinforcing steel interrupted by an opening. The bars shall have sufficient length to develop bond at each end beyond the opening or penetration.

3.03 SPLICING OF REINFORCEMENT

- A. Splices designated as compression splices on the Drawings, unless otherwise noted, shall be 30 bar diameters but not less than 12 inches. The lap splice length for column vertical bars shall be based on the bar size in the column above.
- B. Tension lap splices shall be provided at all laps in compliance with ACI 318. Splices in adjacent bars shall be staggered. Class A splices may be used when 50% or less of the bars are spliced within the required lap length. Class B splices shall be used at all other locations.
- C. Splicing of reinforcing steel in concrete elements noted to be "tension members" on the Drawings shall be avoided whenever possible. However, if required for

constructability, splices in the reinforcement subject to direct tension shall be welded to develop, in tension, at least 125% of the specified yield strength of the bar. Splices in adjacent bars shall be offset the distance of a Class B splice.

- D. Install wire fabric in as long lengths as practicable. Wire fabric from rolls shall be rolled flat and firmly held in place. Splices in welded-wire fabric shall be lapped in accordance with the requirements of ACI 318 but not less than 12 inches. The spliced fabrics shall be tied together with wire ties spaced not more than 24 inches on center and laced with wire of the same diameter as the welded wire fabric. Do not position laps midway between supporting beams or directly over beams of continuous structures. Offset splices in adjacent widths to prevent continuous splices.
- E. Mechanical reinforcing steel splicers shall be used only where shown on the Drawings. Splices in adjacent bars shall be offset by at least 30 bar diameters. Mechanical reinforcing splices are only to be used for special splice and dowel conditions approved by the Engineer.

3.04 ACCESSORIES

- A. Determine, provide, and install accessories such as chairs, chair bars, and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.
- B. Use precast concrete blocks where the reinforcing steel is to be supported over soil.
- C. Stainless steel bar supports or steel chairs with stainless steel tips shall be used where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity, or liquid (including bottom of slabs over liquid containing areas). Use of galvanized or plastic-tipped metal chairs is permissible in all other locations unless otherwise noted on the Drawings or specified in this Section.
- D. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

3.05 INSPECTION

- A. In no case shall any reinforcing steel be covered with concrete until the installation of the reinforcement, including the size, spacing, and position of the reinforcement has been observed by the Engineer and the Engineer's release to

proceed with the concreting has been obtained. The Engineer shall be given ample prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the Engineer has finished his/her observations of the reinforcing steel.

END OF SECTION

SECTION 03250
CONCRETE JOINTS AND JOINT ACCESSORIES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install accessories for concrete joints as shown on the Drawings and as specified in this Section.

1.02 RELATED WORK

- A. Section 03100, Concrete Formwork.
- B. Section 03200, Concrete Reinforcement.
- C. Section 03300, Cast-In-Place Concrete.
- D. Section 03360, Concrete Finishes.
- E. Section 03600, Grout.
- F. Section 05500, Metal Fabrications.

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:
 - 1. Standard Waterstops: Product data, including catalogue cut, technical data, storage requirements, splicing methods, and conformity to ASTM standards.
 - 2. Special Waterstops: Product data, including catalogue cut, technical data, location of use, storage requirements, splicing methods, installation instructions, and conformity to ASTM standards.
 - 3. Premolded joint fillers: Product data, including catalogue cut, technical data, storage requirements, installation requirements, location of use, and conformity to ASTM standards.
 - 4. Bond breaker: Product data, including catalogue cut, technical data, storage requirements, installation requirements, location of use, and conformity to ASTM standards.

5. Expansion joint dowels: Product data on the complete assembly, including dowels, coatings, lubricants, spacers, sleeves, expansion caps, installation requirements, and conformity to ASTM standards.
6. Compressible joint filler: Product data, including catalogue cut, technical data, storage requirements, installation requirements, location of use, and conformity to ASTM standards.
7. Bonding agents: Product data, including catalogue cut, technical data, storage requirements, product life, application requirements, and conformity to ASTM standards.

B. Certifications

1. Certification that all materials used within the joint system are compatible with each other.
2. Certification that materials used in the construction of joints are suitable for use in contact with potable water 30 days after installation.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM A675—Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
2. ASTM C881—Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
3. ASTM C920—Specification for Elastomeric Joint Sealants
4. ASTM C1059—Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
5. ASTM D1751—Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
6. ASTM D1752—Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

B. U.S. Army Corps of Engineers (CRD).

1. CRD C572—Specification for Polyvinylchloride Waterstop.

C. Federal Specifications

1. FS SS-S-210A—Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 WEATHER CONSTRAINTS (NOT USED)

PART 2 PRODUCTS

2.01 GENERAL

- A. The use of the manufacturer's name and model or catalog number is to establish the standard of quality and general configuration desired.
- B. All materials used together in a given joint (bond breakers, backer rods, joint fillers, sealants, etc.) shall be compatible with one another. Coordinate selection of suppliers and products to ensure compatibility. Under no circumstances shall asphaltic bond breakers or joint fillers be used in joints receiving sealant.
- C. All chemical sealant type waterstops shall be products specifically manufactured for the purpose for which they will be used and the products shall have been successfully used on similar structures for more than 5 years.

2.02 MATERIALS

A. Standard Waterstops

1. Steel Plate Waterstops Non-expansion joint. 6-inch-by- $\frac{1}{4}$ -inch steel plate waterstops shall be fabricated from weldable carbon steel plate with a minimum yield strength of 33,000 psi. The Contractor shall use 4-inch-by- $\frac{1}{4}$ -inch steel plate waterstops for wall horizontal construction joints.

B. Special Waterstops

1. Base Seal PVC Waterstop - The waterstop shall be made by extruding elastomeric plastic compound with virgin polyvinylchloride as the basic resins. The compound shall contain no reprocessed materials. Minimum tensile strength of the waterstop shall be 1,750 psi. The waterstop shall conform to CRD C572. Waterstops shall be Style 925 for expansion joints, Style 928 for contraction joints, and Style 927 for construction joints by Greenstreak Plastic Products, St. Louis, MO or equal.
2. Preformed adhesive waterstops - The waterstop shall be a rope-type preformed plastic waterstop meeting the requirements of Federal Specification SS-S-210A. The rope shall have a cross-section of approximately 1 square inch unless otherwise specified or shown on the Drawings. The waterstop shall be Synko-Flex waterstop as manufactured by Synko-Flex Products of Houston, TX or equal. Primer for the material shall be as recommended by the waterstop manufacturer.

C. Joint Sealant

1. Exterior and interior sealant for joints on all other surfaces shall be a one-part, gun-grade polyurethane ASTM C920-87 Type S, Grade NS Class 25, Dymonic by Tremco; Sonolastic NP1 by Sonneborn; or equal. Primer shall be as recommended by the manufacturer.
2. Joint backing for joints in superstructure shall be approved closed-cell polyethylene rods of diameters to suit joint conditions. Where joint depth will not allow for a rod and still, provide $\frac{1}{4}$ -inch minimum depth of sealant. Provide approved bond breaker tape at the bottom of the joint.

D. Premolded Joint Filler

1. Premolded joint filler structures. Self-expanding cork, premolded joint filler shall conform to ASTM D1752, Type III. The thickness shall be $\frac{3}{4}$ inch unless shown otherwise on the Drawings.
2. Premolded joint filler sidewalk and roadway concrete pavements or where fiber joint filler is specifically noted on the Drawings. The joint filler shall be asphalt impregnated fiber board conforming to ASTM D1751. Thickness shall be $\frac{3}{4}$ inch unless otherwise shown on the Drawings.

E. Bond Breaker

1. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape which will satisfactorily adhere to the premolded joint filler or concrete surface as required. The tape shall be the same width as the joint.
2. Except where tape is specifically called for on the Drawings, bond breaker for concrete shall be either bond breaker tape or a nonstaining type bond prevention coating such as Williams Tilt-up Compound by Williams Distributors Inc.; Silcoseal 77, by SCA Construction Supply Division, Superior Concrete Accessories or equal.

F. Expansion Joint Dowels

1. Dowels shall be smooth steel conforming to ASTM A675, Grade 70. Dowels must be straight and clean, free of loose flaky rust and loose scale. Dowels may be sheared to length provided deformation from true shape caused by shearing does not exceed 0.04 inch on the diameter of the dowel and extends no more than 0.04 inch from the end. Bars shall be coated with a bond breaker on the expansion end of the dowel. Expansion caps shall be provided on the expansion end. Caps shall allow for at least 1-1/2 inches of expansion.

G. Bonding Agent

1. Epoxy bonding agent shall be a two-component, solvent-free, moisture-insensitive, epoxy-resin material conforming to ASTM C881, Type II. The bonding agent shall be Sikadur 32 Hi Mod by Sika Corporation of Lyndhurst, N.J.; Concessive Liquid (LPL) by Master Builders of Cleveland, OH, or equal. Acrylic may be used if approved by the Engineer.

H. Compressible Joint Filler

1. The joint filler shall be a non-extruded watertight strip material use to fill expansion joints between structures. The material shall be capable of being compressed at least 40% for 70 hours at 68°F and subsequently recovering at least 20% of its original thickness in the first 1/2 hour after unloading. Compressible joint filler shall be Evasote 380 E.S.P, by E Poxxy Industries, Inc., Ravena, NY, Sikaflex 1a by Sika, or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Standard Waterstops

1. Install waterstops for all joints where indicated on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided. Splices shall be made by welding.
2. Steel plate waterstops shall be spliced by either butt welding the ends of the plates together or lapping the plates and fillet welding along the full width of the plate at both ends of the lap.
3. Steel plate waterstops shall be firmly secured in position during concrete placement.
4. Horizontal waterstops in slabs shall be clamped in position by the bulkhead (unless previously set in concrete).
5. Waterstops shall be installed so that half of the width will be embedded on each side of the joint. Care shall be exercised to ensure that the waterstop is completely embedded in void-free concrete.
6. Waterstops shall be terminated 3 inches below the exposed top of walls. Expansion joint waterstop center bulbs shall be plugged with foam rubber, 1 inch deep, at the point of termination.

B. Special Waterstops

1. Install special waterstops at joints where specifically noted on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided.

2. Each piece of the waterstop shall be of maximum practicable length to provide a minimum number of connections or splices. Connections and splices shall conform to the manufacturer's recommendations and as specified in this Section.
3. Waterstops shall be terminated 3 inches below the exposed top of walls.

C. Construction Joints

1. Make construction joints only at locations shown on the Drawings or as approved by the Engineer. Any additional or relocation of construction joints proposed by the Contractor must be submitted to the Engineer for written approval.
2. Additional or relocated joints should be located where they least impair the strength of the member. In general, locate joints within the middle third of spans of slabs, beams, and girders. However, if a beam intersects a girder at the joint, offset the joint a distance equal to twice the width of the member being connected. Locate joints in walls and columns at the underside of floors, slabs, beams, or girders and at tops of footings or floor slabs. Do not locate joints between beams, girders, column capitals, or drop panels and the slabs above them. Do not locate joints between brackets or haunches and walls or columns supporting them.
3. All joints shall be perpendicular to the main reinforcement. Continue reinforcing steel through the joint as indicated on the Drawings. When joints in beams are allowed, provide a shear key and inclined dowels as approved by the Engineer.
4. Provide sealant grooves for joint sealant where indicated on the Drawings.
5. At all construction joints and at concrete joints designated on the Drawings to be "roughened," uniformly roughen the surface of the concrete to a full amplitude (distance between high and low points or side to side) of approximately $\frac{1}{4}$ inch to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by waterblasting or sandblasting and prepare for bonding.
6. Provide waterstops in all wall and slab construction joints in liquid containment structures and at other locations shown on the Drawings.
7. Keyways shall not be used in construction joints unless specifically shown on the Drawings or approved by the Engineer.

D. Expansion Joints

1. Do not extend through expansion joints, reinforcement, or other embedded metal items that are continuously bonded to concrete on each side of joint.
2. Position premolded joint filler material accurately. Secure the joint filler against displacement during concrete placement and compaction. Place joint filler over the face of the joint, allowing for sealant grooves as detailed on the Drawings. Tape all joint filler splices to prevent intrusion of mortar. Seal expansion joints as shown on the Drawings.
3. Expansion joints shall be $\frac{3}{4}$ inch wide unless otherwise noted on the Drawings.
4. Where indicated on the Drawings, install smooth dowels at right angles to expansion joints. Align dowels accurately with finished surface. Rigidly hold in place and support during concrete placement. Unless otherwise shown on the Drawings, apply oil or grease to one end of all dowels through expansion joints. Provide plastic expansion caps on the lubricated ends of expansion dowels.
5. Provide center-bulb-type waterstops in all wall and slab expansion joints in liquid containment structures and at other locations shown on the Drawings.

E. Contraction Joints

1. Provide sealant grooves, sealants, and waterstops at contraction joints in slabs on grade or walls as detailed. Provide waterstops at all wall and slab contraction joints in water containment structures and at other locations shown on the Drawings.
2. Contraction joints may be sawed if specifically approved by the Engineer. If contraction joint grooves are sawed, properly time the saw cutting with the time of the concrete set. Start cutting as soon as the concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses have developed sufficiently to induce cracking. No reinforcing shall be cut during sawcutting.
3. Extend every other bar of reinforcing steel through contraction joints or as indicated on the Drawings. Where specifically noted on the Drawings, coat the concrete surface with a bond breaker before placing new concrete

against it. Avoid coating reinforcement or waterstops with bond breaker at these locations.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor and materials required and install cast-in-place concrete complete as shown on the Drawings and as specified in this Section.

1.02 RELATED WORK

- A. Section 03100, Concrete Formwork.
- B. Section 03200, Concrete Reinforcement.
- C. Section 03250, Concrete Joints and Joint Accessories.
- D. Section 03360, Concrete Finishes.
- E. Section 03600, Grout.

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:
 - 1. Sources of cement, pozzolan, and aggregates.
 - 2. Material Safety Data Sheets (MSDS) for all concrete components and admixtures.
 - 3. Air entraining admixture. Product data, including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, and conformity to ASTM standards.
 - 4. Water-reducing admixture. Product data, including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, and conformity to ASTM standards.
 - 5. High-range water-reducing admixture (plasticizer). Product data, including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range, and conformity to ASTM standards. Identify proposed locations of use.

6. Concrete mix for each formulation of concrete proposed for use, including constituent quantities per cubic yard, water-cementitious materials ratio, concrete slump, type, and manufacturer of cement. Provide either a. or b. below for each mix proposed:
 - a. Standard deviation data for each proposed concrete mix based on statistical records.
 - b. The curve of water-cementitious materials ratio versus concrete cylinder strength for each formulation of concrete proposed based on laboratory tests. The cylinder strength shall be the average of the 28-day cylinder strength test results for each mix. Provide results of 7- and 14-day tests if available.
7. Sheet curing material. Product data, including catalogue cut, technical data, and conformity to ASTM standard.
8. Liquid curing compound. Product data, including catalogue cut, technical data, storage requirements, product life, application rate, and conformity to ASTM standards. Identify proposed locations of use.

B. Samples

1. Fine and coarse aggregates if requested by the Engineer.

C. Test Reports

1. Fine aggregates—sieve analysis, physical properties, and deleterious substance.
2. Coarse aggregates—sieve analysis, physical properties, and deleterious substances.
3. Cements—chemical analysis and physical properties for each type.
4. Pozzolans—chemical analysis and physical properties.
5. Proposed concrete mixes—compressive strength, slump, and air content.

D. Certifications

1. Certify that admixtures used in the same concrete mix are compatible with each other and with the aggregates.

2. Certify that admixtures are suitable for use in contact with potable water after 30 days of concrete curing.
3. Certify that the curing compound is suitable for use in contact with potable water after 30 days (non toxic and free of taste or odor).

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM C31—Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33—Standard Specification for Concrete Aggregates.
3. ASTM C39—Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42—Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
5. ASTM C94—Standard Specification for Ready-Mixed Concrete.
6. ASTM C143—Standard Test Method for Slump of Hydraulic-Cement Concrete.
7. ASTM C150—Standard Specification for Portland Cement.
8. ASTM C171—Standard Specification for Sheet Materials for Curing Concrete.
9. ASTM C173—Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
10. ASTM C231—Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
11. ASTM C260—Standard Specification for Air-Entraining Admixtures for Concrete.
12. ASTM C309—Standard Specification for Liquid-Membrane Forming Compounds for Curing Concrete.
13. ASTM C494—Standard Specification for Chemical Admixtures for Concrete.
14. ASTM C618—Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
15. ASTM C1017—Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

B. American Concrete Institute (ACI).

1. ACI 304R—Guide for Measuring, Mixing, Transporting and Placing Concrete.
2. ACI 305R—Hot Weather Concreting.
3. ACI 306.1—Standard Specification for Cold Weather Concreting.
4. ACI 318—Building Code Requirements for Structural Concrete.
5. ACI 350R—Environmental Engineering Concrete Structures.

1.06 QUALITY ASSURANCE

- A. Reinforced concrete shall comply with ACI 318; the recommendations of ACI 350R; and other stated requirements, codes, and standards. The most stringent requirement of the codes, standards, and this Section shall apply when conflicts exist.
- B. Only one source of cement and aggregates shall be used on any one structure. Concrete shall be uniform in color and appearance.
- C. Thirty days before placing concrete, the Contractor shall discuss with the Engineer the sources of individual materials and batched concrete proposed for use. Discuss placement methods, waterstops, and curing. Propose methods of hot and cold weather concreting as required. Before placing any concrete containing a high-range water-reducing admixture (plasticizer), the Contractor, accompanied by the plasticizer manufacturer, shall discuss with the Engineer the properties and techniques of batching and placing plasticized concrete.
- D. If, during the progress of the work, it is impossible to obtain concrete of the required workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to obtain the desired properties. All changes so ordered shall be made at the Contractor's expense.
- E. If, during the progress of the work, the materials from the sources originally accepted change in characteristics, the Contractor shall, at his/her expense, make new acceptance tests of aggregates and establish new design mixes.
- F. The Contractor shall furnish testing of the following materials to verify conformity with this Specification Section and the stated ASTM Standards:
1. Fine aggregates for conformity with ASTM C33—sieve analysis, physical properties, and deleterious substances.

2. Coarse aggregates for conformity with ASTM C33—sieve analysis, physical properties, and deleterious substances.
 3. Cements for conformity with ASTM C150—chemical analysis and physical properties.
 4. Pozzolans for conformity with ASTM C618—chemical analysis and physical properties.
 5. Proposed concrete mix designs—compressive strength, slump, and air content.
- G. A firm providing field testing and inspection services will be approved by the Owner. The cost of such work, except as specifically stated otherwise, shall be paid by the Contractor. The following items shall be tested by the Owner to verify conformity with this Specification Section:
1. Concrete placements—compressive strength (cylinders), compressive strength (cores), slump, and air content.
 2. Other materials or products that may come under question.
- H. All materials incorporated in the work shall conform to accepted samples.

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section:

- A. Cement: Store in weathertight buildings, bins, or silos to provide protection from dampness and contamination and to minimize warehouse set.
- B. Aggregate: Arrange and use stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3 feet in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregate.

- C. Sand: Arrange and use stockpiles to avoid contamination. Allow sand to drain to a uniform moisture content before using. Do not use frozen or partially frozen aggregates.
- D. Admixtures: Store in closed containers to avoid contamination, evaporation, or damage. Provide suitable agitating equipment to ensure uniform dispersion of ingredients in admixture solutions which tend to separate. Protect liquid admixtures from freezing and other temperature changes which could adversely affect their characteristics.
- E. Pozzolan: Store in weathertight buildings, bins, or silos to provide protection from dampness and contamination.
- F. Sheet Curing Materials: Store in weathertight buildings or off the ground and under cover.
- G. Liquid Curing Compounds: Store in closed containers.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 WEATHER CONSTRAINTS (NOT USED)

PART 2 PRODUCTS

2.01 GENERAL

- A. The use of the manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance, and manufacturer's service.

2.02 MATERIALS

- A. Materials shall comply with this Section and any applicable State or local requirements.
- B. Cement: Domestic Portland cement complying with ASTM C150. Air entraining cements shall not be used. The brand of cement shall be subject to approval by the Engineer and one brand shall be used throughout the Work. The following cement type(s) shall be used:

1. Class A,B,C,D Concrete Type II with the addition of fly ash resulting in C3A being below 5% of total cementitious content, Type III limited to 5% C3A or Type V.
- C. Fine Aggregate: Washed inert natural sand conforming to the requirements of ASTM C33.
- D. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33. Grading requirements shall be as listed in ASTM C33 Table 2 for the specified coarse aggregate size number. Limits of Deleterious Substances and Physical Property Requirements shall be as listed in ASTM C33 Table 3 for severe weathering regions. Size numbers for the concrete mixes shall be as shown in Table 1 in this Section.
- E. Water: Potable water free from injurious amounts of oils, acids, alkalis, salts, organic matter, or other deleterious substances.
- F. Admixtures: Admixtures shall be free of chlorides and alkalis (except for those attributable to water). When it is required to use more than one admixture in a concrete mix, the admixtures shall be from the same manufacturer. Admixtures shall be compatible with the concrete mix, including other admixtures, and shall be suitable for use in contact with potable water after 30 days of concrete curing.
1. Air-Entraining Admixture: The admixture shall comply with ASTM C260. Proportioning and mixing shall be in accordance with the manufacturer's recommendations.
 2. Water-Reducing Agent: The admixture shall comply with ASTM C494, Type A. Proportioning and mixing shall be in accordance with the manufacturer's recommendations.
 3. High-Range Water-Reducer (Plasticizer): The admixture shall comply with ASTM C494, Type F and shall result in non-segregating plasticized concrete with little bleeding and with the physical properties of low water/cement ratio concrete. The treated concrete shall be capable of maintaining its plastic state in excess of 2 hours. Proportioning and mixing shall be in accordance with the manufacturer's recommendations.
 4. Admixtures causing retarded or accelerated setting of concrete shall not be used without written approval from the Engineer. When allowed, the admixtures shall be retarding or accelerating water-reducing or high-range water-reducing admixtures.

- G. Pozzolan (Fly Ash) shall be Class F fly ash complying with ASTM C618 except that the Loss on Ignition (LOI) shall be limited to 3% maximum.
- H. Sheet Curing Materials. Waterproof paper, polyethylene film, or white burlap polyethylene sheeting all complying with ASTM C171.
- I. Liquid Curing Compound. Liquid membrane forming curing compound shall comply with the requirements of ASTM C309, Type 1 D (clear or translucent with fugitive dye) and shall contain no wax, paraffin, or oil. The curing compound shall be approved for use in contact with potable water after 30 days according to NSF 61 (non toxic and free of taste or odor).

2.03 MIXES

- A. An independent testing laboratory acceptable to the Owner engaged by and at the expense of the Contractor shall develop mix designs and testing.
- B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce concrete having proper placability, durability, strength, appearance, and other required properties. Proportion ingredients to produce a homogenous mixture that will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing excessive free water to collect on the surface.
- C. The design mix shall be based on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if such data are not available, be developed by a testing laboratory acceptable to the Engineer and engaged by and at the expense of the Contractor. Mixes based on standard deviation shall be accepted based on the modification factors for standard deviation tests contained in ACI 318. The water content of the concrete mix, determined by laboratory testing, shall be based on a curve showing the relation between water cementitious ratio and 7- and 28-day compressive strengths of concrete made using the proposed materials. The curves shall be determined by four or more points, each representing an average value of at least three test specimens at each age. The curves shall have a range of values sufficient to yield the desired data, including the specified design strengths as modified below, without extrapolation. The water content of the concrete mixes to be used, as determined from the curve, shall correspond to strengths 16% greater than the specified design strengths. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content as specified in Table 1.

- D. Compression Tests: Provide testing of the proposed concrete mix or mixes to demonstrate compliance with the specified design strength requirements in conformity with the paragraph above.
- E. Entrained air, as measured by ASTM C231, shall be as shown in Table 1.
1. If the air-entraining agent proposed for use in the mix requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in the admixture submittal.
- F. Slump of the concrete as measured by ASTM C143 shall be as shown in Table 1. If a high-range water-reducer (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 7 to 10 inches.
- G. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

TABLE 1
CONCRETE MIX REQUIREMENTS

Class	Design Strength (1)	Cement (2)	Fine Aggregate (2)	Coarse Aggregate (3)	Cementitious Content (4)	
A	2500	C150 Type II	C33	57	440 min.	
B	3000	C150 Type II	C33	57	480 min.	
C	4000	C150 Type II	C33	57	560 min.	
D	5000	C150 Type II	C33	57	600 min.	
Class	W/C Ratio (5)	Fly Ash	AE Range (6)	WR (7)	HRWR (8)	Slump Range (Inches)
A	0.62 max.	--	3.5 to 5	Yes	*	1-4
B	0.54 max.	--	3.5 to 5	Yes	*	1-3
C	0.44 max.	20 - 25%	3.5 to 5	Yes	*	3-5
D	0.40 max.	--	3.5 to 5	Yes	*	3-5

NOTES:

- (1) Minimum compressive strength in psi at 28 days
- (2) ASTM designation
- (3) Size Number in ASTM C33
- (4) Cementitious content in lbs/cu yd
- (5) W/C is Water-Cementitious ratio by weight
- (6) AE is percent air-entrainment
- (7) WR is water-reducer admixture
- (8) HRWR is high-range water-reducer admixture
- * HRWR used at the Contractor's option

PART 3 EXECUTION

3.01 MEASURING MATERIALS

- A. Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, water, and admixtures as specified and shall be produced by a plant acceptable to the Engineer. All constituents, including admixtures, shall be batched at the plant except a high-range water-reducer may also be added in the field.
- B. Measure materials for batching concrete by weighing in conformity with and within the tolerances given in ASTM C94 except as otherwise specified. Scales shall have been certified by the local Weights and Measures official within 1 year of use.
- C. Measure the amount of free water in fine aggregates within 0.3% with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record the number of gallons of water as batched on printed batching tickets.
- D. Admixtures shall be dispensed either manually using calibrated containers or measuring tanks or by an automatic dispenser approved by the manufacturer of the specific admixture.
 - 1. Charge air entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.
 - 2. Inject multiple admixtures separately during the batching sequence.

3.02 MIXING AND TRANSPORTING

- A. Concrete shall be ready mixed concrete produced by equipment acceptable to the Engineer. No hand mixing will be permitted. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant. Equip each transit mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.
- B. Ready mix concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.
- C. Keep the water tank valve on each transit truck locked at all times. Any addition of water must be directed by the Engineer. Added water shall be incorporated by additional mixing of at least 35 revolutions. All added water shall be metered and the amount of water added shall be shown on each delivery ticket.

- D. All central plant and rolling stock equipment and methods shall comply with ACI 318 and ASTM C94.
- E. Select equipment of size and design to ensure continuous flow of concrete at the delivery end. Metal or metal lined non-aluminum discharge chutes shall be used and shall have slopes not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 feet long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.
- F. Retempering (mixing with or without additional cement, aggregate, or water) of concrete or mortar which has reached initial set will not be permitted.
- G. Handle concrete from mixer to placement as quickly as practicable while providing concrete of required quality in the placement area. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.
- H. Furnish a delivery ticket for ready-mixed concrete to the Engineer as each truck arrives. Each ticket shall provide a printed record of the weight of cement and each aggregate as batched individually. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Clearly indicate the weight of fine and coarse aggregate, cement and water in each batch, the quantity delivered, the time any water is added, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of the truck mixer.
- I. Temperature and Mixing Time Control
 - 1. In cold weather, do not allow the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms to drop below 40°F.
 - 2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90°F.
 - 3. In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90°F. If necessary, substitute well-crushed ice for all or part of the mixing water.

4. The maximum time interval between adding mixing water and/or cement to the batch and placing concrete in the forms shall not exceed the values shown in Table 2.

TABLE 2
MAXIMUM TIME TO DISCHARGE OF CONCRETE

Air or Concrete Temperature (whichever is higher)	Maximum Time
80 to 90° F (27 to 32° C)	45 minutes
70 to 79° F (21 to 26° C)	60 minutes
40 to 69° F (5 to 20° C)	90 minutes

- J. If an approved high-range water-reducer (plasticizer) is used to produce plasticized concrete, the maximum time interval shall not exceed 90 minutes.

3.03 CONCRETE APPEARANCE

- A. Concrete mix showing either poor cohesion or poor coating of the coarse aggregate with paste shall be remixed. If this does not correct the condition, the concrete shall be rejected. If the slump is within the allowable limit but excessive bleeding, poor workability, or poor finishability are observed, changes in the concrete mix shall be obtained only by adjusting one or more of the following:
1. The gradation of aggregate.
 2. The proportion of fine and coarse aggregate.
 3. The percentage of entrained air within the allowable limits.
- B. Concrete for the work shall provide a homogeneous structure which, when hardened, will have the required strength, durability, and appearance. Mixtures and workmanship shall be such that concrete surfaces, when exposed, will require no finishing. When concrete surfaces are stripped, the concrete, when viewed in good lighting from 10 feet away, shall be pleasing in appearance and at 20 feet shall show no visible defects.

3.04 PLACING AND COMPACTING

- A. Placing
1. The Contractor shall verify that all formwork completely encloses concrete to be placed and is securely braced before placing concrete. Remove ice, excess water, dirt, and other foreign materials from forms. Confirm that reinforcement and other embedded items are securely in place. Have a competent workman at the location of the placement who can ensure that reinforcing steel and embedded items remain in designated

locations while concrete is being placed. Sprinkle semi-porous subgrades or forms to eliminate suction of water from the mix. Seal extremely porous subgrades in an approved manner.

2. Deposit concrete as near its final position as possible to avoid segregation due to rehandling or flowing. Place concrete continuously at a rate which ensures the concrete is being integrated with fresh plastic concrete. Do not deposit concrete that has partially hardened or has been contaminated by foreign materials or on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.
3. Pumping of concrete will be permitted. Use a mix design and aggregate sizes suitable for pumping and submit for approval.
4. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only when made of galvanized metal or concrete and if prior approval has been obtained.
5. Do not place concrete for supported elements until concrete previously placed in the supporting element (columns, slabs, and/or walls) has reached adequate strength.
6. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of the mortar against the form. Prevent the formation of excessive surface voids.
7. Slabs
 - a. After suitable bulkheads, screeds, and jointing materials have been positioned, the concrete shall be placed continuously between construction joints beginning at a bulkhead, edge form, or corner. Each batch shall be placed into the edge of the previously placed concrete to avoid stone pockets and segregation.
 - b. Avoid delays in casting. If there is a delay in casting, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints. Concrete shall then be brought to correct level and struck off with a straightedge. Bullfloats or darbies shall be used to smooth the surface, leaving it free of humps or hollows.

- c. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow 1 hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep the top surface of the wall moist so as to prevent cold joints.

8. Formed Concrete

- a. Place concrete in forms using tremie tubes and taking care to prevent segregation. Bottoms of tremie tubes shall preferably be in contact with the concrete already placed. Do not permit concrete to drop freely more than 4 feet. Place concrete for walls in 12- to 24-inch lifts, keeping the surface horizontal. If plasticized concrete is used, the maximum lift thickness may be increased to 7 feet and the maximum free fall of concrete shall not exceed 15 feet.
9. Underwater concreting shall be performed in conformity with the recommendations of ACI 304R. The tremie system shall be used to place underwater concrete. Tremie pipes shall be in the range of 8 to 12 inches in diameter and be spaced at not more than 16 feet on centers nor more than 8 feet from an end form. Where concrete is being placed around a pipe, there shall be at least one tremie pipe on each side of each pipe. Where the tremie system is not practical, direct pumped concrete for underwater placement may be used subject to approval of the system, including details, by the Engineer.

B. Compacting

1. Consolidate concrete by vibration, puddling, spading, rodding, or forking so that concrete is thoroughly worked around reinforcement, embedded items, and openings and into corners of forms. Puddling, spading, etc., shall be continuously performed along with vibration of the placement to eliminate air or stone pockets that may cause honeycombing, pitting, or planes of weakness.
2. All concrete shall be placed and compacted with mechanical vibrators. The number, type, and size of the units shall be approved by the Engineer in advance of placing operations. No concrete shall be ordered until sufficient approved vibrators (including standby units in working order) are on the job.
3. A minimum frequency of 7,000 rpm is required for mechanical vibrators. Insert vibrators and withdraw at points from 18 to 30 inches apart. At each

insertion, vibrate sufficiently to consolidate concrete, generally from 5 to 15 seconds. Do not over vibrate so as to segregate. Keep a spare vibrator on the site during concrete placing operations.

4. Concrete Slabs: Concrete for slabs less than 8 inches thick shall be consolidated with vibrating screeds; slabs 8 to 12 inches thick shall be compacted with internal vibrators and (optionally) with vibrating screeds. Vibrators shall always be placed into concrete vertically and shall not be laid horizontally or laid over.
5. Walls and Columns: Internal vibrators (rather than form vibrators) shall be used unless otherwise approved by the Engineer. In general, for each vibrator needed to consolidate the batch at the point of discharge, one or more additional vibrators must be used to densify, homogenize, and perfect the surface. The vibrators shall be inserted vertically at regular intervals through the fresh concrete and slightly into the previous lift, if any.
6. Amount of Vibration: Vibrators are to be used to consolidate properly placed concrete but shall not be used to move or transport concrete in the forms. Vibration shall continue until:
 - a. Frequency returns to normal.
 - b. Surface appears liquefied, flattened, and glistening.
 - c. Trapped air ceases to rise.
 - d. Coarse aggregate has blended into the surface but has not disappeared.

3.05 CURING AND PROTECTION

- A. The Contractor shall protect all concrete work against injury from the elements and defacements of any nature during construction operations.
- B. Curing Methods
 1. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain specified temperature at the surface for a minimum of 7 days after placement. Curing methods to be used are as follows:
 - a. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling, or by covering with saturated burlap. Begin wet cure as soon as concrete attains an initial set and maintain wet cure 24 hours a day.

- b. Sheet Material Curing: Cover entire surface with sheet material. Securely anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.
 - c. Liquid Membrane Curing: Apply over the entire concrete surface except for surfaces to receive additional concrete. Curing compound shall NOT be placed on any concrete surface where additional concrete is to be placed, where concrete sealers or surface coatings are to be used, or where the concrete finish requires an integral floor product. Curing compound shall be applied as soon as the free water on the surface has disappeared and no water sheen is visible, but not after the concrete is dry or when the curing compound can be absorbed into the concrete. Application shall be in compliance with the manufacturer's recommendations.
- 2. Specified applications of curing methods.
 - a. Slabs for Water Containment Structures: Water curing only.
 - b. Slabs on Grade and Footings (not used to contain water): Water curing, sheet material curing, or liquid membrane curing.
 - c. Structural Slabs (other than water containment): Water curing or liquid membrane curing.
 - d. Horizontal Surfaces that Will Receive Additional Concrete, Coatings, Grout, or Other Material that Requires Bond to the Substrate: Water curing.
 - e. Formed Surfaces: None if nonabsorbent forms are left in place 7 days. Water cure if absorbent forms are used. Sheet cured or liquid membrane cured if forms are removed before 7 days. Exposed horizontal surfaces of formed walls or columns shall be water cured for 7 days or until next placement of concrete.
 - f. Concrete Joints: Water cured or sheet material cured.
- C. Finished surfaces and slabs shall be protected from the direct sunlight to prevent checking and crazing.

D. Cold Weather Concreting:

1. *Cold weather* is defined as a period when the average daily outdoor temperature drops below 40°F for more than 3 successive days. The average daily temperature shall be calculated as the average of the highest and the lowest temperature from midnight to midnight.
2. Cold weather concreting shall conform to ACI 306.1 and the additional requirements specified in this Section. Temperatures at the concrete placement shall be recorded at 12-hour intervals (minimum).
3. The Contractor shall discuss a cold weather work plan with the Engineer. The discussion shall encompass the methods and procedures proposed for use during cold weather, including producing, transporting, placing, protecting, curing, and monitoring the temperature of the concrete. The procedures to be implemented upon abrupt changes in weather conditions or equipment failures shall also be discussed. Cold weather concreting shall not begin until the work plan is acceptable to the Engineer.
4. During periods of cold weather, concrete shall be protected to provide continuous warm, moist curing (with supplementary heat when required) for a total of at least 350 degree-days of curing.
 - a. *Degree-days* are defined as the total number of 24-hour periods multiplied by the average daily air temperature at the surface of the concrete (e.g., 5 days at an average 70°F = 350 degree-days).
 - b. To calculate the weighted average daily air temperature, sum hourly measurements of the air temperature in the shade at the surface of the concrete taking any measurement less than 50°F as 0°F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.
5. Salt, manure, or other chemicals shall not be used for protection.
6. The protection period for concrete being water cured shall not be terminated during cold weather until at least 24 hours after water curing has been terminated.

E. Hot Weather Concreting

1. *Hot weather* is defined as any combination of high air temperatures, low relative humidity, and wind velocity which produces a rate of evaporation

estimated in accordance with ACI 305R, approaching or exceeding 0.2 lb/sq ft/hr).

2. Concrete placed during hot weather shall be batched, delivered, placed, cured, and protected in compliance with the recommendations of ACI 305R and the additional requirements specified in this Section.
 - a. Temperature of concrete being placed shall not exceed 90°F and every effort shall be made to maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set, or cold joints.
 - b. All necessary precautions shall be taken to deliver the concrete promptly, to place the concrete promptly upon its arrival at the job, and to provide vibration immediately after placement.
 - c. The Engineer may direct the Contractor to immediately cover plastic concrete with sheet material.
3. The Contractor shall discuss with the Engineer a work plan describing the methods and procedures proposed for concrete placement and curing during hot weather. Hot weather concreting shall not begin until the work plan is acceptable to the Engineer.

3.06 REMOVAL OF FORMS

- A. Except as otherwise specifically authorized by the Engineer, forms shall not be removed before the concrete has attained a strength of at least 30% of its specified design strength, nor before reaching the following number of degree-days of curing (whichever is longer):

TABLE 3
MINIMUM TIME TO FORM REMOVAL

Forms for:	Degree-Days:
Beams and slabs	500
Walls and vertical surfaces	100

(See definition of *degree-days* in Paragraph 3.05D above.)

- B. Shores shall not be removed until the concrete has attained at least 70% of its specified design strength and also sufficient strength to support safely its own weight and construction live loads.

3.07 INSPECTION AND FIELD TESTING

- A. The batching, mixing, transporting, placing, and curing of concrete shall be subject to the inspection of the Engineer at all times. The Contractor shall advise the Engineer of his/her readiness to proceed at least 24 hours before each concrete placement. The Engineer will inspect the preparations for concreting, including the preparation of previously placed concrete, the reinforcing steel and the alignment, and the cleanliness and tightness of formwork. No placement shall be made without inspection and acceptance by the Engineer.
- B. In compliance with ASTM C31, the Engineer (or inspector) will take sets of field-control cylinder specimens during the work. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than one set per day, nor less than one set for each 150 cu yd of concrete, nor less than one set for each 5,000 sq ft of surface area for slabs or walls.
 - 1. A "set" of test cylinders consists of four cylinders: one to be tested at 7 days and two to be tested and their strengths averaged at 28 days. The fourth may be used for a special test at 3 days or to verify strength after 28 days if the 28-day test results are low.
 - 2. When the average 28-day compressive strength of the cylinders in any set falls below the specified design strength or below proportional minimum 7-day strengths (where proper relation between 7- and 28-day strengths have been established by tests), proportions, water content, or temperature conditions shall be changed to achieve the required strengths.
- C. The Contractor shall cooperate in testing by allowing free access to the work for the selection of samples, providing an insulated closed curing box for specimens, affording protection to the specimens against injury or loss through the operations, and furnishing material and labor required for taking concrete cylinder samples. The cost of taking and shipping specimens will be paid for by the Contractor and reimbursed by the Owner under the Concrete Testing Allowance. Curing boxes shall be acceptable to the Engineer.
- D. In accordance with ASTM C143, slump tests will be made in the field immediately before placing the concrete. If the slump is greater than the specified range, the concrete shall be rejected.
- E. Air Content: Air content shall be tested for on fresh concrete samples. Air content for concrete made of ordinary aggregates having low absorption shall be tested for in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173. If lightweight aggregates or aggregates with high absorptions are used, the latter test method shall be used.

- F. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determining concrete quality. The results of tests on such cores shall be the basis for accepting, rejecting, or determining the continuation of concrete work.
- G. The Contractor shall cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding, and such incidental equipment as may be required. Repair all core holes. The work of cutting and testing the cores will be at the expense of the Contractor. Work found to be acceptable will be reimbursed under the Concrete Testing Allowance.

3.08 FAILURE TO MEET REQUIREMENTS

- A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, the Engineer shall have the right to require changes in proportions outlined to apply to the remainder of the work. Furthermore, the Engineer shall have the right to require additional curing on those portions of the structure represented by the test specimens which failed. The cost of such additional curing shall be at the Contractor's expense. If such additional curing does not give the strength required as evidenced by core and/or load tests, the Engineer shall have the right to require strengthening or replacing those portions of the structure that fail to develop the required strength. The cost of all such core borings and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below those specified shall be entirely at the expense of the Contractor. In such cases of failure to meet strength requirements, the Contractor and Engineer shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in ASTM C94 is the Contractor in this Section.
- B. When the tests on control specimens of concrete fall below the specified strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39. In the case of cores not indicating adequate strength, the Engineer, in addition to other recourses, may require, at the Contractor's expense, load tests on any one of the slabs, beams, piles, caps, and columns in which such concrete was used. Tests need not be conducted until concrete has aged 60 days.
- C. Should the strength of test cylinders fall below 60% of the required minimum 28-day strength, the concrete shall be rejected and shall be removed and replaced.

3.09 PATCHING AND REPAIRS

- A. This Section is intended to require quality work, including adequate forming and proper mixing, placing, and curing of concrete so completed concrete surfaces will require no patching.
- B. Defective concrete and honeycombed areas as determined by the Engineer shall be repaired as specified by the Engineer.
- C. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed; recesses left by the removal of form ties shall be filled; and surface defects which do not impair structural strength shall be repaired. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete to the approval of the Engineer.
- D. Immediately after removal of forms remove plugs and break off metal ties as required by Section 03100. Promptly fill holes upon stripping as follows: moisten the hole with water, followed by a 1/16-inch brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1 to 1.5-mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole until dense and an excess of paste appears on the surface in the form of a spiderweb. Trowel smooth with heavy pressure. Avoid burnishing.
- E. When patching exposed surfaces, employ the same source of cement and sand as used in the parent concrete. Adjust color if necessary by adding proper amounts of white cement. Rub lightly with a fine Carborundum stone at an age of 1 to 5 days if necessary to bring the surface down with the parent concrete. Exercise care to avoid damaging or staining the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.

3.10 SCHEDULE

- A. The following (Table 4) are the general applications for the various concrete classes and design strengths:

TABLE 4
CONCRETE SCHEDULE

Class	Design Strength (psi)	Description
A	2,500	Concrete fill and duct encasement
B	3,000	Concrete overlay slabs and pavements
C	4,000	Walls, slabs on grade, suspended slab and beam systems, columns, grade beams, and all other structural concrete
D	5,000	Prestressed concrete

END OF SECTION

SECTION 03360
CONCRETE FINISHES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and finish cast-in-place concrete surfaces as shown on the Drawings and as specified in this Section.

1.02 RELATED WORK

- A. Section 03100, Concrete Formwork.
- B. Section 03300, Cast-In-Place Concrete.
- C. Section 03600, Grout.

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Concrete sealer. Confirmation that the sealer is compatible with additionally applied coatings shall also be submitted.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C33—Standard Specification for Concrete Aggregates.

1.06 QUALITY ASSURANCE

A. Finishes

1. For concrete which will receive additional applied finishes or materials, the surface finish specified is required for the proper application of the specified manufacturer's products. Where alternate products are approved for use, determine if changes in finishes are required and provide the proper finishes to receive these products.
2. Changes in finishes made to accommodate products different from those specified shall be performed at no additional cost to the Owner. Submit the proposed new finishes and their construction methods to the Engineer for approval.

B. Services of Manufacturer's Representative

1. Upon 72 hours notification, make available at no extra cost to the Owner the services of a qualified field representative of the manufacturer of the curing compound, sealer, or hardener to instruct the user on the proper application of the product under prevailing job conditions.

1.07 WARRANTIES

- ### A.
- Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- ### A.
- The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 WEATHER CONSTRAINTS (NOT USED)

PART 2 PRODUCTS

2.01 MATERIALS

- ### A.
- Concrete sealer shall be "Kure N Seal," by Sonneborn, Minneapolis, MN or equal.

PART 3 EXECUTION

3.01 FORMED SURFACES

- A. Forms shall not be removed before the requirements of Section 03300 have been satisfied.
- B. Exercise care to prevent damaging edges or obliterating the lines of chamfers, rustications, or corners when removing the forms or performing any other work adjacent to such chamfers, rustications, or corners.
- C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.
- D. Rough Form Finish
 - 1. Immediately after stripping forms and before concrete has changed color, carefully remove all fins and projections.
 - 2. Promptly fill holes left by tie cones and defects as specified in Section 03300.
- E. Rubbed Finish
 - 1. Immediately upon stripping forms and before the concrete has changed color, carefully remove all fins. While the wall is still damp, apply a thin coat of medium-consistency neat cement slurry by bristle brushes to provide a bonding coat within all pits, air holes, or blemishes in the parent concrete. Avoid coating large areas with the slurry at one time.
 - 2. Before the slurry has dried or changed color, apply a dry (almost crumbly) grout proportioned by volume and consisting of 1 part cement to 1-1/2 parts of clean masonry sand having a fineness modulus of approximately 2.3 and complying with the gradation requirements of ASTM C33 for such a material. Grout shall be uniformly applied by damp pads of coarse burlap approximately 6-inch square used as a float. Scrub grout into the pits and air holes to provide a dense mortar in all imperfections.
 - 3. Allow the mortar to partially harden for 1 or 2 hours depending on the weather. If the air is hot and dry, keep the wall damp during this period using a fine, fog spray. When the grout has hardened sufficiently so it can be scraped from the surface with the edge of a steel trowel without

damaging the grout in the small pits or holes, cut off all that can be removed with a trowel. (Note: Grout allowed to remain on the wall too long will harden and will be difficult to remove.)

4. Allow the surface to dry thoroughly and rub it vigorously with clean dry burlap to completely remove any dried grout. No visible film of grout shall remain after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow sufficient time for grout to dry after it has been cut off with the trowel so it can be wiped off clean with the burlap.
5. On the day after the repair of pits, air holes, and blemishes, the walls shall again be wiped off clean with dry, used pieces of burlap containing old hardened mortar which will act as a mild abrasive. After this treatment, there shall be no built-up film remaining on the parent surface. If, however, such a film is present, a fine abrasive stone shall be used to remove all such material without breaking through the surface film of the original concrete. Such scrubbing shall be light and sufficient only to remove excess material without changing the texture of the concrete.
6. A thorough wash down with stiff bristle brushes shall follow the final bagging or stoning operation. No extraneous materials shall remain on the surface of the wall. The wall shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after the application of the repair grout.

F. Abrasive Blast Finish

1. Coordinate with Rubbed Finish application. Do not begin until Rubbed Finish operation is complete or before concrete has reached minimum 7-day strength. The Rubbed Finish application may be deleted by the Engineer if the unfinished concrete surface is of superior quality. Apply the abrasive blast finish only where indicated on the Drawings.
2. Prepare a sample area a minimum of 4 feet high by 16 feet wide. Blast Finish as directed by the Engineer on a portion of new wall construction which will not be exposed in the final work. The sample area shall contain a variety of finishes obtained with different nozzles, nozzle pressures, grit materials, and blasting techniques for selection by the Engineer. Final accepted sample shall remain exposed until all Blast Finish operations are complete.

3. The Blast Finish operation shall meet all regulatory agency requirements. The Blast Finish contractor shall be responsible for obtaining all required permits and/or licenses.
4. Perform abrasive blast finishing in as continuous an operation as possible, using the same work crew to maintain continuity of finish on each surface or area of work. Maintain patterns or variances in depths of blast as present on the accepted sample.
5. Use an abrasive grit of proper type and gradation as well as equipment and technique to expose aggregate and surrounding matrix surfaces as follows:
 - a. Medium: Generally expose coarse aggregate 1/4 inch to 3/8 inch reveal.
6. Abrade blast corners and edge of patterns carefully, using back-up boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure, and blasting techniques required to match the Architect's samples.
7. Upon completing the Blast Finish operation, thoroughly flush finished surfaces with clean clear water to remove residual dust and grit. Allow to air dry until curing of concrete is complete.
8. After the concrete has cured for a minimum of 28 days, apply a clear acrylic sealer as directed by the manufacturer.

3.02 FLOORS AND SLABS

A. Floated Finish

1. Machine Floating
 - a. Screed floors and slabs with straightedges to the established grades shown on the Drawings. Immediately after final screeding sprinkle a dry cement/sand shake in the proportion of two sacks of Portland cement to 350 lb of coarse natural concrete sand evenly over the surface at the rate of approximately 500 lb/1,000 sq. ft. of floor. Do not sprinkle neat, dry cement on the surface.
 - b. The application of the cement/sand shake may be eliminated at the discretion of the Engineer if the base slab concrete exhibits adequate fattiness and homogeneity and the need is not indicated. When the concrete has hardened sufficiently to support the weight

of a power float without the float's digging into or disrupting the level surface, thoroughly float the shake into the surface with a heavy revolving disc-type power compacting machine capable of providing a 200-lb compaction force distributed over a 24-inch-diameter disc.

- c. Start floating along walls and around columns and then move systematically across the surface leaving a matte finish.
- d. The compacting machine shall be the "Kelly Power Float with Compaction Control" as manufactured by Kelley Industries of SSP Construction Equipment Inc., Pomona, CA or equal. Troweling machines equipped with float (shoe) blades that are slipped over the trowel blades may be used for floating. Floating with a troweling machine equipped with normal trowel blades will not be permitted. The use of any floating or troweling machine which has a water attachment for wetting the concrete surface during finishing will not be permitted.

2. Hand Floating

- a. In lieu of power floating, small areas may be compacted by hand floating. The dry cement/sand shake previously specified shall be used unless specifically eliminated by the Engineer. Screed the floors and slabs with straightedges to the established grades shown on the Drawings. While the concrete is still green but sufficiently hardened to support a finisher and kneeboards with no more than 1/4-inch indentation, wood float to a true, even plane with no coarse aggregate visible. Use sufficient pressure on the wood floats to bring moisture to the surface.

3. Finishing Tolerances

- a. Level floors and slabs to a tolerance of plus or minus 1/8 inch when checked with a 10-foot straightedge placed anywhere on the slab in any direction. Where drains occur, pitch floors to drains such that no low spots are left undrained. Failure to meet either of the above requirements shall be cause for removal, grinding, or other correction as directed by the Engineer.

B. Broom Finish

- 1. Screed slabs with straightedges to the established grades indicated on the Drawings. When the concrete has stiffened sufficiently to maintain small

surface indentations, draw a stiff bristle broom lightly across the surface in the direction of drainage or, in the case of walks and stairs, perpendicular to the direction of traffic to provide a non-slip surface.

C. Steel Trowel Finish

1. Finish concrete as specified in Article 3.04. Then, hand steel trowel to a perfectly smooth hard even finish free from high or low spots or other defects.

D. Concrete Sealer

1. Prepare and seal surfaces indicated on the room finish schedule to receive a sealer as follows:
 - a. Finish concrete as specified in the preceding paragraphs and in accordance with the Schedule in Article 3.05 below.
 - b. Newly Placed Concrete: Surface must be sound and properly finished. Surface is application ready when it is damp but not wet and can no longer be marred by walking workmen.
 - c. Newly Cured Bare Concrete: Level any spots gouged out by trades. Remove all dirt, dust, droppage, oil, grease, asphalt, and foreign matter. Cleanse with caustics and detergents as required. Rinse thoroughly and allow to dry so that the surface is no more than damp and not wet.
 - d. Aged Concrete: Restore surface soundness by patching, grouting, filling cracks and holes, etc. Surface must also be free of any dust, dirt, and other foreign matter. Use power tools and/or strippers to remove any incompatible sealers or coatings. Cleanse as required following the procedure indicated under cured concrete.
 - e. Methods: Apply sealer to form a continuous, uniform film by spray, soft bristle pushbroom, long nap roller, or lambswool applicator. Ordinary garden-type sprayers, using neoprene hose, are recommended for best results.
 - f. Applications: For curing only, apply the first coat evenly and uniformly as soon as possible after final finishing at the rate of 200 to 400 sq. ft. per gallon. Apply the second coat when all trades are completed and the structure is ready for occupancy at the rate of 400 to 600 sq. ft. per gallon.

- g. To meet guarantee and to seal and dustproof, two coats are required. For sealing new concrete, both coats shall be applied full strength. On aged concrete, when renovating, dustproofing, and sealing, the first coat should be thinned 10 to 15% with reducer in accordance with the manufacturer's directions.

3.03 APPROVAL OF FINISHES

- A. All concrete surfaces, when finished, will be inspected by the Engineer.
- B. Surfaces which in the opinion of the Engineer are unsatisfactory shall be refinished or reworked.
- C. After finishing horizontal surfaces, regardless of the finishing procedure specified, the concrete shall be cured in compliance with Section 03300 unless otherwise directed by the Engineer.

3.04 SCHEDULE OF FINISHES

- A. Concrete shall be finished as specified either to remain as natural concrete or to receive an additional applied finish or material under another section.
- B. Concrete for the following conditions shall be finished as noted on the Drawings and as further specified in this Section:
 - 1. Concrete to Receive Dampproofing: Rough form finish. See Paragraph 3.01D above.
 - 2. Concrete Not Exposed to View and Not Scheduled to Receive an Additional Applied Finish or Material: Rough form finish. See Paragraph 3.01D above.
 - 3. Exterior Vertical Concrete Above Grade Exposed to View: Rubbed finish. See Paragraph 3.01E above.
 - 4. Interior Vertical Concrete Exposed to View Except in Water Containment Areas: Rubbed finish. See Paragraph 3.01E above.
 - 5. Interior and Exterior Underside of Concrete Exposed to View: Rubbed finish. See Paragraph 3.01E above.
 - 6. Exterior surfaces exposed to view and indicated to have an abrasive blast finish. See Paragraph 3.01F above.

7. Concrete for Exterior Walks and Interior and Exterior Stairs: Broomed finish perpendicular to direction of traffic. See Paragraph 3.02B above.

END OF SECTION

SECTION 03600 GROUT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install grout complete as shown on the Drawings and as specified in this Section.

1.02 RELATED WORK

- A. Section 03100, Concrete Formwork.
- B. Section 03200, Concrete Reinforcement.
- C. Section 03250, Concrete Joints and Joint Accessories.
- D. Section 03300, Cast-in-Place Concrete.
- E. Section 05500, Metal Fabrications.

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:
 - 1. Commercially manufactured nonshrink cementitious grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards, and Material Safety Data Sheet.
 - 2. Commercially manufactured nonshrink epoxy grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards, and Material Safety Data Sheet.
 - 3. Cement grout. The submittal shall include the type and brand of the cement, the gradation of the fine aggregate, product data on any proposed admixtures, and the proposed mix of the grout.
 - 4. Concrete grout. The submittal shall include data as required for concrete as delineated in Section 03300 and for fiber reinforcement as delineated in Section 03200. This includes the mix design, constituent quantities per cubic yard, and the water/cement ratio.

- B. Laboratory Test Reports: Submit laboratory test data as required under Section 03300 for concrete to be used as concrete grout.
- C. Certifications: Certify that commercially manufactured grout products and concrete grout admixtures are suitable for use in contact with potable water after 30 days curing.
- D. Qualifications: Grout manufacturers shall submit documentation that they have at least 10 years experience in the production and use of the proposed grouts which they will supply.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C33—Standard Specification for Concrete Aggregates.
 - 2. ASTM C150—Standard Specification for Portland Cement.
 - 3. ASTM C531—Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - 4. ASTM C579—Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - 5. ASTM C827—Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.
 - 6. ASTM C1107—Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 - 7. ASTM D695—Standard Test Method for Compressive Properties of Rigid Plastics.
- B. U.S. Army Corps of Engineers Standard (CRD)
 - 1. CRD C-621—Corps of Engineers Specification for Non-Shrink Grout.

1.06 QUALITY ASSURANCE

A. Pre-installation Conference

1. Well in advance of grouting, the Contractor shall hold a pre-installation meeting to review the requirements for surface preparation, mixing, placing, and curing procedures for each product proposed for use. Parties concerned with grouting shall be notified of the meeting at least 10 days before its scheduled date.

B. Services of Manufacturer's Representative

1. A qualified field technician of the nonshrink grout manufacturer, specifically trained in installing the products, shall attend the pre-installation conference and shall be present for the initial installation of each type of nonshrink grout. Additional services shall also be provided as required to correct installation problems.

C. Field Testing

1. All field testing and inspection services required shall be provided by the Owner. The Contractor shall assist in the sampling of materials and shall provide any ladders, platforms, etc, for access to the work. The methods of testing shall comply in detail with the applicable ASTM Standards.
2. The field testing of Concrete Grout shall be as specified for concrete in Section 03300.

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers, and printed instructions.

- C. Store materials in full compliance with the manufacturer's recommendations. Total storage time from the date of manufacture to the date of installation shall be limited to 6 months or the manufacturer's recommended storage time, whichever is less.
- D. Material which becomes damp or otherwise unacceptable shall be immediately removed from the site and replaced with acceptable material at no additional expense to the Owner.
- E. Nonshrink-cement-based grouts shall be delivered as preblended, prepackaged mixes requiring only the addition of water.
- F. Nonshrink epoxy grouts shall be delivered as premeasured, prepackaged, three-component systems requiring only blending as directed by the manufacturer.

1.09 QUALIFICATIONS

- A. The grout manufacturer shall have a minimum of 10 years experience in the production and use of the type of grout proposed for the work.

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 WEATHER CONSTRAINTS (NOT USED)

1.12 DEFINITIONS

- A. Nonshrink Grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state, and bonds to a clean base plate.

PART 2 PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and product or catalog number is to establish the standard of quality desired.
- B. To standardize appearance, like materials shall be the products of one manufacturer or supplier.

2.02 MATERIALS

A. Nonshrink Cementitious Grout

1. Nonshrink cementitious grouts shall meet or exceed the requirements of ASTM C1107, Grades B or C and CRD C-621. Grouts shall be Portland-cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents, and shall require only the addition of water. Nonshrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827. Minimum compressive strength shall be 8,000 psi at 28 days.
 - a. General purpose nonshrink cementitious grout shall conform to the standards stated above and shall be SikaGrout 212 by Sika Corp.; Set Grout by Master Builders, Inc.; Gilco Construction Grout by Gifford Hill & Co.; Euco NS by The Euclid Chemical Co.; NBEC Grout by U. S. Grout Corp.; or equal.
 - b. Flowable (Precision) nonshrink cementitious grout shall conform to the standards stated above and shall be Masterflow 928 by Master Builders, Inc.; Hi Flow Grout by the Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Supreme Grout by Gifford Hill & Co.; Five Star Grout by U. S. Grout Corp.; or equal.

B. Nonshrink Epoxy Grout

1. Nonshrink epoxy based grout shall be a pre-proportioned, three-component, 100% solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of 14,000 psi in 7 days when tested in conformity with ASTM D695 and have a maximum thermal expansion of 30×10^{-6} when tested in conformity with ASTM C531. The grout shall be Ceilcote 648 CP by Master Builders Inc.; Five Star Epoxy Grout by U.S. Grout Corp.; Sikadur 42 Grout Pak by Sika Corp.; High Strength Epoxy Grout by the Euclid Chemical Co.; or equal.

C. Cement Grout

1. Cement grouts shall be a mixture of one part Portland cement conforming to ASTM C150, Types I, II, or III and 1 to 2 parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout but not to the degree that it will allow the grout to flow.

D. Concrete Grout

1. Concrete grout shall conform to the requirements of Section 03300 except as specified in this Section. It shall be proportioned with cement, coarse and fine aggregates, water, water reducer, and an air-entraining agent to produce a mix having an average strength of 2,900 psi at 28 days, or 2,500 psi nominal strength. Coarse aggregate size shall be 3/8-inch maximum. Slump should not exceed 5 inches and should be as low as practical yet still retain sufficient workability.
2. Synthetic reinforcing fibers as specified in Section 03200 shall be added to the concrete grout mix at the rate of 1.5 lb of fibers per cubic yard of grout. Fibers shall be added from the manufacturer's premeasured bags and according to the manufacturer's recommendations in a manner which will ensure complete dispersion of the fiber bundles as single monofilaments within the concrete grout.

E. Water

1. Potable water, free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

PART 3 EXECUTION

3.01 PREPARATION

- A. Grout shall be placed over cured concrete which has attained its full design strength unless otherwise approved by the Engineer.
- B. Concrete surfaces to receive grout shall be clean and sound, free of ice, frost, dirt, grease, oil, curing compounds, laitance and paints, and free of all loose material or foreign matter which may affect the bond or performance of the grout.
- C. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to ensure bond of the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance, and firmly embedded into the parent concrete.
 1. Air compressors used to clean surfaces in contact with grout shall be the oilless type or equipped with an oil trap in the air line to prevent oil from being blown onto the surface.
- D. Remove all loose rust, oil, or other deleterious substances from metal embedments or bottom of baseplates before installing the grout.

- E. Concrete surfaces shall be washed clean and then kept moist for at least 24 hours before the placing of cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, using a soaker hose, flooding the surface, or other method acceptable to the Engineer. Upon completion of the 24-hour period, visible water shall be removed from the surface before grouting. An adhesive bonding agent should only be used in lieu of surface saturation when approved by the Engineer for each specific location of grout installation.
- F. Epoxy-based grouts do not require the saturation of the concrete substrate. Surfaces in contact with epoxy grout shall be completely dry before grouting.
- G. Construct grout forms or other leak-proof containment as required. Forms shall be lined or coated with release agents recommended by the grout manufacturer. Forms shall be of adequate strength, securely anchored in place, and shored to resist the forces imposed by the grout and its placement.
 - 1. Forms for epoxy grout shall be designed to allow the formation of a hydraulic head and shall have chamfer strips built into forms.
- H. Level and align the structural or equipment bearing plates in accordance with the structural requirements and the recommendations of the equipment manufacturer.
- I. Equipment shall be supported during alignment and installation of grout by shims, wedges, blocks, or other approved means. The shims, wedges, and blocking devices shall be prevented from bonding to the grout by appropriate bond breaking coatings and removed after grouting unless otherwise approved by the Engineer.

3.02 INSTALLATION—GENERAL

- A. The Contractor shall mix, apply, and cure products in strict compliance with the manufacturer's recommendations and this Section.
- B. Have sufficient manpower and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.
- C. Maintain temperatures of the foundation plate, supporting concrete, and grout between 40 and 90°F during grouting and for at least 24 hours after or as recommended by the grout manufacturer, whichever is longer. Take precautions to minimize differential heating or cooling of baseplates and grout during the curing period.

- D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the materials in contact with the grout are outside of the 60 and 90°F range.
- E. Install grout in a manner which will preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or contraction joint.
- F. Reflect all existing underlying expansion, contraction, and construction joints through the grout.

3.03 INSTALLATION—CEMENT GROUTS AND NONSHRINK CEMENTITIOUS GROUTS

- A. Mix in accordance with the manufacturer's recommendations. Do not add cement, sand, pea gravel, or admixtures without prior approval by the Engineer.
- B. Avoid mixing by hand. Mixing in a mortar mixer (with moving blades) is recommended. Pre-wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.
- C. Placements greater than 3 inches deep shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.
- D. Place grout into the designated areas in a manner which will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement should proceed in a manner which will ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
- E. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (retemper) after initial stiffening.
- F. Just before the grout reaches its final set, cut back the grout to the substrate at a 45° angle from the lower edge of the bearing plate unless otherwise approved by the Engineer. Finish this surface with a wood float (brush) finish.

- G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer. Saturate the grout surface by use of wet burlap, soaker hoses, ponding, or other approved means. Provide sunshades as necessary. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

3.04 INSTALLATION—NONSHRINK EPOXY GROUTS

- A. Mix in accordance with the procedures recommended by the manufacturer. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not overmix. Mix full batches only to maintain proper proportions of resin, hardener, and aggregate.
- B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 or above 90°F.
- C. Place grout into the designated areas in a manner which will avoid trapping air. Placement methods shall ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
- D. Minimize "shoulder" length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.
- E. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.
- F. Epoxy grouts are self curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placing, or longer if recommended by the manufacturer.

3.05 INSTALLATION—CONCRETE GROUT

- A. Screed underlying concrete to the grade shown on the Drawings. Provide the surface with a broomed finish, aligned to drain. Protect and keep the surface clean until placement of concrete grout.
- B. Remove the debris and clean the surface by sweeping and vacuuming all dirt and other foreign materials. Wash the tank slab using a strong jet of water. Flushing debris into tank drain lines will not be permitted.

- C. Saturate the concrete surface for at least 24 hours before placing the concrete grout. Saturation may be maintained by ponding, by the use of soaker hoses, or by other methods acceptable to the Engineer. Remove excess water just before placing the concrete grout. Place a cement slurry immediately ahead of the concrete grout so that the slurry is moist when the grout is placed. Work the slurry over the surface with a broom until it is coated with approximately 1/16- to 1/8-inch-thick cement paste.
- D. Place concrete grout to final grade using the scraper mechanism as a guide for surface elevation and to ensure that high and low spots are eliminated. Unless specifically approved by the equipment manufacturer, mechanical scraper mechanisms shall not be used as a finishing machine or screed.
- E. Provide grout contraction joints as indicated on the Drawings.
- F. Finish and cure the concrete grout as specified for cast-in-place concrete.

3.06 SCHEDULE

- A. The following list indicates where the particular types of grout are to be used:
 - 1. General purpose nonshrink cementitious grout: Use at all locations where nonshrink grout is called for on the plans except for base plates greater than 3 feet wide by 3 feet long and, except for the setting of anchor rods, anchor bolts or reinforcing steel in concrete.
 - 2. Flowable nonshrink cementitious grout: Use under all base plates greater in area than 3 feet by 3 feet. Use at all locations indicated to receive flowable nonshrink grout by the Drawings. The Contractor, at his/her option and convenience, may also substitute flowable nonshrink grout for general purpose nonshrink cementitious grout.
 - 3. Nonshrink epoxy grout: Use for setting anchor rods, anchor bolts, and reinforcing steel in concrete and for all locations specifically indicated to receive epoxy grout.
 - 4. Cement grout: Cement grout may be used for grouting incidental base plates for structural and miscellaneous steel such as post base plates for platforms, base plates for beams, etc. It shall not be used when nonshrink grout is specifically called for on the Drawings or for grouting primary structural steel members such as columns and girders.

5. Concrete grout: Use for overlaying the base concrete under scraper mechanisms of clarifiers to allow more control in placing the surface grade.

END OF SECTION

DIVISION 5

METALS

SECTION 05500
METAL FABRICATIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes the following:

1. Metal bollards.
2. Loose bearing and leveling plates.
3. Shelf and relieving angles.
4. Miscellaneous framing and supports.
5. Prefabricated steel building columns.
6. Steel channels for overhead door openings.
7. Loose steel lintels.
8. Gratings.

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Electrical Panel/Switch Canopy.

1.02 RELATED WORK

- A. Section 03300, Cast-in-Place Concrete, for installing anchor bolts, steel pipe sleeves, wedge-type inserts, and other items indicated to be cast into concrete.

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

A. Product Data: For the following:

1. Non-slip aggregates and non-slip-aggregate surface finishes.
2. Prefabricated building columns.
3. Paint products.
4. Grout.

- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
 - 2. Provide templates for anchors and bolts specified for installation under other Sections.
 - 3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Mill Certificates: Signed by the manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.
- D. Welding certificates.
- E. Qualification Data: Florida Professional Engineering Registration certificate.

1.04 WORK SEQUENCE

- A. The Contractor shall coordinate the installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to the Project site in time for installation.
- B. The Contractor shall coordinate the installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to the Project site in time for installation.

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American National Standards Institute (ANSI)
 - 1. ANSI A14.3—Ladders – Fixed – Safety Requirements.
 - 2. ANSI/NAAMM MBG 531—Gratings.

B. American Society for Testing and Materials (ASTM)

1. ASTM A27—Standard Specification for Steel Castings, Carbon, for General Application.
2. ASTM A36—Standard Specification for Carbon Structural Steel.
3. ASTM A47—Standard Specification for Ferritic Malleable Iron Castings.
4. ASTM A48—Standard Specification for Gray Iron Castings.
5. ASTM A53—Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
6. ASTM A123—Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
7. ASTM A153—Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
8. ASTM A276—Standard Specification for Stainless Steel Bars and Shapes.
9. ASTM A307—Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
10. ASTM A325—Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
11. ASTM A489—Standard Specification for Carbon Steel Lifting Eyes.
12. ASTM A500—Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
13. ASTM A563—Standard Specification for Carbons and Alloy Steel Nuts.
14. ASTM A653—Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
15. ASTM A666—Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
16. ASTM A780—Standard Practice for Repair of Damages and Uncoated Areas of Hot-Dip Galvanized Coatings.
17. ASTM A786—Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
18. ASTM B108—Standard Specification for Aluminum-Alloy Permanent Mold Castings.
19. ASTM B209—Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
20. ASTM B221—Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
21. ASTM B633—Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
22. ASTM C1107—Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
23. ASTM D1187—Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.

24. ASTM E488—Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
25. ASTM F436—Standard Specification for Hardened Steel Washers.
26. ASTM F568M—Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners.
27. ASTM F593—Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
28. ASTM F594—Standard Specification for Stainless Steel Nuts.
29. ASTM F738M—Standard Specification for Style 1 Stainless Steel Metric Bolts, Screws, and Studs.
30. ASTM F836M—Standard Specification for Style 1 Stainless Steel Metric Nuts.
31. ASTM F879—Standard Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws.
32. ASTM F1554—Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

C. American Society of Mechanical Engineers (ASME)

1. ASME B18.6.3—Machine Screws and Machine Screw Nuts.
2. ASME B18.6.7M—Metric Machine Screws.
3. ASME B18.2.1—Square and Hex Bolts and Screws, Inch.
4. ASME B18.2.3.8M—Metric Hex Lag Screws.
5. ASME B18.6.1—Wood Screws (Inch Series).
6. ASME B18.22.1—Plain Washers.
7. ASME B18.22M—Metric Plain Washers.
8. ASME B18.21.1—Lock Washers (Inch Series).
9. ASME B18.21.2M—Lock Washers (Metric Series).

D. American Welding Society (AWS)

1. AWS D1.1—Structural Welding Code - Steel.
2. AWS D1.2—Structural Welding Code – Aluminum.
3. AWS D1.3—Structural Welding Code – Sheet Steel.
4. AWS D1.6—Structural Welding Code – Stainless Steel.

E. Environmental Protection Agency (EPA)

1. EPA Method 24—Surface Coatings.

F. Federal Regulations (FR)

1. 40 CFR 59—National Volatile Organic Compound Emission Standards for Consumer and Commercial Products.

G. Society for Protection Coatings (SSPC)

1. SSPC-PA1—Shop, Field, and Maintenance Painting of Steel.
2. SSPC-SP6—Commercial Blast Cleaning.
3. SSPC-SP10—Near-White Blast Cleaning.
4. SSPC-Paint 20—Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic).
5. SSPC-Paint 29—Zinc Dust Sacrificial Primer, Performance-Based.
6. SSPC-Zone 1A—Interior, Normally Dry.
7. SSPC-Zone 1B—Exterior, Normally Dry.

1.06 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, Structural Welding Code—Steel.
2. AWS D1.2, Structural Welding Code—Aluminum.
3. AWS D1.3, Structural Welding Code—Sheet Steel.
4. AWS D1.6, Structural Welding Code—Stainless Steel.

1.07 WARRANTIES (NOT USED)

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.09 QUALIFICATIONS (NOT USED)

1.10 PROJECT REQUIREMENTS

- A. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120°F, ambient; 180°F, material surfaces.

1.11 PROJECT CONDITIONS

- A. Field Measurements: The Contractor shall verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on shop drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2. Provide allowance for trimming and fitting at site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 Articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include but are not limited to products specified.
 - 2. Products: Subject to compliance with requirements, provide one of the products specified.
 - 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include but are not limited to manufacturers specified.
 - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.03 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
 - 1. Unless noted otherwise, steel that is not stainless steel shall be galvanized with a G90 coating conforming to ASTM A123/A123M.
- B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 316L.
- C. Stainless-Steel Bars and Shapes: ASTM A276, Type 316L.
- D. Steel Tubing: ASTM A500, cold-formed steel tubing.
- E. Steel Pipe: ASTM A53/A53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

2.04 ALUMINUM ALLOY PRODUCTS

- A. Aluminum Sheet Plates: Conforming to ASTM B209
- B. Aluminum Extrusions: Conforming to ASTM B221
- C. Aluminum Castings: Conforming to ASTM B108

2.05 FASTENERS

- A. General: For all exterior applications and where fastening aluminum, provide Type 304 stainless-steel fasteners. Provide hot-dipped galvanized fasteners in all other applications in accordance with ASTM A153 unless noted otherwise on the Drawings. Select fasteners for type, grade, and class required.
- B. High-Strength Bolts and Nuts: ASTM A325 with heavy hex nuts ASTM A563 and hardened carbon-steel washers ASTM F436.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and flat washers; ASTM F593 for bolts and ASTM F594 for nuts, Alloy Group A4.
- E. Stainless Steel Socket Button and Flat Countersunk Head Cap Screws: ASTM F879.

- F. Anchor Bolts: ASTM F 1554, Grade 36.
- G. Eyebolts: ASTM A489.
- H. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- I. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- J. Wood Screws: Flat head, ASME B18.6.1.
- K. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).
- L. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).
- M. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining without failure a load equal to four times the load imposed, as determined by testing according to ASTM E488, conducted by a qualified independent testing agency.
 - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized in accordance with ASTM A153/A153M.
- N. Expansion Anchors: Anchor bolt and sleeve assembly with ability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488 conducted by a qualified independent testing agency.
 - 1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633, Class Fe/Zn 5.
 - 2. Material for Anchors in Exterior Locations: Alloy Group (A4) stainless-steel bolts complying with ASTM F593 (ASTM F738M) and nuts complying with ASTM F594 (ASTM F836M).

2.06 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Division 9.

- C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
 - 1. Use primer with a VOC content of 3.5 lb/gal or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Available Products:
 - a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19.
 - b. Carboline Company; Carbozinc 621.
 - c. ICI Devoe Coatings; Catha-Coat 313.
 - d. International Coatings Limited; Interzinc 315 Epoxy Zinc-Rich Primer.
 - e. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.
 - f. Sherwin-Williams Company (The); Corothane I GalvaPac Zinc Primer.
 - g. Tnemec Company, Inc.; Tneme-Zinc 90-97.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187
- E. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- F. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C1107, specifically recommended by the manufacturer for heavy-duty loading applications.
- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by the manufacturer for interior and exterior applications.

2.07 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to the greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work true to line and level with accurate angles, surfaces, and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather so as to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of the type indicated and coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 inch by 1-1/2 inches with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.08 METAL BOLLARDS

- A. Steel Pipe Bollards: Fabricate pipe bollards from Schedule 80 steel pipe. Fill bollards with concrete.
 - 1. Where bollards are indicated to receive push-button controls for door operators, provide necessary cutouts for push-button controls and hole for wire.
- B. Fabricate bollards with 3/8-inch-thick steel base plates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
 - 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch-thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
- D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch wall-thickness steel tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4-inch steel machine bolt.

2.09 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.

2.10 GRATINGS

Design floor gratings to withstand a live load of 250 pounds per square foot for the span indicated, with a maximum deflection of $L/240$.

- A. Gray Cast Iron-Gratings: Conforming to ASTM A48/A48M.

- B. Metal Plank Gratings: Non-slip type, aluminum conforming to ASTM B209, 6061 T6, and steel conforming to ASTM A653/A653M, G90 galvanized. Stainless steel conforming to ASTM A276, Type 304 or 316.
- C. Metal Bar Gratings: Conforming to ANSI/NAAMM MBG 531.

2.11 PATTERNED FLOOR PLATES

Design floor plates to withstand a live load of 250 pounds per square foot for the span indicated, with a maximum deflection of $L/240$.

- A. Steel Floor Plates: Conforming to ASTM A786/A786M, minimum 14 gauge, and with G90 galvanized coating.
- B. Aluminum Floor Plate: Conforming to ASTM B209, 6061 T6.

2.12 MISCELLANEOUS METAL FABRICATIONS

- A. Loose Bearing and Leveling Plates: Flat, free from warps or twists, and of the required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.
- B. Shelf and Relieving Angles:
 - 1. Fabricate from steel angles of sizes indicated and for attachment to concrete framing. Provide slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and not more than 24 inches o.c., unless otherwise indicated.
 - 2. For cavity walls, provide vertical channel brackets to support shelf/relieving angles from back-up masonry and concrete. Align expansion joints in angles with indicated control and expansion joints in cavity wall exterior wythe.
 - 3. Galvanize shelf angles.
 - 4. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete or masonry.
- C. Miscellaneous Framing and Supports:
 - 1. Provide steel framing and supports for applications indicated that are not a part of structural steel framework as required to complete the Work.

2. Fabricate units to sizes, shapes, and profiles indicated and required to receive other adjacent construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
3. Galvanize miscellaneous framing and supports in all locations.

D. Steel Channels for Overhead Door Openings

1. Fabricate steel door frame channels from structural shapes of size and to dimensions indicated, fully welded together.
2. Galvanize frames and anchors in all locations.

2.13 FINISHES, GENERAL

- A. Comply with NAAMM's *Metal Finishes Manual for Architectural and Metal Products* for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.14 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 1. ASTM A123/A123M, for galvanizing steel and iron products.
 2. ASTM A153/A153M, for galvanizing steel and iron hardware.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Interiors (SSPC Zone 1A): SSPC-SP 10 "Near White Metal Blast Cleaning."
- C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with

SSPC-PA 1, *Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel*, for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.15 STAINLESS STEEL FINISHES

- A. Remove tool and die marks and stretch lines or blend into finish.
- B. Dull Satin Finish: No. 6.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.

Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.02 INSTALLING METAL BOLLARDS

- A. Anchor bollards to existing construction with anchor bolts. Provide four 3/4-inch bolts at each bollard, unless otherwise indicated.
 - 1. Embed anchor bolts at least 4 inches in concrete.
- B. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with nonshrink, nonmetallic grout mixed and placed to comply with the grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- C. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above the bottom of the excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until the concrete has cured.
- D. Anchor internal sleeves for removable bollards in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of sleeve. Fill annular space around internal sleeves solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward internal sleeve.
- E. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches above the bottom of the excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- F. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. The Owner will furnish padlocks.

G. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.03 INSTALLING BEARING AND LEVELING PLATES

- A. The Contractor shall clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean the bottom surface of bearing plates.
- B. Set loose leveling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if they are protruding cut off flush with the edge of the bearing plate before packing with grout.
1. Use non-shrink, metallic grout in concealed locations where not exposed to moisture; use non-shrink, nonmetallic grout in exposed locations, unless otherwise indicated.
 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.04 ADJUSTING AND CLEANING

The Contractor shall do the following:

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION

DIVISION 7

THERMAL AND MOISTURE PROTECTION

SECTION 07900
JOINT FILLERS, SEALANTS, AND CAULKING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install all caulking, sealants, joint fillers, and related work necessary for the proper completion of the project as required by the Drawings and as specified in this Section.

1.02 RELATED WORK

- A. Division 8, Doors and Frames.

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. The Contractor shall submit to the Engineer for review product data including detailed product information and colors on materials proposed and material installation methods.
- C. The Contractor shall submit for review and approval two sets of special-colored sealant samples.
- D. The Contractor shall submit for review two sets of representative samples of any or all other proposed materials required for the work of this Section as requested by the Engineer.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE SPECIFICATIONS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

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

1. ASTM C920—Specification for Elastomeric Joint Sealants
2. ASTM D395—Standard Test Methods for Rubber Property—Compression Set
3. ASTM D412—Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
4. ASTM D573—Standard Test Method for Rubber—Deterioration in an Air Oven
5. ASTM D695—Standard Test Method for Compressive Properties of Rigid Plastics
6. ASTM D790—Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
7. ASTM D1002—Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)
8. ASTM D1149—Standard Test Methods for Rubber Deterioration-Cracking in an Ozone Controlled Environment
9. ASTM D1708—Standard Test Method for Tensile Properties of Plastics by Use of Microtensile Specimens
10. ASTM D2228—Standard Test Method for Rubber Property-Relative Abrasion Resistance by the Pico Abrader Method
11. ASTM D2240—Standard Test Method for Rubber Property—Durometer Hardness

B. Federal Specifications

1. FS-HH-F-34I—Fillers, Expansion Joint; Bituminous (Asphalt and Tar) and Nonbituminous (Preformed For Concrete)

C. Sealants and Waterproofers Institute (SWI)

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

- B. The Contractor shall deliver materials in the manufacturer's original unopened and undamaged packages with labels legible and intact. The Contractor shall store and handle materials in accordance with the manufacturer's instructions.

1.09 QUALIFICATIONS (NOT USED)

PART 2 PRODUCTS

2.01 MATERIALS

A. Caulking

1. Standards

- a. SWI
- b. ASTM C920

- 2. All colors for caulking above grade in the superstructure of the building shall be approved by the Engineer.
- 3. Exterior and interior sealant for joints on the horizontal plane shall be a two-part, pour-grade polyurethane base, ASTM C920-87 Type M, Grade P, Class 25, THC-900 by Tremco; Sonolastic SL2 by Sonneborn; or equal. Primer shall be as recommended by the manufacturer.
- 4. Exterior and interior sealant for joints on all other surfaces shall be a one-part, gun-grade polyurethane ASTM C920-87 Type S, Grade NS Class 25, Dymonic by Tremco; Sonolastic NP1 by Sonneborn; or equal. Primer shall be as recommended by the manufacturer.
- 5. Joint backing for joints in superstructure shall be approved closed-cell polyethylene rods of diameters to suit joint conditions. Where joint depth will not allow for a rod and still, provide 1/4-inch minimum depth of sealant. Provide approved bond breaker tape at the bottom of the joint.

- B. Compressible filler shall be foamed polyurethane strip saturated with polybutylene waterproofing material. When compressed to 50% of its original volume, filler shall hold a head of 6 feet of water and a head of 10 feet of water when compressed 60%. Filler shall maintain its resiliency to allow for installation in temperatures as low as 40°F. Filler shall remain waterproof at 50% compression between temperatures of -40°F and 200°F. Elongation shall be at least 325% with a tensile strength of not less than 53 psi.

1. The polybutylene compound shall not migrate in the polyurethane strip. Compressible filler shall be Polytite by Sandell Manufacturing Company; Combriband by Secoa Corporation, Division of Phoenix Building Products, Incorporated; or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation of Caulking

1. Caulk all exterior wall joints, between adjacent materials, joints between frames or louvers and adjacent materials, copings, masonry contraction joints, and all other joints shown on the Drawings or required for the completion of the work. Joints noted as "caulk," "caulking," or "sealant" shall be caulked as specified in this Section.
2. Caulk all interior joints between frames and masonry, at tops of masonry walls, between masonry and structural concrete, floor joints in tile, joints in rooms to be airtight, and all other joints shown on the Drawings or required for the completion of the work.
3. All joints to receive sealant shall be cleaned, primed, backfilled, and caulked in complete accordance with the manufacturer's instructions.
4. Sealant shall be applied generally to a square section configuration. Minimum depth of joint shall be 1/4-inch and maximum 1/2-inch. For joints greater than 1/2-inch wide, provide sealant in a 2 to 1 width-to-depth ratio.
5. The surfaces of all materials adjoining caulked joints shall be cleaned free of all smears of sealant or other soiling due to caulking operations.

B. Installation of Compressible Filter

1. Install compressible filler as shown on the Drawings.
2. Install compressible filler according to the manufacturer's written instructions for the situation where it is used.

END OF SECTION

DIVISION 8
DOORS AND WINDOWS

SECTION 08110
STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and deliver the following as shown on the Drawings and as specified in this Section:
1. Steel hollow-metal doors.
 2. Pressed-metal door.
 3. All fasteners, frame closure pieces, system reinforcing, and appurtenances required.
 4. Door louvers when shown on the Drawings.
 5. Doors, frames, and components shall be galvanized steel.

1.02 RELATED WORK

- A. Section 09900, Painting and Coating.

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. The Contractor shall submit to the Engineer shop drawings of all metal doors, frames, and appurtenances. Shop drawings shall show each door and frame type, schedule of doors and frames, door and frame elevations and details, conditions at openings with various wall thicknesses and materials, location and installation requirements for hardware, thickness of materials, joints, connections and trim, and frame anchorage meeting Code requirements.
1. The Contractor shall provide to local authorities, if required, the manufacturer's anchorage details meeting project design loads and specific Code requirements for this jurisdiction for door frames submitted.

- C. Hardware templates shall be furnished to the door manufacturer by the Hardware Supplier for correct hardware alignment and reinforcing.
- D. The Contractor shall submit to the hardware supplier the requirements of any hardware for exterior doors that is necessary to be a component of the door system to conform to the Florida Building Code and local amendments.
- E. The Contractor shall submit to the glazing supplier the requirements of any glazing for exterior doors that is necessary to be a component of the door system in order to conform to the Florida Building Code and local amendments.
- F. Evidence of compliance with the requirements of Article 1.06 Regulatory Requirements shall be included with the initial submittal for the products.
- G. The Contractor shall provide samples and certification as follows:
 - 1. Frame corner with 6-inch-long legs showing construction with the galvanized material specified, welding, touch-up, and priming.
 - 2. Door panel corner, 6-inch square, showing door and insulating materials, construction, and finishing as specified above.
 - 3. Provide certification as approved that all materials, construction requirements, and fire ratings specified in this Section will be met in the project.
 - 4. If required by the Engineer, provide independent laboratory testing, conforming to ASTM E376, of galvanized coating on samples of the door and frame submitted for approval to confirm thicknesses of zinc on base metal.
- H. The Contractor shall provide copies of current, valid statewide product approval for product, material, or systems specified in this Section and on the Drawings, in accordance with Rule 9B-72. Product approval shall be for the specific manufacturer, product type, model, or style. If an "equal" product is submitted by the successful Contractor, the Contractor shall be responsible for filing the appropriate Product Approval information with the local authority having jurisdiction.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A153—Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 2. ASTM A653—Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM A924—Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 4. ASTM E376—Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Examination Methods.
- B. American National Standards Institute (ANSI)
 - 1. ANSI A115—Specification for Preparation of Steel Doors and Frames for Hardware.
- C. National Fire Protection Association (NFPA)
 - 1. NFPA Standard No. 80—Fire Doors and Windows.
- D. Underwriters Laboratories, Inc. (UL)
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

- A. The Contractor shall provide custom hollow metal work manufactured by a single firm specializing in the production of this type of work. Hollow metal work shall conform to Hollow Metal Manufacturers Association (Division of National Association of Architectural Metal Manufacturers) standards for commercial hollow metal doors and frames except where more stringent requirements are specified in this Section.

- B. Provide custom hollow metal work by one of the following or equal:
1. Firedoor of Florida.
 2. Curries Hollow Metal.
 3. Or Equal.
- C. Provide fire-rated hollow metal frames investigated and tested as fire door assemblies, complete with type of fire door hardware to be used. Identify each fire door and frame with Underwriters Laboratories labels, indicating applicable fire rating of both door and frame. Construct assemblies to comply with NFPA Standard No. 80 and as specified in this Section.
- D. The products, materials, and assemblies, including anchorage, proposed for the work of this Section shall comply with project-specific calculated design pressures and to the Florida Building Code, including wind-borne debris region requirements, and shall be designed by the manufacturer and installed by the Contractor to meet these requirements. Refer to project design pressures in the components and cladding table on the structural drawings. Where a conflict occurs between the requirements of this Specification and the Code, the more stringent requirement shall apply.
- E. The Drawings and Specifications list the approved products, materials, or systems specified for use in this Section. For substitutions, it shall be the sole responsibility of the Contractor to provide evidence of code compliance for any product, material, or system not listed. It shall be the responsibility of the Contractor to obtain the required Local Product Approval for the product, material, or system by demonstrating the product's compliance with the Florida Building Code, using one of the methods outlined in Chapter 9B-72 of the Department of Community Affairs, Florida Building Commission.

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. The Contractor shall deliver materials in the manufacturer's original unopened and undamaged packages with labels legible and intact. Doors and panels shall be individually wrapped in corrugated cardboard with wood strips on vertical edges

and banded with metal straps. Store materials in unopened packages so as to prevent damage from the environment and construction operations. Handle in accordance with the manufacturer's instructions.

1.09 QUALIFICATIONS (NOT USED)

PART 2 PRODUCTS

2.01 MATERIALS

- A. All exterior doors and components shall be designed by the manufacturer and installed by the Contractor to withstand wind pressures, both positive and negative, and salient corner conditions as calculated in accordance with the Florida Building Code to withstand the wind load required by the Florida Building Code.
- B. At no additional cost to the Owner, provide additional, non-standard door bracing reinforcements or heavier gauge materials required to conform to wind load and the requirements of Articles 1.06 and 2.01.A of this Section.
- C. Doors, frames, and components shall be galvanized steel.
- D. Galvanized steel sheets—Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A653, with ASTM A924, G60 zinc coating, mill phosphatized.
- E. Zinc-rich touch-up primer—95% metallic zinc dust primer in a vehicle compatible with the specified painting system.
- F. Supports and anchors—Fabricate of not less than 16-gauge sheet metal. Galvanize after fabrication units complying with ASTM A153, Class B.
- G. Inserts, bolts, and fasteners—Hot-dip galvanize, complying with ASTM A153, Class C or D as applicable.
- H. Rust-inhibitive primer—Air drying or baking type approved as compatible with epoxy finish paints. Provide non-standard primer if required to obtain approval for compatibility.

2.02 FABRICATION

- A. Fabricate metal units to be rigid, neat in appearance, and free from defects, warp, or buckle. Accurately form metal to required sizes and profiles. Fit and assemble units in the manufacturer's plants including units which are approved to be

partially disassembled and field spliced. Weld exposed joints continuously; grind, dress, and make smooth, flush, and invisible. Metallic filler to conceal manufacturing defects is not acceptable. Clearly identify work that cannot, where approved, be permanently factory-assembled before shipment to ensure proper assembly at the project site.

- B. Exposed fasteners—Unless otherwise indicated, provide countersunk flat phillips heads for exposed screws and bolts.
- C. Prepare metal units to receive mortised and concealed finish hardware, including cutouts, reinforcing, drilling, and tapping in accordance with the final Finish Hardware Schedule and templates provided by the hardware supplier. Comply with applicable requirements of ANSI A115 series specifications for door and frame preparation for hardware.
- D. Reinforce metal units to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.
- E. Shop Painting—Clean, treat, and paint exposed galvanized surfaces of fabricated metal units.
 - 1. Clean steel surfaces of mill scale, rust, oil, grease, and other foreign materials and apply approved zinc-rich primer to galvanized surfaces damaged in fabrication.
 - 2. Apply pretreatment to cleaned metal surfaces, using cold phosphate solution or hot phosphate solution.
 - 3. Apply one full shop coat of rust-inhibitive primer within time limits recommended by the pretreatment manufacturer. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 2.0 mils.

2.03 DOORS

A. General

- 1. Provide flush design doors, 1-3/4-inch thick, seamless hollow construction, unless otherwise indicated.
- 2. For single-acting swing doors, bevel both vertical edges 1/8-inch in 2 inches.

3. Provide filler of mineral-wool or other approved insulating material solidly packed full door height to fill voids between inner core reinforcing members. No asbestos products will be allowed.

B. Galvanized Steel Doors

1. Fabricate doors of two outer galvanized stretcher-leveled steel sheets not less than 16 gauge. Construct doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges. Provide weep hole openings in the bottom of doors to permit escape of entrapped moisture.
2. Reinforce inside of doors with vertical galvanized sheet steel sections not less than 22 gauge. Space vertical reinforcing 6 inches on center (o.c.) and extend full door height. Spot-weld at not more than 5 inches o.c. to both face sheets.
3. Reinforce tops and bottoms of doors with 16-gauge horizontal steel channels welded continuously to outer sheets. Close top and bottom edges to provide seal as integral part of door construction while providing recesses for required hardware and appurtenances.

C. Finish hardware reinforcement—Reinforce doors using galvanized steel for required finish hardware, as follows:

1. Hinges—Steel plate 3/16-inch thick by 1-1/2-inch wide by 6-inch longer than hinge, secured by not fewer than six spot-welds.
2. Mortise locksets and dead bolts: 14-gauge steel sheet, secured with not fewer than two spot-welds.
3. Cylinder locks—12-gauge steel sheet, secured with not fewer than two spot-welds.
4. Flush bolts—12-gauge steel sheet, secured with not fewer than two spot-welds.
5. Surface-applied closers—12-gauge steel sheet, secured with not fewer than six spot-welds.
6. Push plates and pull handles—16-gauge steel sheet, (except when through bolts are shown or specified), secured with not fewer than two spot-welds.
7. Other required comparable reinforcements as submitted and approved.

2.04 FRAMES

- A. Provide pressed metal frames for doors, side-lights, borrowed lights, and for other openings, where shown, of size and profile as indicated.
- B. Fabricate frames of full-welded unit construction, with corners mitered, reinforced, and continuously welded full depth and width of frame. No field spliced frames will be allowed.
- C. Form frames of 14-gauge galvanized steel sheets.
- D. Finish hardware reinforcement—Reinforce frames using galvanized steel for required finish hardware, as follows:
 - 1. Hinges—Steel plate 3/16-inch thick by 1-1/2-inch wide by 6 inches longer than the hinge, secured by not fewer than six spot-welds.
 - 2. Strike plate clips—Steel plate 3/16-inch thick by 1-1/2 inch wide by 3 inches long.
 - 3. Surface-applied closers—12-gauge steel sheet, secured with not fewer than six spot-welds.
 - 4. Other required comparable reinforcements as submitted and approved.
- E. Mullions and transom bars—Provide closed or tubular mullions and transom bars where indicated. Fasten mullions and transom bars at crossings and to jambs by butt-welding. Reinforce joints between frame members with concealed clip angles or sleeves of the same metal and thickness as frame.
- F. Where installed in masonry, leave vertical mullions in frames open at top for grouting. Grout all frames in masonry walls.
- G. Jamb anchors—Furnish jamb anchors formed of not less than 18-gauge galvanized steel as required to secure frames to adjacent construction.
 - 1. Masonry construction—Adjustable, flat, corrugated, or perforated, t-shaped to suit frame size, with leg not less than 2 inches wide by 10 inches long. Provide UL-approved fixed anchors at labeled openings. Furnish at least three anchors per jamb up to 7 feet 6 inches height; four anchors up to 8 feet 0 inch jamb height; one additional anchor for each 24 inches or fraction thereof over 8 feet 0 inch height.

2. In-place concrete or masonry—Anchor frame jambs with minimum 3/8-inch diameter concealed bolts into expansion shields or inserts 6 inches from top and bottom and 26 inches o.c., unless otherwise shown. Reinforce frames at anchor locations. Apply removable stop to cover anchor bolts unless otherwise indicated.
- H. Floor anchors—Provide floor anchors for each jamb and mullion which extends to floor, formed of not less than 14-gauge galvanized steel sheet, as follows:
1. Monolithic concrete slabs—Clip-type anchors with two holes to receive fasteners, welded to bottom of jambs and mullions.
- I. Head reinforcing—For frames over 4 feet 0 inch wide in masonry wall openings, provide continuous steel channel or angle stiffener, not less than 12 gauge for full width of opening, welded to back of frame at head.
- J. Spreader bars—Provide removable spreader bar across bottom of frames, tack welded to jambs and mullions.
- K. Plaster guards—Provide 26-gauge galvanized steel plaster guards or dust cover boxes, welded to frame, at back of finish hardware cutouts where mortar or other materials might obstruct hardware installation.

2.05 DOOR AND FRAME STOPS

- A. Provide stops in frames to receive glass and doors, where indicated and as shown.
- B. Form fixed stops integral with frame unless otherwise indicated.
- C. Provide removable stops where indicated or required, on secured room side of opening, formed of not less than 18-gauge steel sheets. Secure with oval head machine screws spaced uniformly not more than 12 inches o.c. Form corners with butted hairline joints.
- D. Coordinate width of rabbet between fixed and removable stops with type of glass and type of installation indicated.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install hollow metal units and accessories in accordance with approved shop drawings, manufacturer's data, and as specified in this Section.

- B. The Contractor shall install the components of this Section to comply with the requirements of Article 1.06 of this Section.
- C. Setting masonry anchorage devices—Provide masonry anchorage devices where required for securing hollow metal frames to in-place concrete or existing masonry construction. Set anchorage devices opposite each anchor location, in accordance with details on shop drawings and anchorage device manufacturer's instructions. Leave drilled holes rough, not reamed, and free from dust and debris.
- D. Placing Frames—Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
 - 1. In new masonry construction, coordinate frame setting with and before building masonry walls. Provide the required anchors for building in place.
 - 2. At in-place concrete or masonry construction, set frames and secure in place with machine screws and masonry anchorage devices.
 - 3. Place frames at fire-rated openings in accordance with NFPA Standard No. 80.
 - 4. Remove spreader bars only after frames or bucks have been properly set and secured.

3.02 ADJUSTMENT AND TOUCH-UP

- A. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames which are warped, bowed, or otherwise unacceptable.
- B. Immediately after the doors and frames are erected, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

3.03 TESTING (NOT USED)

END OF SECTION

SECTION 08330
OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Section includes insulated and non-insulated overhead coiling doors.
- B. The Specifications are written in the imperative mode, directed to the Contractor. The Contractor is responsible for the execution of all Work and compliance with all requirements of the Drawings, Specifications, Florida Building Code, Project Wind Design Criteria, and Product Approval Schedules for all buildings. Delegation of work assignments is under the Contractor's purview, except where noted herein.

1.02 RELATED WORK (NOT USED)

1.03 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Shop Drawings: Show elevations of each door type, construction details, and methods of assembling sections; hardware locations and installation methods; dimensions and shapes of materials; anchorage and fastening methods; door frame type and details; wall opening construction details; weatherstripping; and finish requirements.
 - 1. Provide a schedule of doors and frames using the same reference numbers for details and openings as those on Contract Drawings and Schedules.
- B. Provide documentation showing that exterior doors meet wind-loading requirements.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. ASTM International (ASTM)

1. ASTM A653/A653M—Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM D3363—Standard Test Method for Film Hardness by Pencil Test.

1.06 QUALITY ASSURANCE

- A. Doors shall be designed to meet Project Wind Design Criteria per the Structural Drawings.
- B. Endlocks/windlocks shall be installed on every slat on doors over 14 feet wide.
- C. Overhead coiling doors shall be designed to a standard maximum of 10 cycles per day and an overall maximum of 25,000 operating cycles for the life of the door.
- D. All overhead coiling doors installed within a rated partition shall be constructed in accordance with the testing agency requirements.

1.07 WARRANTIES (NOT USED)

1.08 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.09 QUALIFICATIONS (NOT USED)

PART 2 PRODUCTS

2.01 ACCEPTED MANUFACTURERS

- A. Cornell Iron Works, Inc.
- B. The Cookson Company.
- C. Overhead Door Corporation.
- D. The basis of design is Cornell Iron Works, Inc.

2.02 MATERIALS AND CONSTRUCTION

- A. Curtain:
 1. Slats: No. 5F, 20-gauge, Grade 40 steel, ASTM A653 galvanized steel zinc coating.
 2. Bottom Bar: Two 2-inch-by-2-inch-1/8-inch structural steel angles.

3. Fabricate interlocking sections with high strength nylon endlocks on alternate slats each secured with two 1/4-inch rivets. Provide windlocks as required to meet specified wind load.
 4. Slat Finish:
 - a. GalvaNex™ Coating System to include An ASTM A653 galvanized base coating treated with dual process rinsing agents in preparation of a chemical bonding, light gray baked-on polyester base coat and a light gray baked-on polyester finish goat.
 5. Curtain Configuration:
 - a. Standard curtain configuration.
 6. Bottom Bar Finish:
 - a. Steel: Phosphate treatment followed by a light gray baked-on polyester powder coat; minimum 2.5 mils cured film thickness.
- B. The guides shall consist of three structural steel angles bolted together with 3/8-inch fasteners to form a channel to travel and shall include weatherstripping continuously along the exterior leg of the guide. Provide windlock bars of same material as required to meet specified wind load. The wall angle portion shall be continuous and fastened to the surrounding structure to meet specified wind load. Top of inner and outer guide angles to be flared outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar.
1. Finish: Phosphate treatment followed by baked-on polyester powder coat, to match door slats; minimum 2.5 mils cured film thickness; ASTM D3363 pencil hardness: H or better.
- C. The brackets shall be constructed of steel not less than 1/4-inch-thick and shall be bolted to the wall angle with minimum 1/2-inch fasteners.
1. Finish: Phosphate treatment followed by baked-on polyester powder coat, to match door slats; minimum 2.5 mils cured film thickness; ASTM D3363 pencil hardness: H or better.
- D. All gears shall be cast iron with teeth cast from machine cut patterns. The pinion gear shall not be less than 3-inch pitch diameter. The gear ratio shall be designed for a maximum effort of not more than 30 pounds.

- E. The hood shall be fabricated from 24-gauge galvanized steel and shall be formed to fit the curvature of the brackets. The hood shall be corrugated every 1 inch along the curvature for the entire length of the hood.
 - 1. Finish: Phosphate treatment followed by baked-on polyester powder coat, to match door slats; minimum 2.5 mils cured film thickness; ASTM D3363 pencil hardness: H or better.
- F. Weatherstripping:
 - 1. Bottom Bar, Motor Operated Doors: Weather/sensing edge with neoprene or rubber astragal extending full width of door bottom bar.
 - 2. Guides: Replaceable vinyl strip on guides sealing against fascia side of curtain.
 - 3. Lintel Seal: Nylon brush seal fitted at door header to impede air flow.
 - 4. Hood: Neoprene/rayon, waterproof baffle to impede air flow above coil.

2.03 OPERATION

- A. Electric Motor Operation: (Provide Underwriters' Laboratories (UL) listed, industrial duty, electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second.) The motor operator shall include a geared limit switch and an electrically interlocked emergency chain operator. The motor shall be housed in a NEMA 1 housing and include a magnetic reversing starter size 0, a 24-volt control transformer, and complete terminal strip to facilitate field wiring. The motor operator shall be activated by a flush mounted three-button push button station in a NEMA 1 enclosure. The motor shall be the size required by the door. All motors shall be UL listed.
- B. Weather/Sensing Edge: Provide automatic reversing control by an automatic sensing switch within neoprene or rubber astragal extending full width of door bottom bar.
 - 1. Provide an electric sensing edge device. Contact before door fully closes shall cause door to immediately stop downward travel and reverse direction to the fully opened position. Provide a self-monitoring wireless sensing edge connection to motor operator eliminating the need for a physical traveling electric cord connection between bottom bar sensing edge device and motor operator. Supervised system alters normal door