SECTION 03100
Cast-In-Place Concrete

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Part 1 General

1.01 Description of Work

Furnish and install miscellaneous cast-in-place concrete as shown and indicated on the Contract Drawings and as specified in this Section. This specification does not include structural concrete as in bridge or roadway uses.

1.02 Related References

A. The latest edition of the publications listed below form a part of these Specifications:

1. American Concrete Institute (ACI) Publications:

211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
304	Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
305R	Hot Weather Concreting
306R	Cold Weather Concreting

2. United States Army Corps of Engineers Waterways Experiment Station Publication CRD-C-621: Handbook for Concrete and Cement, Specifications for Non-shrink Grout, Volume II

3. American Association of State Highway and Transportation Officials Publication M 182 Burlap Cloth Made From Jute or Kenaf

4. ASTM International (ASTM) Publications:

C 31	Making and Curing Concrete Test Specimens in the Field
C 33	Concrete Aggregates
C 39	Compressive Strength of Cylindrical Concrete Specimens
C 94	Ready-Mixed Concrete
C 143	Slump of Portland Cement Concrete
C 150	Portland Cement
C 172	Sampling Freshly Mixed Concrete
C 173	Air Content of Freshly Mixed Concrete by the Volumetric Method
C 231	Air Content of Freshly Mixed Concrete by the Pressure Method
C 260	Air-Entraining Admixtures for Concrete
C 494	Chemical Admixtures for Concrete
C 595	Blended Hydraulic Cements

1.03 Submittals

A. Contractor shall be responsible for timely submittals to the Owner's Representative.

B. The following submittals shall be provided for filling/plugging the Pond D outlet pipe:

1. Filling Plan. A plan detailing the Contractor's concrete mix equipment, setup, procedure, sequencing, plan for handling waste, method for communication, and

method for sealing and bulkheading upstream and downstream should be submitted to the Owner's Engineer prior to initiation of the filling operations. The watertight bulkhead must be capable of resisting the loads from the grout or concrete.

2. Concrete Mixtures. Documentation of adequate strength and flow from the planned mixture should be submitted to the Owner's Engineer prior to initiation of the filling operations.

Part 2 Products

2.01 Cement

Cement shall be standard Portland cement of American manufacture, conforming to ASTM C 150, Type I. Only one brand of commercial Portland cement shall be used in the exposed concrete of the structure. Cement reclaimed by cleaning bags or from leaking containers shall not be used.

2.02 Concrete Aggregates

A. Fine aggregate shall be sand having clean, hard, durable, uncoated grains and free from deleterious substances and shall conform to ASTM C 33.

B. Coarse aggregate shall be crushed stone having clean, hard, durable, uncoated particles conforming to ASTM C 33.

2.03 Water

Water used in mixing concrete shall be clean, potable, and free from deleterious amounts of acids, alkalis, or organic materials.

2.04 Admixtures

A. Water reducing admixture shall conform to ASTM C 494, Type A.

B. Water reducing, retarding admixture shall conform to ASTM C 494, Type D.

C. Non-Corrosive, Non-Chloride Accelerator: The admixture shall conform to ASTM C 494, Type C.

D. Air entraining admixture shall conform to ASTM C 260.

E. High range water reducer (HRWR) shall conform to ASTM C494, Type F or G.

F. Calcium Chloride: Calcium chloride or admixtures containing more than 0.1 percent chloride ions are not permitted.

Part 3 Execution

3.01 Concrete Quality

A. Mix designs other than pipe filling concrete shall be proportioned in accordance with ACI 211.1. The proportioning shall be based on the requirements of a well-graded high density plastic and workable mix within the slump range and strengths required. The following class of concrete is required:

Class of Concrete	Compressive Strength at 28 Days	Slump Range
Virginia Department of Transportation A4	3,000 pounds per square inch	2 to 4 inches

1. Air Content: All concrete shall have an air content of 6.5 percent, +/- 1.5 percent.
2. Water-Cement Ratio: All concrete shall have a maximum water-cement ratio of 0.45.
3. Admixture Usage: All concrete shall contain a water reducing admixture or water reducing-retarding admixture, and an air entraining agent. All concrete placed at air temperatures below 50°F shall contain the specified non-corrosive non-chloride accelerator.

B. Concrete for filling the outlet pipe shall be a non-shrink mix proportioned to provide a slump of about 6 to 7 inches and a compressive strength of 3,000 pounds per square inch at 28 days.

The mix shall have a water to cement ratio of 0.7:1 to 0.5:1. A grout fluidifier (ASTM C937) may be needed to promote flowability, reduce water requirements, reduce bleeding, reduce segregation, increase strength, and eliminate grout shrinkage during setting of the grout mix.

3.02 Plant Mixing

A. Proportioning Concrete

1. Proportions shall be in compliance with approved design mix for each class of concrete.
2. The mixing plant shall be provided with adequate equipment and facilities for accurate measurement and control of the quantities of material and water used in the concrete.
3. Concrete materials shall be measured by weight except that admixtures shall be measured by volume.

B. Batching

1. Ready-mixed concrete shall be mixed and delivered in accordance with requirements of ASTM C 94 and to the following:
   a. A separate water metering device (not truck tank) shall be used for measuring water added to the original batch.
   b. Use of wash water as a portion of the mixing water is not permitted. Wash water added to empty drums after discharging shall be dumped before a new batch is received.
   c. Centrally mixed concrete shall be mixed for the length of time specified herein, not "shrink-mixed".
   d. Mixing drums shall be watertight.
   e. Concrete shall be discharged within one and a half hours from the time concrete was mixed, if centrally mixed, or from time the original water was added, if transit-mixed.
   f. Furnish delivery ticket with each load of concrete delivered under these Specifications. Delivery ticket shall show clearly the class and strength of concrete, size of coarse aggregate, water per cubic yard, the slump

ordered, quantities of all admixtures, and the date and time of departure from the batching plant.

3.03 Conveying Equipment

A. If concrete is to be transported in carts or buggies, the carts or buggies shall be equipped with pneumatic tires.

B. Equipment for chuting or other methods of conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at delivery without segregation of materials.

3.04 Delivery and Protection of Materials

Deliver ready-mixed concrete in compliance with requirements set forth in ASTM C 94.

3.05 Severe-Weather Provisions

A. Hot-Weather Concreting

1. Provide adequate methods of lowering temperature of concrete ingredients so that the temperature of concrete when placed does not exceed 90°F.
2. When the weather is such as to raise concrete temperature, as placed, consistently above 90°F, Pozzolith retarder shall be used.
3. Subgrade and forms shall be wetted with water before placing of concrete. All excess water shall be removed before concrete is placed.
4. Curing shall start as soon as practicable to prevent evaporation of water. Flat work shall be protected from dry winds, direct sun, and high temperatures.

B. Cold-Weather Concreting

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather. No frozen materials, or materials containing ice, shall be used.
2. All concrete materials and all reinforcement, forms, fillers and ground with which concrete is to come into contact shall be free from frost.
3. Whenever the temperature of the surrounding air is below 40°F and falling, all concrete placed in the forms shall have a temperature of between 70 and 80°F, and adequate means shall be provided for maintaining a temperature of not less than 70°F for 3 days, or 50°F for 5 days, or for as much more time as is necessary to insure proper curing of the concrete. If high early strength concrete is used, the requirement for maintenance of 50°F can be reduced to 3 days.
4. Use only the specified non-chloride accelerator. Calcium chloride or admixtures containing more than 0.1 percent chloride ions are not permitted.
5. Housing, covering, or other protection used in connection with curing shall remain in place and intact at least 24 hours after the artificial heat is discontinued.

3.06 Placing

A. Deposit concrete as nearly as practicable in its final position to avoid segregation due to re-handling or flowing. Do not deposit concrete on work that has partially hardened or been contaminated by foreign material, and do not use re-tempered concrete.

B. Concrete shall not be dropped more than 4 feet. For greater distances of drop, concrete shall be handled with metal chutes or tremie pipes.

C. Concrete shall be placed in layers not over 12 inches deep and each layer shall be compacted with the aid of mechanical internal-vibrating equipment supplemented by hand spading. Vibrators shall in no case be used to transport concrete. Use of form vibrators will not be permitted. Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the concrete. At least one spare vibrator shall be maintained as a relief. Provide backup power source. Duration of vibrator use shall be limited to that necessary to produce satisfactory consolidation without causing objectionable segregation. Vibrator shall not be lowered into courses that have begun to set. Apply vibrator at uniformly spaced points not further apart than the visible effectiveness of the machine.

D. Foundations shall be Seced and the concrete deposited in the dry.

E. Outlet Pipe Filling

1. Remaining outlet pipe shall be filled after Phase 3 grading has been established but prior to placement of CCM.
2. Prior to filling the pipe shall be inspected for the existence of voids, protrusions, or obstructions. The Contractor shall use a camera to complete a video inspection of the outlet pipe.
3. The existing conduit surfaces against which grout will be placed shall be free of roots, sediments, mineral deposits, loose or defective concrete, and other foreign materials. Any sediment or debris should be removed.
4. The downstream end of the pipe shall be sealed with a watertight bulkhead capable of resisting the loads from the grout or concrete.
5. Grouting equipment should be capable of continuously pumping grout at any pressure up to 50 pounds per square inch. Injection pipes for concrete should be about 5 inches in diameter.
6. Concrete shall be placed such that air will not be trapped in the pipe. Tremie or alternate method should be used to distribute the grout in the outlet pipe.
7. After the concrete has set, the bulkhead(s) shall be removed, as appropriate.

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