

SECTION 03300

CAST-IN-PLACE CONCRETE

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Diversion Chamber.
- B. Concrete Headwall.
- C. Inlet Control Structure.
- D. Outlet Works.
- E. Pump Station Inlet Structure.
- F. Outlet Control Structure/Pump Station.
- G. Water Level Control Structure.
- H. Wetland Control Structure.
- I. Upstream Concrete Headworks.
- J. Downstream Concrete Headworks.
- K. Control, and Expansion and Contraction Joint Devices Associated with Concrete Work, Including Joint Sealants.
- L. Thrust blocks.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 03100 - Concrete Formwork: Placement of joint device in formwork.

1.3 RELATED SECTIONS

- A. Section 01039 – Coordination and Meetings.
- B. Section 01300 – Submittals.
- C. Section 01400 - Quality Control.
- D. Section 02110 – Site Clearing.
- E. Section 02140 – Dewatering.
- F. Section 02660 – Water Distribution.
- G. Section 02722 – Storm Sewerage Systems.

- H. Section 03100 - Concrete Formwork: Formwork and accessories.
- I. Section 03200 - Concrete Reinforcement.
- J. Section 03370 - Concrete Curing.
- K. Section 05500 – Metal Fabrications.
- L. Section 15100 – Gates.

1.4 UNIT PRICE MEASUREMENT AND PAYMENT

- A. Diversion Chamber:
 - 1. Basis of Measurement: At the lump sum unit price as stated in the proposal.
 - 2. Basis of Payment: Includes equipment, material, labor, and dewatering necessary to construct the diversion chamber complete as indicated in the plans.
- B. Concrete Headwall:
 - 1. Basis of Measurement: At the lump sum unit price as stated in the proposal.
 - 2. Basis of Payment: Includes equipment, material, labor, and dewatering necessary to construct the headwall complete as indicated on the plans. Including but not limited to rebar, I-beams, tie rods, formwork, and all material necessary for construction of headwall, wing wall, apron, and knee wall.
- C. Inlet Control Structure:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all equipment, material, labor, and dewatering necessary to construct the inlet control structure complete as indicated on the plans. Including but not limited to gates, gate actuators, stop log systems, cobblestone, upstream sedimentation basin excavation, rebar, I-beam, tie rods, formwork, mechanical systems, and all material necessary for construction of inlet control structure.
- D. Outlet Works:
 - 1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all equipment, material, labor, and dewatering necessary to construct the outlet works complete as indicated in the plans. Including but not limited to rebar, cobblestone, staff gauges where indicated, I-beam, tie rods, formwork, energy dissipation basin excavation, flapgates where indicated, and all material, equipment and work necessary for construction of the outlet works.
- E. Inlet Works:
 - 1. Basis of Measurement: At the unit lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all equipment, material, labor, and dewatering necessary to excavate and construct the inlet works as shown on the plans. Including but not limited to rebar, I-beams, formwork, concrete, mechanized systems, pumps and material necessary for construction of the inlet works.
- F. Outlet Control Structure / Pump Station:
 - 1. Basis of Measurement: At the unit price bid per lump sum as stated in the proposal.

2. Basis of Payment: Includes all equipment, material, labor, and dewatering necessary to excavate and construct the outlet control structure/pump station as shown on the plans. Including but not limited to rebar, I-beams, form work, concrete, mechanized systems, pumps and material necessary for construction of the outlet control structure/pump station.
- G. Water Level Control Structure
1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 2. Basis of Payment: Includes all equipment, material, labor, and dewatering necessary to construct the water level control structure complete as indicated on the plans. Including but not limited to pipe, end sections and fittings, concrete headwalls where indicated, precast concrete structures, stop log systems, rebar, I-beam, tie rods, formwork, grates, hatches, and all material necessary for construction of water level control structure.
- H. Wetland Control Structure
1. Basis of Measurement: At the lump sum price bid as stated in the proposal.
 2. Basis of Payment: Includes all equipment, material, labor, and dewatering necessary to construct the wetland control structure complete as indicated on the plans. Including but not limited to stop log systems, rebar, I-beam, tie rods, formwork, grates, hatches, and all material necessary for construction of wetland control structure.
- I. Upstream Concrete Headworks:
1. Basis of Measurement: At the unit price bid per lump sum as stated in the proposal.
 2. Basis of Payment: Includes all labor, material, equipment, and dewatering necessary to excavate and construct the upstream concrete headworks. Includes the riprap, fabric, and seeding for restoration of the area contours as indicated on the plans. Includes rebar, tie rods, formwork, and all related material for the construction of the headwall, wing wall, apron, and knee wall.
- J. Downstream Concrete Headworks:
1. Basis of Measurement: At the unit price bid per lump sum as stated in the proposal.
 2. Basis of Payment: Includes all labor, material, equipment, and dewatering necessary to excavate and construct the downstream concrete headworks. Includes the riprap, fabric, and seeding for restoration of the area contours as indicated on the plans. Includes rebar, tie rods, formwork, and all related material for the construction of the headwall, wing wall, apron, and knee wall.

1.5 REFERENCES

- A. ACI 301 – Structural Concrete for Buildings.
- B. ACI 302 - Guide for Concrete Floor and Slab Construction.
- C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- D. ACI 305R - Hot Weather Concreting.
- E. ACI 306R - Cold Weather Concreting.
- F. ACI 308 - Standard Practice for Curing Concrete.

- G. ACI 318 Building Code Requirements for Reinforced Concrete.
- H. ACI 347R - Guide to Formwork for Concrete.
- I. ANSI/ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- J. ANSI/ASTM D1190 - Concrete Joint Sealer, Hot-Poured Elastic Type.
- K. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- L. ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- M. ASTM C33 - Concrete Aggregates.
- N. ASTM C94 - Ready-Mixed Concrete.
- O. ASTM C150 - Portland Cement.
- P. ASTM C260 - Air Entraining Admixtures for Concrete.
- Q. ASTM C330 - Light Weight Aggregates For Structural Concrete.
- R. ASTM C494 - Chemicals Admixtures for Concrete.
- S. ASTM C618 - Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01300 – Submittals.
- B. Product Data: Provide data on joint devices, attachment accessories and admixtures.
- C. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent Work.
- D. Concrete mix design test reports and aggregate test reports a minimum of 35 days prior to beginning concrete work.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301.
- B. Maintain one copy of ACI 301 on Site.
- C. Acquire cement and aggregate from same source for all Work. Course aggregate shall meet the requirements of MDOT 6AA while fine aggregate shall meet requirements of MDOT Class 2A sand.
- D. Conform to ACI 305R when concreting during hot weather.

- E. Conform to ACI 306R when concreting during cold weather.

1.8 COORDINATION

- A. Coordinate Work under provisions of Section 01039 – Coordination and Meetings.
- B. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

2. PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type II cement with air entraining admixtures conforming to ASTM C260.
- B. Fine Aggregates: ASTM C33 and MDOT Class 2A.
- C. Coarse Aggregates: ASTM C33 and MDOT 6AA.
- D. Water: Clean and not detrimental to concrete.

2.2 ADMIXTURES

- A. Fiber Reinforcement: 1/2 inch polypropylene fibers by Fibermesh Company.
- B. Air Entrainment: ASTM C260; manufactured by W. R. Grace and Company or Axim Concrete Technologies.
- C. Chemical: ASTM C494, Type A - Water Reducing admixture; manufactured by W. R. Grace and Company or Axim Concrete Technologies.
- D. Fly Ash: ASTM C618.
- E. Chloride based admixtures are prohibited in reinforced concrete without written approval from Owner/Engineer.

2.3 ACCESSORIES

- A. Bonding Agent: Two component modified epoxy resin; Sikadur 32 Hi-Mod manufactured by Sika Corp., Glendale Hts., Illinois or Concsive 1001 LPL 3007 manufactured by Structural Bonding Company, Flint, MI.
- B. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days; Five Star Grout manufactured by U.S. Grout Company, Flint, MI or Sika-Grout by Sika Corporation.
- C. Epoxy Adhesive: Two component epoxy resin adhesive; Sikadur 35, Hi-Mod LV manufactured by Sika Corporation, Glendale Hts., IL (708) 924-7900.
- D. Adhesive Anchors: Hilti HVA adhesive anchoring system. Hilti adhesive anchors shall be comprised of an HEA capsule with an ASTM A193, Grade B7, HAS stainless steel rod

assembly with stainless steel ASTM F594 nuts and ANSI B18.221 (1965), Type A, plain washers under the turned element. Install per manufacturer's specifications.

- E. Floor Hardener: Lapidolith Concrete Hardener and Dustproofer, manufactured by Sonneborn Building Products, Chemrex, Inc.
- F. Manhole Steps: Shall be steel reinforced polypropylene.

2.4 JOINT DEVICES AND FILLER MATERIALS

- A. Expansion and Contraction Joint Devices: Extruded preformed neoprene compression seals as manufactured by Jeene Technology Corporation or equivalent.
- B. Sealant and Adhesive: As recommended by expansion/contraction joint device manufacturer.

2.5 CONCRETE MIX

- A. Mix and deliver concrete in accordance with ASTM C94, Alternative No. 2.
- B. Use accelerating admixtures in cold weather only when approved by the Engineer. Use of admixtures will not relax cold weather placement requirements.
- C. The use of calcium chloride is prohibited except as addressed in paragraph 2.2.
- D. Use set retarding admixtures during hot weather only when approved by Owner/Engineer.
- E. Use Type II cement with air entraining admixtures conforming to ASTM C260, air entraining portland cement shall contain a non-liquid addition conforming to the requirements of ASTM C226.
- F. Refer to schedule at the end of this Section for specific concrete mixes and locations for their use.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions under provisions of Section 01039 – Coordination and Meetings.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify that reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.2 PREPARATION

- A. Remove hardened concrete and foreign materials from the inner surfaces of the mixing and conveying equipment.
- B. Remove debris from the space to be occupied by the concrete. Secure reinforcement in position and obtain approval of the Engineer before concrete placement.

- C. Remove water from the space to be occupied by the concrete before concrete is deposited. Divert flow of water into an excavation, in order to avoid washing the freshly deposited concrete.
- D. Before depositing new concrete on or against concrete, which has hardened, roughen the hardened concrete in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface. Thoroughly clean concrete of foreign matter and laitance and saturate with water. To ensure an excess of mortar at the juncture of the hardened and the newly deposited concrete, the cleaned and saturated surfaces, including vertical and inclined surfaces, shall first be thoroughly covered with a coating of mortar or neat cement grout against which the new concrete shall be placed before the grout has attained its initial set.
- E. Unless otherwise noted, give surfaces of existing concrete against which new concrete will be placed a heavy brush coat of epoxy bonding agent. Apply in accordance with manufacturer's instructions. Submit manufacturer's instructions to Engineer prior to application.
- F. In locations where new concrete is dowelled to existing work, drill holes in existing concrete and install adhesive anchors per manufacturer's instructions as noted on the drawings.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301.
- B. Notify Owner/Engineer minimum 24 hours prior to commencement of operations.
- C. Concrete transported in a truck mixer, agitator or other transportation device shall be discharged at the job within 1-1/2 hours after the cement has been added to the water or the aggregates.
- D. When hand mixing is authorized, it shall be done on a watertight platform and in such a manner as to ensure a uniform distribution of the materials throughout the mass. Mixing shall be continued until a homogeneous mixture of the required consistency is obtained.
- E. The retempering of concrete or mortar which has partially hardened, that is, remixing with or without additional cement, aggregate, or water, will not be permitted.
- F. Ensure reinforcement, embedded parts, formed joint fillers and joint devices are not disturbed during concrete placement.
- G. Install joint fillers, primer and sealant in accordance with manufacturer's instructions.
- H. Install joint devices in accordance with manufacturer's instructions.
- I. Apply sealants in joint devices in accordance with manufacturer's instructions.
- J. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- K. Place concrete continuously between predetermined expansion, control, and construction joints.
- L. Do not interrupt successive placement; do not permit cold joints to occur.

- M. Concrete, during and immediately after depositing shall be thoroughly compacted by means of mechanical vibrators or other suitable tools approved by the Engineer.
- N. Saw cut joints within 24 hours after placing. Using 3/16 inch thick blade, cut into 1/4 depth of slab thickness.

3.4 CONSTRUCTION JOINTS

- A. Make joints in accordance with standard practice. Install water stops in joints in structures subject to hydraulic forces. Seal joints indicated on the plans or designated by the Engineer.
- B. In general, contraction control joints for large slabs shall be provided by construction joints between alternate casts. Adjoining units shall not be cast until a minimum period of 72 hours. Casts shall be arranged in sections no larger than 30 feet wide in any direction and edged with an approved edging tool unless otherwise shown on plans. False joints, where indicated on the drawings, shall be provided by grooving with an approved grooving tool. Contractor shall submit a pour sequence to the Engineer for approval prior to beginning construction.

3.5 CONCRETE FINISHING

- A. Finish concrete floor surfaces in accordance with ACI 301.
- B. Broomed Concrete Finish: Provide a broomed finish for areas such as exterior sidewalks and slabs, and as directed by the Engineer. After receiving the finish for unformed surfaces, a broomed finish shall be applied with a fiber-bristle brush in a direction transverse to the line of traffic.

3.6 CURING AND PROTECTION

- A. Cure concrete in accordance with Section 03370 - Concrete Curing.
- B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- C. Maintain concrete with minimal moisture loss at relatively constant temperature for a period necessary for the hydration of cement and hardening of concrete.

3.7 FROST PROTECTION

- A. In the event that a heavy frost or near freezing weather is forecasted (below 35 degrees), the concrete must be protected from early-age freezing when in the saturated state. After form removal, protection of all exposed concrete surfaces should continue for an additional 24 and 48 hours for air-entrained and non-air-entrained concrete respectively. The internal concrete temperature must remain at 50 degrees minimum during this protection period.
- B. Concrete should be protected from freezing and not be moist cured in the late afternoons if weather forecasts show possible freezing for that evening.

3.8 COLD WEATHER CONCRETING

- A. Placing and curing concrete for air temperatures consistently below 50 degrees falls into the category called cold weather concreting. Cold weather is defined as more than 3 consecutive days, which the average daily air temperature is below 40° F and, the air temperature is not above 50° F for more than 12 hours of a 24-hour period.
- B. Cold weather shall be determined by recent project weather conditions and future weather forecasts in advance of any concrete pour. The Engineer must verify all data.
- C. Concrete not air-entrained but maintained at 50° F in a moist condition shall have forms removed after 7 days except when cured by an accepted accelerated curing process. This process may include high-pressure steam, steam at atmospheric pressure, heat and moisture, or any other method approved by the Engineer. Accelerated curing may reduce form removal times to 72 hours.
- D. Air-entrained concrete shall have forms in place for a minimum of 72 hours regardless the type of curing.

3.9 CONCRETE PROTECTION AFTER FORM REMOVAL DURING COLD WEATHER CONCRETING

- A. Additional protection period shall be 6 days for structural elements that will receive any small early age loads, which may include self weight, and 3 days for all others. At no time shall the internal concrete temperature fall below 50° F during the protection period.
- B. At the end of the protection period, the concrete shall be gradually cooled in order that cracking does not occur due to the difference in temperature between the interior of the concrete element and the exterior surface of the concrete element.
- C. The maximum allowable temperature drop during the first 24 hours after ending the protection period is 40° F.
- D. Surface thermometers will be used to measure the temperature of the exterior concrete surface. This value will be compared to the concrete temperature prior to ending the protection period in order to assure less than a 40° F drop in 24 hours has been achieved.

3.10 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01400 – Quality Control.
- B. Provide free access to Work and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to Engineer for review prior to commencement of Work. Submittal shall include aggregate test reports and mix design test reports in accordance with ACI 301.
- D. Tests of cement and aggregates may be performed to ensure conformance with specified requirements.

- E. One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.
- F. One slump test will be taken for each set of test cylinders taken.
- G. Samples for strength tests of each class of concrete will be taken not less than once a day nor less than once for each 100 cubic yard of concrete or for each 500 square feet of surface area placed. Each sample will consist of 4 cylinders. In special cases this normal number of samples may be exceeded when, in the opinion of the Engineer, such additional tests are necessary. The Contractor, however, shall not be required to furnish for such additional tests more than 2 cubic feet of concrete from each 100 cubic yards of concrete being placed. One cylinder shall be tested when it is 7 days old; 2 cylinders shall be tested when they are 28 days old.

3.11 PATCHING

- A. Allow the Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify the Engineer upon discovery.
- C. Upon approval from the Engineer, patch imperfections in accordance with ACI 301.

3.12 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by the Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of the Engineer for each individual area.

3.13 SCHEDULE - CONCRETE TYPES AND FINISHES

- A. Concrete types and finishes shall be as follows:

Class	Min. Allowable Compressive Strength at 7 days	Min. Allowable Compressive Strength at 28 days	Max. Allowable Consistency New Water Range of Slump Content per Sack	
	(psi)	(psi)	(gal)	(in)
A	2600	4000	5½	4-2
B	2400	3500		5-2
C	1300	2000	8½	6-3

Air content 5 percent to 7 percent by volume.

- Class A - Beams, walls, slabs, and all primary structural elements.
- Class B - Curb and gutter, sidewalks, concrete fill.
- Class C - Fill under structures, mudmats, encasement for piping below adjacent to structures and encasement for floor drains, sewer inlets and similar items.

END OF SECTION