

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL:

1.01 SECTION INCLUDES

- A. The work included in this section encompasses all cast-in-place concrete structures, such as manhole bases, storm water inlets, junction boxes, headwalls and other miscellaneous structures as may be required. Specifically, this work is comprised of all labor, equipment, tools, materials, and supervision necessary to complete all cast-in-place concrete structures in accordance with the Plans or herein specified, including concrete finishing, patching, grouting, crack repair, installation of all embedments, concrete curing, and sealing of joints in liquid containing structures.

1.02 REFERENCE STANDARDS:

- A. Except as modified herein, concrete work shall conform to the requirements of ACI 318, latest revision.

1.03 SOURCE QUALITY CONTROL:

- A. Code Requirements. Unless otherwise specified herein or shown on the Plans, all work shall conform to the applicable requirements of the Uniform Building Code, latest edition.

1.04 SUBMITTALS:

- A. At least 30 days before any class of concrete is to be placed, the CONTRACTOR shall submit for approval by the ENGINEER, mix designs for each proposed mix. All mixes are to be made by testing laboratory, approved by the OWNER.

PART 2 PRODUCTS:

2.01 PORTLAND CEMENT:

- A. Portland cement shall be the domestic standard brand conforming to the requirements of ASTM C150, Type I. It shall be tested in accordance with the provisions of ASTM C150 with a tensile strength test conducted at seven days. It shall be tested at a frequency of one test for every 250 barrels of cement.

2.02 AGGREGATES:

- A. Stone aggregates shall be furnished from approved pits that are free from opaline, chert, feldspar, mica, siliceous magnesium limestone or other deleterious or reactive substances and shall conform to the requirements of ASTM C33. Fine aggregates shall pass a #4 sieve. Other requirements include:
1. Coarse aggregates shall be clean, hard, fine-grained crushed rock or washed gravel.
 2. Aggregate shall be tested in accordance with the following standards presented in Table 1.

Table 1 Aggregate Testing Standards

Test	Standard Reference	Performance Requirement
Sieve Analysis	ASTM C136	
Organic Impurities	ASTM C40	Fine aggregate shall not develop a color that is darker than the reference color.
Soundness	ASTM C88	Loss from 5 cycles shall not exceed 18% for coarse aggregate or 10% for fine aggregate.
Abrasion of Concrete Aggregate	ASTM C131	Loss after 100 revolutions shall not exceed 10-1/2%; loss after 500 revolutions shall not exceed 42%.
Deleterious Materials	ASTM C33	
Material finer than No. 200 Sieve	ASTM C117	Shall not exceed 1% for gravel or 1.5% for crushed aggregate per ASTM C33.
Reactivity Potential	ASTM C289	Ratio of silica released to reduction in alkalinity shall not exceed 1.0.

- B. Aggregate shall be tested once for every 100 cubic yards of batched concrete.
- C. All sampling and testing shall be performed by an OWNER approved testing laboratory at the expense of the CONTRACTOR (to be covered by the Testing Allowance, reference Section 01400). Additional costs caused by re-testing or re-inspection that result from faulty materials or workmanship shall be borne by the CONTRACTOR.

2.03 CONCRETE MIXES:

- A. The CONTRACTOR shall mix, place, and cure concrete that shall be of 145 pounds per cubic foot, nominal density, and that complies with the class characteristics shown in table 2.

Table 2 Class Characteristics of Concrete

	Minimum Compressive Strength after 28 days	Maximum Water-Cement Ratio	Slump Range in Inches	Min./Max. Sacks of Cement per cubic yard
A	3,000	7.0	2 - 5	5.0
B	2,500	8.0	2 - 5	4.5
C	2,000	9.0	1 - 4	4.0
D	1,000	11.0	1 - 4	2.0
G	as specified on Plans	5.50	2 - 3	6.0 / 8.0

- B. Concrete shall be ready-mixed, supplied from an off-site commercial ready mix plant approved by the OWNER. Each load will be accompanied by a bonded weightmaster's certificate listing the quantity of each concrete ingredient, admixture quantity, water content, slump, and time of loading and departure from the ready mix plant.
- C. Unless otherwise approved in advance of batching, all concrete of a single design mix for any one day's placement shall be from a single batch plant of a single supplier.
- D. Ready mix concrete shall not be held in the mixer for more than 90 minutes after the time water is added. Concrete shall not be delivered to the job site with the total specified amount of water already added. The CONTRACTOR shall withhold 2-1/2 gallons of water per cubic yard at the batch plant, so that it may be added at the job site prior to discharge from the mixer truck. Adding water at the job site shall be done under the supervision of the OWNER.
- E. The amount of water added at the job site shall be carefully adjusted so as not to exceed the maximum slumps or water cement ratios specified in Table 2. Consistency shall be measured in accordance with ASTM C143. Concrete that exceeds the maximum slump shall be rejected.

2.04 ADMIXTURES:

- A. Admixtures used on this project will all come from one manufacturer. Admixtures used in combination shall be physically and chemically compatible and shall be so certified by each admix manufacturer and by the testing laboratory that prepared the mix designs.
- B. In all Class A concrete and, at the CONTRACTOR'S option, in all Class B concrete, in amounts recommended by the manufacturer, as approved by the ENGINEER, the CONTRACTOR may use water-reducing, retarding chemical admixture conforming to ASTM C 494, Type D. The admixture shall provide the following:

1. Decrease drying shrinkage.
 2. Increase compressive strength at all ages up to 5 years.
 3. Increase flexural strength.
 4. The water cement ratio and required strengths shall be maintained as scheduled.
 5. There shall be no loss of workability resulting from a reduction in slump.
- C. Use air entrainment additive conforming to ASTM C260 as approved by the ENGINEER. Concrete subject to freezing and thawing after curing, shall contain air entrainment in accordance with ACI 318 and ACI 301, latest edition.
- D. At the CONTRACTOR's option, as approved by the ENGINEER, the CONTRACTOR may use a high range water reducing admixture (superplasticizer) conforming to ASTM C494 to increase workability.

2.05 EXPANSION JOINT MATERIAL:

- A. Expansion joint material shall be type I, preformed sponge neoprene expansion joint filler conforming to AASHTO M153.

2.06 CONCRETE JOINT SEALANTS:

- A. Concrete joints that will be immersed or intermittently immersed in water shall be sealed with Karlee Company's "Lastex M" 100 percent solids polyurethane sealant, Mameco International's Vulkem 227, Mameco International's Vulkem 45, Mameco International's Vulkem 245, Hunt's Seal Flex 227-U Special Reservoir Grade polyurethane sealant, or approved equal.
- B. The primer used prior to application of the sealant shall be that recommended by the sealant manufacturer.
- C. The back-up preformed joint filler shall consist of a closed cell polyethylene foam or equal impervious, compatible, compressible foam material recommended for retaining sealant depth in expansion joints while curing. Bitumen based or oil saturated material will not be acceptable.

- D. Bond breakers shall be polyethylene tape or equal as recommended by the sealant manufacturer to prevent adherence to the backup material.

2.07 NON-SHRINK GROUT:

- A. The CONTRACTOR shall use Masterflow 713, manufactured by Master Builders, or equal nonmetallic, non-shrinking, non-staining, premixed, water and oil resistant, high strength grout that meets or exceeds US Army Corps of Engineer standard specification CRD-C621-80.

2.08 EPOXY ADHESIVES:

- A. Epoxy adhesives used for crack repair, grouting, patching, bonding or other uses shall be manufactured by Adhesive Engineering Company, Sika Chemical Company, or equal. The CONTRACTOR shall use the products of one manufacturer. Mixing products from multiple manufacturers will not be allowed.
- B. For bonding new concrete to old concrete and for grouting metal anchors, the CONTRACTOR shall use Sika's Sikadur Hi-Mod, Adhesive Engineering Company's Concessive 1001-LPL, or equal.
- C. For patching concrete surfaces, making high strength epoxy grout or concrete, and for grouting metal anchors use Sika's Sikadur Hi-Mod LV, Adhesive Engineering Company's Concessive Structural Concrete Bonding Process System, or equal.
- D. For pressure injection or gravity feed grouting use Sika's Sikadur Hi-Mod LV, Adhesive Engineering Company's Concessive Structural Concrete Bonding Process System, or equal.

2.09 LIQUID CONCRETE CURING COMPOUND:

The curing compound shall be TLF or Clear All Resin Base by Hunt Process Company, Burke Rez-X, or equal. It shall conform to the requirements and provisions of ASTM C309 and shall not prove detrimental to the surface of the concrete.

2.10 SHEET CURING MATERIALS:

Sheet curing materials shall conform to the requirements of ASTM C171 and shall consist of waterproof paper, polyethylene film, or white burlap-polyethylene sheets. Any sheet materials selected for use shall be non-staining.

PART 3 EXECUTION:

3.01 PREPARATION BEFORE PLACING:

- A. Remove excess water from forms prior to placing concrete. Divert any flow from washing over freshly placed concrete. Remove hardened concrete, debris, and foreign materials from interior of forms and from inner surfaces of mixing and conveying equipment.
- B. Reinforcement and forms shall have been installed in accordance with the provisions of Section 03100, Concrete Formwork and Section 03200, Concrete Reinforcement. Embedded metal shall be free from old mortar, oils, mill scale, and other encrustations or coatings that might reduce bonding.
- C. Wet wood forms sufficiently to tighten up cracks and to reduce suction and maintain concrete workability.
- D. Fine grade subgrade so that it is smooth and level. Subgrade should be lightly dampened 24 hours in advance of placing. When aggregate fill bases are specified, place 30 mil plastic sheeting on the base course to retain mix fines within the mix and prevent their migration into the base course.
- E. For those surfaces to which new work is to be bonded, conform to the requirements herein specified in paragraph 3.02, Joints in Concrete. For abutting surfaces that are not to be bonded to new work, clean surfaces to remove dirt and other deleterious substances which may contaminate or interfere with the new work.

3.02 JOINTS IN CONCRETE:

- A. Locate joints in concrete where shown on the Plans or otherwise approved.
- B. Unless otherwise shown, all construction joints shall be provided with keyways. Clean and roughen contact surfaces of construction joints by removing the entire surface and exposing clean aggregate solidly embedded in the mortar matrix. Use mechanical chipping or sandblasting, or application of surface retarder followed by washing and scrubbing with a stiff broom. Cover and protect all inserts from damage. The hardened concrete shall be watered and kept wet for at least 24 hours before placing new concrete. Just prior to placing adjoining concrete, slush face of construction joints with 1:2 mix of cement and sand mixed to paint consistency.

- C. Expansion joints shall be used to relieve slab pressures where exterior slabs abut structures and where slabs abut equipment pads. They shall be provided where shown on the Plans and shall be a minimum of ½ inch in width, unless otherwise detailed. Except where sealed joints are shown or specified, provide expansion joint filler and joint sealer. The joint filler shall be held down below the level of the slab at least ½ inch. Joint sealer shall then be installed and finished flush with the slab surface.
- D. The CONTRACTOR shall make concrete pours for slabs on grade and other structural slabs in a checkerboard pattern sequence. Make concrete pours for walls in an alternating pattern sequence between indicated construction joints. In place concrete shall be cured at least seven days before placing an abutting section.

3.03 PLACING CONCRETE:

- A. The base slabs of inlets, junction boxes, headwalls, culverts, and other structures shall be placed and allowed to set before the remainder of the structure is constructed. Sidewalls shall be bonded to the base slab in accordance with the provisions specified herein in paragraph 3.02, Joints in Concrete.
- B. The top slabs of culverts and like structures may be placed monolithically with the walls, provided the walls are placed and allowed to set at least one hour, but no more than two hours shall elapse between placing the concrete in the wall and the top slab.
- C. All concrete shall be placed with the aid of mechanical vibrating equipment supplemented inside the forms. Vibrating equipment shall be of the internal type and shall maintain a speed of 6,000 impulses per minute when submerged in concrete. Vibrators shall be adequate in number of units to properly consolidate all concrete. Form or surface vibrators shall not be used. The duration of vibration shall be limited to that required to properly consolidate the concrete without causing segregation of the aggregates in the concrete. Insertion of vibrating equipment into lower layers of concrete that have begun to set shall be prohibited.
- D. Concrete shall not be allowed to drop freely for more than five feet in unexposed work, nor more than three feet in exposed work. Where greater drops are required, a tremie or other approved means shall be employed.
- E. Concrete shall not be placed when the ambient temperature is less than 40 degrees F. during the first 72 hours of the curing period, polyethylene sheeting or burlap-polyethylene blankets shall be placed in direct contact with the concrete. When concrete is placed in temperatures above 85

degrees an approved retarding agent, meeting the requirements of paragraph 2.04, Admixtures will be required in all concrete used in superstructures and top slabs of culverts.

3.04 FORM REMOVAL:

A. Forms shall be removed only with the approval of the ENGINEER and in a manner to ensure complete safety of the structure where the structure is supported on shoring. Form removal from structures shall not begin until the concrete has attained the following required compressive strengths:

1. Vertical forms shall not be removed until the concrete has set a minimum of 24 hours and has attained a minimum compressive strength of 500 psi.
2. When wall and top forms are placed monolithically, wall forms shall not be removed until the concrete has attained a minimum strength of 2,000 psi.
3. Forms for the top slab shall not be removed until the top slab has attained a minimum compressive strength of 2,000 psi.

3.05 FINISHES:

Finishes for concrete surfaces shall comply with the following:

- A. Rough Finish - Concrete for which no other finish is indicated or specified shall have fins and rough edges removed.
- B. Smooth Finish - Smooth finish shall be given to the interior of junction boxes, inlets, culverts, and other structures indicated on the Plans. Joint marks, fins, and rough edges shall smoothed off and blemishes shall be removed leaving finished surfaces smooth and unmarred subject to approval by the ENGINEER.
- C. Floor Finish - Floor finish shall be given to the floors of all inlets, culverts, and other structures, and shall be struck off true to the required grade as shown on the Plans and floated to a smooth, even finish by manual or mechanical methods. No coarse aggregate shall be visible after finishing.
- D. Rubbed Finish - All exposed surfaces of retaining walls, wing walls, headwalls, and other structures after patching and pointing has been completed, and the surface has been wetted, shall be given a first rubbing with a No. 16 carborundum stone. After the first rubbing is completed and the ground material has been evenly spread, the material shall be allowed

to reset. After sufficient aging, the surface shall be wetted and given a finish rubbing with a No. 30 carborundum stone, after which the surface shall be neatly striped with a brush and allowed to reset. On the inside surfaces of all culvert walls an area from the top of the slab, on a line 30 degrees down from vertical, to the bottom slab shall be rubbed as specified above.

- E. Building Floor Finish. Building floor shall be given a steel trowel finish and be sealed using "protecrete" by Advanced Concrete Technology, Inc., Dallas, TX "Kure-NLSeal", by Sonneborn, Minneapolis, MN or equal.
- F. The entire structure shall be left with a clear neat uniform finish, free from markings and shall be uniform in color.
- G. Sidewalk surfaces shall be given a wood float finish, a light broom finish, or may be striped with a brush as directed by the ENGINEER or shown in the Plans.

3.06 CURING:

- A. Immediately after placing or finishing, concrete surfaces not covered by forms shall be protected from loss of surface moisture for not less than four curing days. When forms are left in place they shall be kept sufficiently wet to reduce cracks in the forms and prevent the form joints from opening. If forms are removed before four curing days have transpired, the formed surface shall be protected for the remainder of the four day period. Protection and curing shall be accomplished by one of the four following methods and shall be subject to the approval of the ENGINEER:
 - 1. Water Curing - Water curing shall be effected by covering exposed surface with sheet curing materials. In the event white burlap-polyethylene sheets are used, these sheets shall be previously wetted before applying, and kept thoroughly wet during the entire curing period.
 - 2. Liquid Curing Compound - Liquid curing compound shall be applied in accordance with the recommendations of the manufacturer.

END OF SECTION