

**SECTION 03 30 00**  
**CAST-IN-PLACE CONCRETE**

**PART I - GENERAL**

1.1 WORK INCLUDED: Provide all cast-in-place concrete, complete, in place, as indicated on the Drawings, specified here-in, and needed for a complete and proper installation.

1.2.1 Throughout the progress of installation of the work of this Section, provide at least one person who shall be thoroughly familiar with the specified requirements, completely trained and experienced in the necessary skills, and who shall be present at the site and shall direct all work performed under this Section 1.2.2.2. In actual installation of the work of this Section, use adequate numbers of skilled workmen to ensure installation in strict accordance with the approved design.

1.2.2 In acceptance or rejection of work performed under this Section, the Engineer will make no allowance for lack of skill on the part of workmen.

1.2.3 Prior to all work under this Section, make all necessary arrangements with the testing laboratory. The testing laboratory shall:

- (1) Test, and furnish certified reports on:
  - (a) Proposed aggregates;
  - (b) Proposed cements, unless such testing waived by the Engineer; and
  - (c) Mixing water.
- (2) Prepare design mixes for each type of concrete, using previously tested

and approved materials. These mix designs shall be prepared under the supervision of a concrete technologist experienced in the special consideration of materials and mixes.

(3) Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the Work for each class of concrete required, and reporting to the Engineer:

- (a) Complete identification of aggregate source of supply;
- (b) Results of tests of aggregates for compliance with specified requirements;
- (c) Scale weight of each aggregate;
- (d) Absorbed water in each aggregate;
- (e) Brand, type chemistry, and physical test for each cement;
- (f) Brand, type, and amount of each admixture;
- (g) Amounts of water used in trial mixes;
- (h) Proportions of each material per cu. yd.;
- (I) Gross weight and yield per cu. yd. of trial mixes;
- (j) Measured slump;
- (k) Measured air content;

4. Compressive strength developed at seven days, and 28 days, from not less than three test cylinders cast for each seven, and 28 day test, and for each design mix.

1.2.3.1 Do not begin concrete production until all mixes have been reviewed by the Engineer.

1.2.3.2 Also see other requirements for testing as stated in Part Three of this Section.

1.3 SUBMITTALS: See Section:013323

1.4 PRODUCT HANDLING

1.4.1 Protection: Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all other trades.

1.4.2 Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

**PART II - PRODUCTS**

2.1 CEMENT:

2.1.1 All portland cement shall conform to the requirements of ASTM C 150, except that 28 day strength shall be a minimum of:

- 3,000 psi for manhole bases and valve vaults.
- 3,500 psi for curbs, gutters and pavement.
- 3,500 psi for drives, garage floors, and sidewalks
- 5,000 psi for footings and retaining walls.

2.1.2 The minimum Portland Cement content shall be **six (6)** sacks per Cubic Yard of Concrete.

2.1.3 Mill tests: Furnish mill tests for all cement. The 28 day cube strength results may be submitted in a separate report but shall be related to the specific batch tested.

2.2 AGGREGATES

2.2.1 General: All aggregates shall conform to requirements of ASTM C 33, except as modified below:

2.2.2 Coarse Aggregates:

2.2.2.1 Coarse aggregate shall be crushed limestone complying with ASTM C 33, size 67.

2.2.2.2 If the Contractor demonstrates to the Engineer by tests that a finer gradation can be used with the proposed fine aggregate to produce an equal or better quality concrete, the use of the finer gradation will be approved by the Engineer when complete substantiating data is submitted and approved.

2.2.2.3 Quality comparisons will be made on compressive strength flexural strengths, workability, and drying shrinkage.

2.2.3 Aggregate sources: Provide aggregates from one source of supply only.

2.2.4 Aggregate sizes:

2.2.4.1 Maximum aggregate size shall be not larger than one-fifth of the narrowest dimension between sides of forms, one-third of the depth of slabs, nor three-fourths of the minimum clear spacing between individual reinforcing bars or bundles of bars.

2.2.3 WATER

Water used as an ingredient in concrete shall be clean, potable, and free from injurious amounts of foreign matter.

2.3.1 Maximum Water-Cement Ratio by Weight

0.45 for structures containing wastewater with over 1500 mg/l sulfates  
0.50 for structures containing wastewater with under 1500 mg/l sulfates  
0.49 for all other concrete.

The above criteria apply only when lower water cement ratio or higher strength is not required to meet 28 day compressive strength requirements specified above.

#### 2.3.2 Slump

1-inch minimum.

4-inch maximum.

3-inch maximum for footings, substructure walls of liquid containing structures, and structural foundations.

A tolerance of 1-inch above maximum will be allowed provided average for all batches or most recent 10 batches, whichever is least, does not exceed the maximum.

#### 2.4 CONCRETE ADMIXTURES

##### 2.4.1 General:

2.4.1.1 Admixtures shall conform to ASTM C 494, Type A for water-reducing and Type D for water-reducing/set-retarding.

2.4.1.2 Acceptable substitutes: The Engineer will only consider those proposed admixture substitutions which have been completely tested and reported upon by the testing laboratory in accordance with the provisions of subparagraph 1.2.3.1 above.

#### 2.5 CURING MATERIALS

2.5.1 Liquid Membrane-Forming Compounds, Liquid membrane forming compounds shall conform to AASHTO M148 with these exceptions:

2.5.1.1 The Type 2, white pigmented compound hiding power shall have an apparent

daylight reflectance of not less than 65 percent compared to magnesium oxide as determined by ASTM E-97.

2.5.1.2 The Type 1-D compound shall be colored by a red fugitive dye so that inspection may indicate complete coverage. The color must be maintained at least 4 hours after which it should gradually disappear.

2.5.1.3 When tested in accordance with OHD L-17, the curing compound shall have a water retention of at least 90 percent.

2.5.2 Sheet materials shall conform to ASTM C 171

2.5.3 Burlap cloth made from jute and weighing approximately (9 oz. per sq. yd.) for moist curing shall conform to AASHTO M 182 and shall use two layers.

## 2.6 OTHER MATERIALS

2.6.1 Prefomed expansion joint filler material shall be bituminous fiber type conforming to ASTM D 1751.

2.6.2 Waterstops shall be extruded from new stock polyvinyl chloride, ribbed, and expandable center bulb. The minimum width shall be 150 mm and minimum thickness shall be 6.4 mm.

2.7 BATCHING, MIXING, AND DELIVERY EQUIPMENT - Use transit-mixed concrete from approved batching and mixing plant. Batch, mix, and transport concrete to site in accordance with provisions of ASTM C 94.

**PART III - EXECUTION**

3.1 INSPECTION - Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 CONCRETE PLACEMENT:

3.2.1 General: Place concrete in compliance with practices and recommendations of ACI 304, and as herein specified.

3.2.2 Procedures:

3.2.2.1 Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section.

3.2.2.2 If a section cannot be placed continuously, provide construction joints as herein specified.

3.2.2.3 Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic.

3.2.2.4 Deposit concrete as nearly as practicable in its final location to avoid segregation due to re-handling and flowing.

3.2.2.5 Do not subject concrete to any procedure which will cause segregation.

3.2.2.6 Do not use concrete which becomes nonplastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials.

3.2.2.7 Remove rejected concrete from the site and dispose of it in a location approved by the Engineer for that purpose.

3.2.3 Placement schedule: Place concrete in conformance with the placement schedule to ensure an even distribution of loads throughout entire structure.

3.2.4 Concrete conveying:

3.2.4.1 Handle concrete from the point of delivery and transfer to the concrete conveying equipment, and to the locations of final deposit, as rapidly as practicable and by methods which will prevent segregation and loss of concrete mix materials.

3.2.4.2 Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit.

3.2.4.3 Keep interior surfaces of conveying equipment, including chutes and tremies, free from hardened concrete, debris, water, and other deleterious materials.

3.2.4.4 Pumps may be used only if they can pump the mix designed. Do not add fine aggregate or water to the mix to satisfy needs of a pumping device.

3.2.4.5 Use chutes or tremies for placing concrete where a drop of more than (72") is required.

3.2.4.6 Where free drop through tremies exceeds (18'-0"), use flow checking devices.

3.2.5 Placing concrete in forms:

(1) Deposit concrete in forms in horizontal layers not deeper than (24"), and to avoid inclined construction joints.

- (2) Where placement consists of several layers, place each layer while preceding layer is still plastic and to avoid cold joints.
- (3) Remove temporary spreaders in forms when concrete placing has reached the elevation of such spreaders.
- (4) Do not place concrete in supporting elements until the concrete previously placed in columns and walls is no longer plastic.

3.2.7 Cold weather placing: Comply with ACI 306 to protect all concrete work from physical damage and reduced strength which would be caused by frost, freezing actions, or low temperatures.

3.2.8 Hot weather placing:

3.2.8.1 When hot weather conditions exist which would seriously impair the quality and strength of concrete, place the concrete as follows:

- (1) Maintain concrete temperature at time of placement below (90 degrees F). Use chilled mixing water or chopped ice to control concrete temperature, provided the water equivalent of the ice is calculated to the total amount of water.
- (2) Cover reinforcing steel with water-soaked burlap if the steel becomes too hot. Steel temperature shall not exceed the ambient air temperature immediately prior to placement of concrete.
- (3) Wet forms thoroughly prior to placement of concrete.
- (4) Use set-control admixtures in the mix.

### 3.3 CONSOLIDATION

3.3.1 General:

3.3.1.1 Consolidate all concrete in accordance with provisions of ACI 309.

3.3.1.2 Consolidate each layer of concrete immediately after placing, by use of internal concrete vibrators supplemented by hand-spading, rodding, or tamping.

3.3.1.3 Do not use vibrators to transport concrete inside the forms.

3.3.1.4 During all phases of operation, maintain a frequency of not less than 10,000 vibrations per minute per internal vibrator.

3.3.1.5 Do not vibrate forms or reinforcement.

3.3.2 Equipment:

3.3.2.1 Provide adequate number of units and power source at all times. Maintain spare units on hand to ensure adequacy.

3.3.2.2 If, in the opinion of the Engineer, the equipment being used is not adequate to accomplish proper consolidation, the Engineer may order delay in further placement of concrete until such equipment is available for use at the location of placement of concrete.

3.3.3 Preparation of Subgrade for Slabs on Ground - Insure that the subgrade is well drained and compacted. Verify that in-place density of the subgrade soils is at least the minimum required in the specifications. The bottom of an undrained granular base course shall not be lower than the adjacent finished grade.

3.3.4 Insure that the subgrade is free of frost before concrete placing begins. If the temperature where concrete is to be placed is below freezing, raise and maintain above 50 degrees Fahrenheit long enough to remove all frost from the subgrade.

3.3.5 Insure that the subgrade is moist at time of concreting. If necessary, dampen

with water in advance of concreting, but not to the extent that free water is standing on the subgrade nor any muddy or soft spots exist when the concrete is placed.

### 3.4 JOINTS

#### 3.4.1 Construction joints:

3.4.1.1 Horizontal construction joints will not be permitted except as may be shown on the Drawings.

3.4.1.2 If construction joints necessary for the progress of the work are not shown on the Drawings, show them in complete detail on the Shop Drawings required under Paragraph 1.3.3.

3.4.1.3 For slabs on grade, locate the joints in a manner to divide the slab into areas not in excess of 600 sq. ft., with one dimension being not greater than 120% of the other dimension.

3.4.1.4 Provide keyways at least 1-1/2" deep in all construction joints in walls, slabs, and between footings and walls.

3.4.1.5 Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints.

### 3.5 CONCRETE FINISHING

#### 3.5.1 Finish of formed surfaces:

##### 3.5.1.1 Rough form finish:

- (1) Provide as-cast rough form finish to formed concrete surfaces that are to

be concealed in the finish Work or by any other construction.

(2) Standard rough form finish shall be the concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched, and all fins and other projections exceeding 1/4" in height rubbed down or chipped off. 3.5.1.2 Smooth form finish:

(3) Provide as-cast smooth form finish for formed concrete surfaces that are to be exposed to view, or that are to be covered with a coating material other than cement plaster applied directly to the concrete.

(4) Produce smooth form finish by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrically with a minimum of seams.

(5) Repair and patch defective areas with all fins and other projections completely removed and smoothed.

3.5.1.3 Related unformed surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a smooth troweled finish.

3.5.2 Not Applicable

### 3.6 CURING AND PROTECTION

3.6.1 General - Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury. Assure minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete.

3.6.2 Preservation of Moisture - For concrete surfaces not in contact with forms, utilize one of the following procedures shall be applied immediately after completion of placement and finishing:

-Ponding or continuous sprinkling.

- Application of absorptive mats or fabric kept continuously wet.
- Application of sand kept continuously wet.
- Continuous application of steam (not exceeding 150 degrees Fahrenheit) or mist spray.
- Application of waterproof sheet materials, conforming to "Specifications for Waterproof Sheet Materials for Curing Concrete" (ASTM C171).
- Application of other moisture-retaining covering as approved.
- Application of a curing compound conforming to "Specification for Liquid Membrane-forming Compounds for Curing Concrete" (ASTM C309).

Apply compound in accordance with the recommendations of the manufacturer immediately after any water sheen after finishing has disappeared from the concrete surface. Do not use any surface against which additional concrete or other material is to be bonded unless it is certified that the curing compound will not prevent bond, or unless positive measures are taken to remove it completely from areas to receive bonded applications. Where "Hardener" is indicated or scheduled, cure and seal with material recommended by hardener manufacturer. Do not use compounds which would discolor the surface. Apply sealers in accordance with manufacturer's instructions.

3.6.3 Minimize moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by the sun by keeping the forms wet until removed. After form removal, the concrete shall be cured for time period below by methods previously specified.

3.6.4 Cure all concrete for at least 7 days. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, moisture retention measures may be terminated when the average compressive strength has reached 70 percent of the specified strength, f'c. Moisture retention measures may also be terminated when the temperature of the concrete is maintained at least 50 degrees Fahrenheit for the same length of time that laboratory-cured cylinders, representative of the concrete in-place, require to achieve 85 percent of f'c. If one of the curing

procedures previously specified is used initially, it may be replaced by one of the other listed methods after the concrete is 1 day old and the concrete is not permitted to become surface dry during the transition.

3.6.5 Cold Weather - When the mean daily outdoor temperature is less than 40 degrees F, the temperature of the concrete shall be maintained between 50 and 70 degrees F for the specified curing period. Arrange for heating, covering, insulating, or housing the concrete work in advance of placement and maintain the required temperature. Prevent damage from concentration of heat. Do not use combustion heaters during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide. Heated enclosures shall be strong and windproof to protect corners, edges and thin sections. Do not permit heating units to locally heat or dry the concrete. Do not use combustion heaters during the first 24 hours unless the concrete is protected from exposure to exhaust gases which contain carbon dioxide.

### 3.7 REINFORCING STEEL

3.7.1 General - Remove all mud, oil, loose rust or mill scale and other foreign materials that may reduce bond prior to placing concrete. "Tight" rust or mill scale will be permissible without cleaning or brushing, provided weights and dimensions are not less than the minimum specified. Conform to ACI 301, Chapter 5.

3.7.2 Bar Supports - Support and fasten all reinforcement to prevent displacement by construction loads or the placing of concrete. Reinforcement supported from the ground shall rest on precast concrete blocks not less than 4 in. square, and having a compressive strength equal to the specified compressive strength of the concrete being placed.

3.7.3 Reinforcement supported from form work shall rest on bar supports and spacers made of concrete, metal, plastic, or other approved materials.

3.7.4 Splices - Bars up to No. 11 in size may be spliced by overlapping them and wiring them together. The length of lap shall be sufficient to transfer the entire computed stress from bar to bar without exceeding three-fourths the allowable bond stress. (Ref. ACI 318 Sec. 7.6, 7.7)

3.7.5 Materials - Deformed Billet Steel ASTM - A615 Grade 60.

END OF SECTION