

STANDARD SPECIFICATIONS  
SECTION 03300  
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 DESCRIPTION

- A. Section includes requirements for providing normal weight cast-in-place concrete to sizes and shapes shown.
  - 1. See other Sections of Specifications for concrete used for other than normal weight cast-in-place concrete and for pipes and precast concrete.

1.2 QUALITY ASSURANCE

- A. Field Requirements
  - 1. Obtain and maintain on site a copy of ACI 301, ACI 347, ACI 350, and appropriate documents referred to therein.
  - 2. Furnish materials and labor; make cylinders for reinforced concrete.
  - 3. Provide visual means of identification of reinforcing steel, size, strength, and specification designation, and welded wire fabric designation, following CRSI Manual of Standard Practice.

1.3 SUBMITTALS

- A. Submit following Section 01330.
  - 1. Certified concrete mix design for each strength following ACI 301 and ACI 211. Include dry weight of ingredients and volume of water per cubic yard of concrete.
  - 2. Source of fly ash and mix design for flowable fill.
  - 3. Shop drawings showing reinforcing steel prepared following ACI 315, including bar lists and bending diagrams, placement drawings, and special details.
  - 4. Drawings showing location, types, and details of joints.
  - 5. Sequence of pours.
    - a. Calculations showing concrete strength to be attained at proposed time of removal of formwork, falsework, and centering.
- B. Submit following Section 01450 before delivery of materials.
  - 1. Certified Test Reports:
    - a. Admixtures.
    - b. Aggregate.
    - c. Cement with percentage of alkali ( $\text{Na}_2\text{O}$ ).
    - d. Copy of ASTM C1260 test with percentage of expansion due to Alkali Silica Reaction (ASR) when alkali content in cement exceeds 0.6 percent.

- e. Fly ash for flowable fill showing chemical analysis, including quantity of calcium as CaO and analytical Toxicity Characteristic Leaching Procedure (TCLP) data, establishing that fly ash is not hazardous, following 40 CFR 261.
- C. Submit certified delivery tickets for concrete furnished.
1. Name and location of batch plant and name of plant inspector.
  2. Ticket number.
  3. Load number (batch number).
  4. Date and truck number.
  5. Destination including name and location of WSSC contract.
  6. Concrete type and class (strength) and design mix designation.
  7. Actual quantities of all materials including admixtures and amount of concrete in cubic yards.
  8. Time at which mixer drum was charged with cement.
  9. Amount of free moisture by percentage of permissible mixing water in aggregates, and maximum amount of mixing water that can be added at job site to obtain specified water to cement ratio.
  10. Blank space for initials of on-site receiving party.
  11. Time of arrival of concrete or flowable fill truck on site.
  12. Time of concrete or flowable fill placement.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Reinforcement.
1. Reinforcing Bars: Unless otherwise indicated, ASTM A615, with minimum yield strength of 60,000 psi.
  2. Welded Wire Fabric: ASTM A185, size and spacing of wires following Drawings.
  3. Reinforcing Accessories: CRSI Manual of Standard Practice.
- B. Rapid Hardening Grout: Quick-setting Non-Shrink Grout: ASTM C928:
1. Approved Products:
    - a. IPA Systems Inc., Octocrete.
    - b. Tamms Industries Co., Speedcrete Blue Line.
    - c. Preblend Products, Inc., Blendcrete.
    - d. National Permacrete Company, Inc., Permacrete.
    - e. Chesco Creative Products, Cempatch II.
    - f. Kaufman Products, Inc., HiCap 15.
- C. Non-Shrink Grout: Dry Pack Under Structure Steel and Equipment: ASTM C1107.
1. Approved Products:
    - a. Degussa Admixtures, Inc., Masterflow 713 grout.
    - b. Five Star Products Inc., Five Star Grout.
    - c. Euclid Chemical, NS Grout.

d. Or equal.

D. Appurtenant Materials:

1. Vapor Barrier:
  - a. Building Paper: FS-UU-B-790A.
  - b. Polyethylene Sheeting: ASTM D2103, 6 mil thick.
2. Curing Materials:
  - a. Non-staining, Clear, or Translucent Curing Compounds: ASTM C309 over all concrete surfaces to remain permanently exposed.
  - b. Curing Compound for Concrete Surfaces to be Covered or Hidden from View: ASTM C309, Type 2, white pigmented.
  - c. Sheet Materials for Curing: ASTM C171.
  - d. Burlap Cloth Made From Jute or Kenaf For Curing: AASHTO M182, Class 1.
3. Expansion Joint Filler:
  - a. Filler Not Exposed To Traffic or Weather: ASTM D994.
  - b. Filler Exposed To Traffic or Weather: ASTM D1751 or ASTM D1752.
4. Temporary Wood Joint Filler:
  - a. Straight, sound strips of width and depth shown on Drawings or as approved, to produce true, straight joint edges.
  - b. Tapered slightly from face-to-back and coated with paraffin, or equivalent, to seal against moisture and to promote ready removal with forms.
5. Joint Sealer:
  - a. Hot applied: ASTM D6690.
  - b. Cold applied: ASTM C920.
6. Waterstops:
  - a. For expansion joints, unless otherwise shown on Drawings: Nine inches wide and minimum 3/8 inch thick, dumbbell type with center bulb of minimum 3/4 inch inside diameter.
  - b. For construction or control joints, unless otherwise shown on Drawings: Six inch wide and 3/8 inch thick, dumbbell type without center bulb.
  - c. Materials:
    - 1) Polyvinyl chloride: U.S. Corps of Engineers Specifications, CRD C572.
    - 2) Rubber or neoprene: U.S. Corps of Engineers Specifications, CRD C513.
  - d. Manufactured accessories at waterstop intersections: Form field splices with butt joints only following manufacturer's recommendations.
  - e. Heat-sealed field splices: Capable of developing water tightness equal to that of unspliced material and with tensile strength of not less than 50 percent of unspliced material.
7. Bonding Compound: ASTM C881.
8. Corrosion Protection for Aluminum to Be in Contact with Concrete:
  - a. Prepare, prime and topcoat surfaces to be coated following coating manufacturer's recommendations and apply 2 coats of:
    - 1) Ameron Amerlock 400 Hi-Build Epoxy.
    - 2) Tnemec Series N69 Hi-Build Epoxoline II.
    - 3) Or equal.

- b. Coating system: 10 to 16 mils DFT (dry film thickness).
- E. Cement: ASTM C150, Types I and II. Utilize Type III cement only when approved by Engineer.
- F. Formwork: ACI 347 with materials suitable for use intended and adequate to support loads within tolerances as recommended.
- G. Aggregates: ASTM C33.
- H. Fly Ash: ASTM C618, Class F.
- I. Ground Granulated Blast-Furnace (GGBF) Slag: ASTM C-989, Grade 120.
- J. Water:
  - 1. Mixing and Curing Concrete: Clean, fresh, and free from injurious substances.
  - 2. Water of Questionable Quality: Meet limits of comparison tests with distilled water following AASHTO T26.

## PART 3 EXECUTION

### 3.1 DESIGN MIX

- A. Design Strength of 28-Day Concrete:
  - 1. Minimum 4,000 psi concrete for structurally reinforced concrete work, concrete ditches, channels, slope protection, exterior work, and flatwork underfoot, including walks, steps, ramps, drives, slabs, and floors.
  - 2. Minimum 3,000 psi for non-reinforced concrete thrust blocking, water pipe cradle in casing or tunnels, and masonry cell fill.
  - 3. Minimum 2,000 psi concrete for mud mats, pipe encasement and cradle, filling voids between sewer pipes and casing or tunnel liners, and for under foundations where excavated to excessive depth.
  - 4. Minimum 2,000 psi concrete for grout with maximum size coarse aggregate not exceeding 3/8 inch.
  - 5. Minimum 94 pounds cement per cubic yard and aggregate no larger than 1-1/2 inch for lean mix concrete for filling abandoned manholes.
  - 6. 50 to 150 psi for flowable fill for filling voids between sewer pipes and casing or tunnel liners, limited site voids, soil boring voids, manholes and pipes.
- B. Mix Proportioning:
  - 1. 4,000 psi concrete: ACI 301, to produce watertight concrete resistant to naturally occurring or commonly used chemicals, and following:
    - a. Water to cement ratio: Maximum 0.45.
    - b. Minimum cement content and air entrainment:

<u>ASTM C33 Coarse Aggregate No.</u>	<u>Pounds/Cubic Yard</u>	<u>Air Entrainment</u>
467	517	5±1 percent
57 or 67	564	6±1 percent

- c. Slump: 1 inch minimum, 4 inches maximum.
2. Other concrete: ACI 301.
3. Substitution: GGBF Slag
  - a. Maximum of 50 percent of weight of cement.
  - b. Percentage: Establish by
    - 1) Importance of early strength.
    - 2) Curing temperature involved.
    - 3) Properties of other concrete materials.
  - c. Minimum percentage: Determine by performing ASTM C1260 test if alkali content of cement is higher than 0.6 percent, so expansion of test mortar does not exceed 0.1 percent
  - d. Minimum cement content and water to cement ratio: Determine on basis of combined weight of cement and GGBF slag.
4. Flowable fill: Cement, fly ash, and water.
  - a. Filler, if required: Sand and/or aggregates of 3/8 inch maximum size.
  - b. Fly ash: Maximum of 25 percent of weight of cement.

C. Admixtures:

1. Water reducing and retarding admixtures may be used with Engineer's approval. Ensure compatibility of admixtures, and if retarding admixtures are used, follow form removal procedure specified below.
2. Do not use calcium chloride without prior approval.

### 3.2 FORMWORK DESIGN AND CONSTRUCTION

- A. Design, engineer, construct, and remove formwork:
  1. Chamfer exposed concrete corners of edges not less than 3/4 inch in each dimension.
  2. Do not use removable form ties in water-retaining structures.
- B. Design and construct to support loads following ACI 347 within tolerances specified in ACI 301.
- C. Provide form coatings producing desired finish.
- D. Schedule for Removal of Forms, Falsework, and Centering:
  1. Forms, Falsework, and Centering: ACI 347.
  2. Provided concrete has attained proper design strength, and Contractor meets requirements below, Engineer will approve removal of forms, falsework, and centering for:

- a. Forms under unordinary conditions.
  - b. Concrete made with cement other than Type I or Type II.
  - c. Concrete made with GGBF slag.
  - d. Concrete made with retarders.
3. Determine concrete strength attained before removal of forms, falsework, and centering from tests of job-cured cylinders, cured under conditions not more favorable than most unfavorable conditions for portions of concrete which specimens represent.
    - a. Test following ASTM C31 except as modified herein.
    - b. Provide 3 additional cylinders for each pour or for each 1,000 square feet of form contact area, whichever is less, for testing.
      - 1) See Section 01450.
      - 2) Submit certified test report of cylinders to Engineer.
  4. Demonstrate conclusively specified strength of concrete has been attained.
    - a. After removal of forms, falsework, and centering and before attainment of design strength by concrete, do not alter loading conditions to exceed permissible stresses and deformations at attained strength of concrete.
    - b. Minimum strength level required for each cylinder: 28 days compressive strength.
  5. Immediately after forms are stripped, repair defects following ACI 301.
- E. Use of earth cuts as forms for small foundations will be permitted, provided cuts are vertical, sharp, true, and with Engineer's approval.

### 3.3 PLACING REINFORCEMENT

- A. Unless otherwise indicated, place reinforcement following ACI 301 and with concrete cover following in ACI 318.

### 3.4 PLACING CONCRETE

- A. Notify Engineer at least 24 hours before placing concrete.
  1. Place vapor barrier under slabs poured on earth, following Drawings.
  2. Wet down formwork and reinforcement before placing concrete to prevent leaching of water from concrete, but do not allow free water to stand in forms.
  3. Place concrete within 90 minutes after addition of cement, aggregates, water, and admixtures.
  4. Discard off-site concrete not placed within these time limits.
  5. Do not exceed the concrete free drop of 5 feet without use of adjustable length pipes.
  6. Locate joints where shown on Drawings and approved submittals.
  7. Seal control joints in exterior slabs.
  8. When bonding new concrete to existing, prepare for subsequent placement following ACI 301 with approved bonding compound applied and permitted to cure following manufacturer's recommendations, or as directed by Engineer.

B. Weather Conditions.

1. When air temperature has fallen to, or may be expected to fall below, 40 degrees F. during 7-day period after placement:
  - a. Protect concrete work from physical damage or reduced strength caused by frost, freezing action, or low temperatures following recommendations of ACI 306 and as specified herein.
  - b. Provide adequate means to maintain temperature, in area where concrete is being placed, at between 50 and 70 degrees F. for at least 7 days after placement.
  - c. Uniformly heat water and aggregates before mixing as required to obtain concrete mixture temperature of not less than 55 degrees F. and not more than 85 degrees F. at point of placement.
  - d. Provide temporary housings or coverings and maintain heat and protection to ensure that ambient temperature does not fall more than 30 degrees F. in 24 hours during 7-day period after placement.
  - e. Avoid rapid dry-out of concrete due to overheating, and avoid thermal shock due to sudden cooling or heating.
  - f. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - g. Ensure that forms, reinforcing steel, and adjacent concrete surfaces are entirely free of frost, snow, and ice before placing concrete.
  - h. Do not use chlorides and other materials containing antifreeze agents, or chemical accelerators, or set-control admixtures in mix designs, unless approved by Engineer in advance.
2. When Hot Weather Conditions Exist:
  - a. Place concrete following recommendations of ACI 305 and as specified herein.
  - b. Cool ingredients before mixing to maintain concrete temperature at time of placement below 80 degrees F. when temperature is rising and below 85 degrees F. when temperature is falling.
  - c. Cover reinforcing steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedment in concrete.
  - d. Do not place concrete when hot weather conditions will cause difficulty from loss of slump, flash set, or cold joints.
  - e. Do not use set control admixtures in mix designs unless approved by Engineer in advance.

### 3.5 CURING AND PROTECTION

- A. Method of Curing and Protection: Follow ACI 301 and as required elsewhere in Contract Documents.
- B. Protect structural floors left exposed to atmosphere for more than 3 days by polyethylene covering, dampened burlap, straw, or equivalent materials, as required to control hydration.

- C. During hot and cold weather, cure and protect concrete as required for placing concrete herein.
- D. Cure unreinforced concrete formed with earth, wood, or metal for thrust blocks, joint encasements, pipe encasements, and cradles for at least 2 hours before placing backfill.

### 3.6 FINISHES

- A. Method of Finishing: Follow ACI 301 and as required elsewhere in Contract Documents.
- B. Where not shown on Drawings, use following finishes:
  - 1. Curbs and Equipment Bases: Rubbed finish.
  - 2. Exterior Slabs: Broom finish, Class B tolerance.
  - 3. Interior Slabs: Trowel finish, Class A tolerance.
  - 4. Other Concrete Not Exposed To View: Rough form finish.
  - 5. Other Concrete Exposed To View: Smooth form finish with voids filled and rubbed smooth.

### 3.7 ACCEPTANCE OF STRUCTURE

- A. For sanitary engineering installations defined by ACI 350, concrete meeting acceptance criteria of ACI 301 and ACI 350 will be acceptable.
- B. If concrete is cored and cores fail to meet specified 28-day strength, Engineer may reject.
- C. For other structures, concrete will be acceptable if it meets acceptance criteria of ACI 301.
- D. Engineer: Sole judge of whether concrete meets requirements.
- E. Remove, dispose of, and replace concrete not meeting specified requirements at no cost to the Commission.
- F. Make repairs using approved repair procedure in Engineer's presence.

## PART 4 MEASUREMENT AND PAYMENT

- 4.1 Measurement of concrete work for payment will not be made under this Section. Concrete work is considered essential material required in construction of specific items of work that will be measured and paid for under various items or lump sums listed in Bid Schedule.

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