

DIVISION 3  
Concrete





## SECTION 03300 - CAST-IN-PLACE CONCRETE

### 1.1 GENERAL

- A. Drawings and general provisions of the Contract from the front of the Specification book, including General Conditions, Supplementary General Conditions and Division 1 Specification Sections, apply to this Section.
- B. Summary
  - 1. Furnish all labor, materials, tools, equipment and services necessary for and reasonably incidental to complete the cast-in-place concrete work as shown on the drawings or as specified.
  - 2. Refer to Structural Notes on Drawings.
  - 3. Sub-contractor shall grade and backfill for concrete work as directed by the Contractor and Soils Engineer.
  - 4. Below slab insulation is specified in Section 07210.
- C. Submittals: Submit the following:
  - 1. Product data for reinforcement, forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, and others as requested by Architect.
  - 2. Shop drawings for fabricating, bending, and placing concrete reinforcement.
  - 3. Shop drawings showing control joint layout for sidewalks, interior slab and exterior slab construction.
  - 4. Laboratory test reports or evaluation reports for concrete materials and concrete mix designs.
  - 5. Written report to Architect for each proposed concrete mix at least 15 days prior to start of concreting. Do not begin concrete production until mixes have been reviewed by Architect. Identify for each mix submitted the method by which proportions have been selected.
    - a. For mix designs based on field experience, include individual strength test results, standard deviation, and required average compressive strength  $f'(cr)$  calculations.
    - b. For mix designs based on trial mixtures, include trial mix proportions, test results, and graphical analysis and show required average compressive strength  $f'(cr)$ .
    - c. Indicate quantity of each ingredient per cubic yard of concrete.
    - d. Indicate type and quantity of admixtures proposed or required.

- D. Quality Assurance: Comply with provisions of ACI 301, "Specifications for Structural Concrete for Buildings," ACI 318, "Building Code Requirements for Reinforced Concrete," and CRSI "Manual of Standard Practice," except where more stringent requirements are indicated.
  - 1. Concrete Testing Service: Employ, at owner's expense, an independent testing agency acceptable to the architect to perform specified tests and other services required for quality assurance.
    - a. Testing agency shall meet ASTM E 329 requirements.
  - 2. Apply surface evaporation retardant to slab surface when water loss reaches .15 lbs of water loss per square foot (.6 kg per sm) per hour as determined in ACI 308.
  - 3. Source of Materials: Obtain materials of each type from same source for the entire project.
  
- E. Project Conditions:
  - Cold-Weather Concreting: Comply fully with the recommendations of ACI 306.
    - a. Well in advance of proposed concreting operations, advise the architect of planned protective measures including but not limited to heating of materials, heated enclosures, and insulating blankets.
  - 2. Hot-Weather Concreting: Comply fully with the recommendations of ACI 305R.
    - a. Well in advance of proposed concreting operations, advise the architect of planned protective measures including but not limited to cooling of materials before or during mixing, placement during evening to dawn hours, fogging during finishing and curing, shading, and windbreaks.

## 1.2 PRODUCTS

- A. Form Materials: Furnish form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection.
  - 1. Forms for Unexposed and Exposed Concrete Surfaces: Suitable panel-type material to provide continuous, straight, smooth, exposed surfaces.
  - 2. Cylindrical Column Forms: Weather-resistant tubes of metal, plastic, or laminated paper or fiber.
  - 3. Form Coating: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

- B. Reinforcing Materials: As follows:
  - 1. Deformed Reinforcing Bars: ASTM A 615, Grade 60, unless otherwise indicated.
  - 2. Welded Wire Fabric: ASTM A 185.
  - 3. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications, unless otherwise acceptable.
    - a. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
  
- C. Concrete Materials: As follows:
  - 1. Portland Cement: ASTM C 150, Type 1 or Type 2.
    - a. The use of high early strength cement may be permitted only in concealed work and during the months of November, December, January, February and March with the approval of the Architect. It will not be permitted for slabs when the air temperature at the slab exceeds 80 degrees F.
  - 2. Fly Ash: ASTM C 618, Type F.
  - 3. Aggregates: ASTM C 33, except local aggregates of proven durability may be used when acceptable to Architect.
  - 4. Water: Potable.
  - 5. Fiber Reinforcement: Engineered polypropylene fibers designed for secondary reinforcement of concrete slabs.
  - 6. Use one brand of cement throughout project, unless otherwise acceptable to Architect.
  - 7. Water: Potable.
  
- D. Admixtures: Provide admixtures that contain not more than 0.05 percent chloride ions.
  - 1. Air-Entraining Admixture: ASTM C 260.
  - 2. Water-Reducing, Retarding, and Accelerating Chemical Admixtures: ASTM C 494.
  - 3. Water-Reducing Non-Chloride Accelerator Admixture: ASTM C 494, Type E.
  - 4. Water-Reducing, Retarding Admixture: ASTM 494, Type D.
  - 5. Certification: Provide admixture manufacturer's written certification that chloride ion content complies with specified requirements.

- E. Related Materials: As follows:
1. Vapor Retarder: 10 mil virgin polyethelene w/ tape or adhesive acceptable to manufacturer of vapor retarder material.
  2. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
  3. Moisture-Retaining Cover: Waterproof paper, polyethylene film, or polyethylene-coated burlap, complying with ASTM C 171.
  4. Membrane-Forming Curing Compound: ASTM C 309, Type I. Moisture loss not more than 0.55 kg/sq. meter when applied at 200 sq. ft./gal.
  5. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.
  6. Sealer for Interior and Exterior Slabs: "Dress and Seal"; L&M Construction Chemicals, Inc.
  7. Bonding Compound: Non-redisersable acrylic bonding admixture, ASTM C 1059, Type II.
  8. Expansion Joint Filler: Nonextruding bituminous type: ASTM D 1751, "Sonoflex F"; Sonneborn, Chemrex Inc.
- F. Mix Proportions and Design: Proportion mixes complying with mix design procedures specified in ACI 301.
1. Limit use of fly ash to not exceed 25 percent of cement content by weight.
  2. Design mixes to provide normal weight concrete with the following properties:
    - a. Exterior Slabs: 4000-psi, 28-day compressive strength; water-cement ratio, 0.45 maximum
    - b. All remaining concrete: 3000-psi, 28-day compressive strength; water-cement ratio, 0.50 maximum
  3. Limit maximum water-cement ratio of concrete exposed to freezing and thawing to 0.45.
  4. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows: Use mid-range or high-range water reducer in all concrete except footings.
    - a. Ramps, Slabs, and Sloping Surfaces: Not more than 4 inches.
    - b. Reinforced Foundation Systems: Not less than 1 inch and not more than 4 inches.
    - c. Other Concrete: Not more than 4 inches.
    - d. The method for determining the correct amount of water and aggregate for each batch shall permit the proportion of water to cement to be closely controlled and easily checked at any time.

5. Adjust mix designs when material characteristics, job conditions, weather, test results, or other circumstances warrant. Do not use revised concrete mixes until laboratory test data and strength results have been submitted to and reviewed by Architect.
  6. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.
    - a. When air temperature is between 85 degrees F and 90 degrees F reduce mixing and delivery time from 1 1/2 hours to 75 minutes, and when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.
- G. Maximum size of coarse aggregate as recommended in ACI 211.1.
- H. Use air-entraining admixture in exterior exposed concrete, providing not less than 4.5 percent nor more than 7 percent entrained air for concrete exposed to freezing and thawing, and from 2 percent to 4 percent for other concrete. Do not use air-entraining in interior slabs.
- I. Use water-reducing, accelerating, and retarding admixtures that have been tested and accepted in mix designs in strict compliance with manufacturer's directions.
  1. Use water-reducing admixture in concrete as required for placement and workability.
  2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F.
- J. Job-Site Mixing: Use drum-type batch machine mixer, mixing not less than 1-1/2 minutes, but not more than 5 minutes for 1 cu. yd. or smaller capacity. Increase mixing time at least 15 seconds for each additional cu. yd.
- K. Ready-Mix Concrete: ASTM C 94.
- L. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity and amount of water introduced.
  1. Provide tickets on a daily basis during time of concrete pours.
- M. Sub-contractor shall provide curing and hardeners as specified in this Section.

### 1.3 EXECUTION

- A. Formwork: Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation, and position. Select form materials to obtain required finishes.
  - 1. Maintain formwork tolerances and surface irregularities within ACI 347 limits, Class A tolerances for concrete exposed to view and Class C tolerances for other concrete surfaces.
  - 2. Provide openings in formwork to accommodate work of other trades. Accurately place and securely support items built into forms.
  - 3. Clean and adjust forms prior to concrete placement. Apply form-release agents or wet forms as required. Retighten forms during concrete placement, if required, to eliminate mortar leaks.
- B. Vapor Retarders/Barriers: Place vapor retarder/barrier membrane for slabs on grade, with joints lapped 6 inches and sealed.
- C. Reinforcement: Accurately position and support reinforcement, and secure against displacement. Locate and support reinforcement to maintain minimum cover with metal chairs, runners, bolsters, spacers, and hangers as required. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
  - 1. Install welded wire fabric in lengths as long as practicable; lap at least one full mesh and lace splices with wire.
- D. Joints: Locate and install construction, isolation, and control joints as indicated or required. Locate construction joints so they do not impair strength and appearance of structure. Place isolation and control joints in slabs-on-ground to stabilize differential settlement and prevent random cracking.
- E. Contraction (Control) Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade to form panels of patterns as shown and specified below. Use saw cuts 1/8 inch (3 mm) wide by 1 inch (25 mm) of slab depth, unless otherwise indicated using the methods specified below.
  - 1. Saw control joints, 1 inch (25 mm) deep with Sof-Cut Model 280 saw, immediately after final troweling with cutting completed within 2 hours after final pass of trowel. Remove saw cut concrete spoils from floor surface immediately behind the saw cutting operations.



2. Contraction joints shall be placed in accordance with approved Shop Drawings, with a maximum panel area as specified below. The panel shall be as nearly square as possible. Conform to bay spacing wherever possible (at column centerlines, half bays, third bays, one quarter bays, etc.).
  3. Saw cut non-reinforced slabs on grade in accordance with the following maximum spacing;
    - a. 4 inch thick: 10 feet
    - b. 5 to 6 inches thick: 12 feet.
- F. Installation of Embedded Items: Set and build anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting diagrams, templates, and instructions provided by others for locating and setting.
1. Locate and set anchor bolts.
- G. Concrete Placement: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," for placing concrete in a continuous operation within planned joints or sections. Do not begin concrete placement until other affected work is completed.
1. Consolidate placed concrete using mechanical vibrating equipment with hand rodding and tamping so that concrete is worked around reinforcement and other embedded items and into forms.
  2. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing.
    - a. In cold weather comply with ACI 306.
    - b. In hot weather comply with ACI 305.
- H. Finish of Formed Surface: As follows:
1. Smooth-Formed Finish: Provide a smooth finish for concrete surfaces exposed to view and surfaces to be covered with a coating or covering material applied directly to concrete. Repair and patch defective areas, with fins and other projections completely removed and smoothed. Parge all holes and indents in the concrete wall.

- I. Monolithic Slab Finishes: As follows:
  1. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish when surface water has disappeared and when concrete has stiffened sufficiently to permit operation of power-driven floats. Consolidate surface with power-driven floats or by hand-floating.
    - a. Check and level surface plane to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness). Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
  2. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed to view and slab surfaces to be covered with resilient flooring, carpet, paint, or other thin film-finish coating system.
    - a. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of F(F) 20 (floor flatness) and F(L) 17 (floor levelness). Grind smooth surface defects that would telegraph through applied floor covering system.
  3. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
  4. Nonslip Broom Finish: Apply nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
    - a. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route.
  5. Slab Finish Schedule: Apply finishes in the following typical locations and as otherwise shown on the drawings:
    - a. Trowel finish:
      - (1) Exposed interior floors not otherwise scheduled.
      - (2) Surfaces to receive resilient tile.
      - (3) Surfaces to receive carpet.
      - (4) Surfaces to receive thickset tile over cleavage membrane.
    - b. Trowel and fine broom:
      - (1) Outdoor storage room.
      - (2) Sidewalks.
      - (3) Exterior slabs not otherwise scheduled.

- J. Curing: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, apply an evaporation-control compound according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
1. Begin initial curing as soon as free water has disappeared from exposed surfaces.
  2. Continue curing unformed concrete surfaces by water ponding, continuous fog spraying, continuously wetted absorptive cover, or by moisture-retaining cover curing. Cure formed surfaces by moist curing until forms are removed. Keep concrete continuously moist for not less than 72 hours for high- early strength concrete and 7 days for all other concrete.
  3. Apply membrane-forming curing compound to exposed interior slabs and to exterior slabs, walks, and curbs as soon as final finishing operations are complete. Apply uniformly according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
    - a. Use membrane-curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
  4. Apply Curing Compound on Interior Slabs receiving resilient flooring and carpet
  5. Cure exposed interior slabs with waterproof curing paper placed over slab that has been misted with water. Seal all joints and properly, weight down and maintain in intimate contact with the slab for the duration of the curing period.
  6. Sealer for Slabs: Install sealer as per manufacturer's instructions.
- K. Field Quality Control: The Owner will employ a testing agency to perform tests and to submit test reports. Sampling and testing for quality control during concrete placement shall include the following:
1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
    - a. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete and for each 50 yd. maximum; additional tests when concrete consistency seems to have changed.
    - b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete and for each 50 yd. maximum.

- c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
  - d. Compression Test Specimen: ASTM C 31; one set of six standard cylinders for each compressive-strength test. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
  - e. Compressive-Strength Tests: ASTM C 39; One test per 50 cubic yards or fraction thereof for each day's pour of each concrete class; one test per 1500 square feet of slab or wall area or fraction thereof for each day's pour of each concrete class. When less than 5 cubic yards is placed in one day, the architect may, at architect's option, waive laboratory testing of specimens if adequate evidence of satisfactory strength is provided. (Molding and curing of these specimens is not waived.); one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
  3. When total quantity of a given class of concrete is less than 50 cu. yd., Architect may waive strength testing if adequate evidence of satisfactory strength is provided.
  4. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
  5. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.
  6. Test results will be reported in writing to Architect, Structural Engineer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.
  7. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

8. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Cost of additional testing shall be borne by the contractor when unacceptable concrete has been verified.

END OF SECTION 03300

