

SECTION 03 30 13

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 CONTRACT CONDITIONS

- A. Drawings, Details of Construction and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work specified in this section.

1.02 SUMMARY

- A. Section Includes: Providing all items, articles and materials listed, mentioned, or scheduled on the Drawings or herein, including all labor, materials, equipment, and incidentals necessary and required for the installation of all cast-in-place concrete indicated on the Drawings or specified herein.
- B. In general, the Work involves the following:
1. Slabs on grade.
 2. Concrete fill for masonry lintels, bond beams and cores.
 3. Concrete pads and curbs for mechanical and other equipment.
- C. Products furnished under other Sections and installed by this Section:
1. Anchor bolts, setting plates and inserts.
 2. Pipe Sleeves
 3. Embedded steel and miscellaneous metal items.
- D. Related Sections:
1. Section 05 10 00 - Embedded Structural Steel, Anchor Bolts
 2. Section 05 50 00 - Embedded Miscellaneous Metal
 3. Divisions 21, 22, 23, 26, 27, and 28 - Mechanical and Electrical Equipment Pad Requirements

1.03 REFERENCES

- A. The following specifications and standards are incorporated by reference. Materials and operations shall comply with requirements of the specified issue of published reference. Where provisions of these Project Specifications are at variance with these reference specifications and recommended practices, the maximum criteria or requirements shall govern.
1. American Concrete Institute (ACI) 117-90, "Standard Specification for Tolerances for Concrete Construction and Materials"
 2. American Concrete Institute (ACI) 304R-00, "Guide for Measuring, Mixing, Transporting, and Placing Concrete"
 3. American Concrete Institute (ACI) 308.1-98, "Standard Specification for Curing Concrete"
 4. ASTM A185-02, "Steel Welded Wire Fabric, Plain, for Concrete Reinforcement"
 5. ASTM C33-03, "Concrete Aggregates"
 6. ASTM C94-03, "Ready-Mixed Concrete"
 7. ASTM C494-99ae1, "Chemical Admixtures for Concrete"
 8. ASTM E1643-98, "Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs"
 9. ASTM E1745-97, "Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs"

1.04 SUBMITTALS

- A. Make submittals in accordance with Section 01300.
- B. Cast in place concrete
 - 1. Concrete mix designs for each mix used. Include field test data to support mix proportions on request.
 - 2. Product data for admixtures, curing materials and compounds, joint fillers, vapor retarders and non-shrink grout.

1.05 QUALITY ASSURANCE

- A. Work shall conform to the following:
 - 1. ACI 315
 - 2. ACI 318
 - 3. ACI 301 except as modified by the requirements of this Section.
 - 4. ACI 347R.
- B. Maintain a copy of ACI 301 at project site.
- C. Contractor is responsible for dimensions that shall be confirmed and correlated at the job site.
- D. Contractor is responsible for the fabrication processes, techniques of construction, coordination of his work with that of all other trades, and the satisfactory performance of his work.

1.06 MATERIAL DELIVERY, HANDLING, AND STORAGE

- A. Concrete and Accessories
 - 1. Furnish delivery tickets with each load of concrete delivered to the Project. Information on each ticket shall be as required by ASTM C94 and shall also include: type of concrete (mix number); weights of all ingredients; maximum aggregate size; type, brand, an amount of admixtures; total water in the batch; maximum amount of water that can be added at the site without exceeding design mix proportions; amount of water added at site and initials of person adding water. Retain tickets until substantial completion unless directed otherwise.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Formwork
 - 1. Form Material: As given in Chapters 2 and 6 of ACI 301. Do not use aluminum materials in contact with the concrete.
 - 2. Form Release Agent shall be manufactured for the type of form material used; prevent adhesion of concrete to form material, staining of concrete or injury to exposed concrete surfaces; and be compatible with finish material applied to the concrete.
- B. Reinforcement:
 - 1. Welded Wire Fabric: ASTM A185.

C. Cementitious materials

1. Cement: ASTM C150, Type I.
2. Fly Ash: ASTM C618, Class C or Class F.
3. Use only one type and brand of Portland cement for all exposed concrete. Architect's permission is required to change brands.

D. Concrete Aggregates:

1. Fine and coarse aggregates for normal weight structural and non-structural concrete: ASTM C33, well graded with not more than 18% and not less than 8% retained on an individual sieve, except:
 - a. Less than 8% may be retained on the coarsest sieve and the No. 50 sieve, and
 - b. Less than 8% shall be retained on sieves finer than No. 50.
 - c. The above gradation limits are required for walls and slabs on grade only.
2. Provide maximum size specified in mix design schedule.

E. Water: Clean and free from deleterious amounts of acids, alkalis or organic materials.

F. Admixtures:

1. Air Entraining Admixture: ASTM C260.
2. Water Reducing Admixtures: ASTM C494, Type A and free from chlorides and added lignin.
3. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or G, free from chlorides and added lignin.
4. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than .05% chloride ions.
5. Do not use accelerating or retarding admixtures without written approval of the Architect.

2.02 ACCESSORIES

A. Curing Materials:

1. Interior Curing Compounds: ASTM C309, Type 1-D, compatible with other surface treatments.
2. Acrylic Curing and Sealing Compound: ASTM C309, Type 1, VOC compliant, 18% minimum solids.
3. Moisture-cover curing materials: ASTM C171, curing paper, white polyethylene film at temperatures above 60°F, black polyethylene film at temperatures below 80°F.
4. Curing compounds shall not have any adverse affect on finishes, traffic topping or sealers. Coordinate with the finish, traffic topping or sealer manufacturer and receive written confirmation before applying.

B. Vapor Barrier: Conform to the requirements of Section 07 21 00 Insulation.

C. Expansion Joint and Isolation Joint Filler: Preformed, resilient, non-extruding asphalt impregnated cane fiber, ASTM D1751.

D. Grout for bearing plates for steel beams and columns bearing on concrete and masonry: ASTM C1107, non-metallic, Grade B. Conformance to ASTM C1107 shall occur with a minimum temperature range of 45°F to 90°F, a fluid consistency, and a minimum 30 minute working time.

E. Self-leveling Cement based Underlayment: BASF/Sonneborn: Sonoflow; BASF/Thoro: Underlayment – self-leveling; BASF/Master Builders: Master Top 110 Plus Underlayment; Ardex: K-15; L&M Construction Chemicals: Levelex Euclid Chemical Company: FLo-Top or Super FLo-Top; ProSpec/Bonsal American Inc.: Level Set 300.

2.03 MIXES

- A. Submit concrete mix design for each type of concrete at least 14 days prior to the proposed start of placement. Mix designs must be reviewed prior to pouring concrete. Review is for conformance with specification requirements only. Contractor is responsible for performance.
- B. Concrete shall conform to the requirements of ASTM C94 (Option A) unless other requirements of this project specification are more stringent. Establish mix proportions according to the procedure in ACI 301.
- C. Provide concrete with workability such that it will fill the forms, without voids or honeycombs, when properly vibrated, without permitting materials to separate or excess water to collect on the surface.
- D. Provide mixes meeting the following minimum requirements:

Use	28-Day Compressive Strength (Min.)	Maximum Aggregate Size	Air Content (ASTM C231)	Maximum Water Cement Ratio	Maximum Chloride Ion Content %
Exterior Concrete, Garage Floors	5,000 psi	3/4" Class 4S	4½% - 7½%	0.40	0.15
Slabs on Grade	4,000 psi	3/4" Class 2S	----	0.45	1.00
Masonry Core Fill, Bond Beams, Lintels, Pilasters	3,000 psi	3/8" Class 1S	----	0.60	1.00

- E. Slump at point of discharge shall not exceed 6" for concrete without superplasticizer and 8" for concrete with superplasticizer.
- F. Substitution of fly ash for Portland cement shall not exceed 30% by weight of cement for footings and 25% by weight of cement for other concrete.
- G. Exterior concrete includes: exterior sidewalks, aprons and slabs; semi-exterior slabs at overhead doors, loading docks, etc.; exterior walls, etc.

PART 3 EXECUTION

3.01 PREPARATION

- A. Establish a bench mark in an accessible location and use as a reference point for various construction levels. Maintain in an undisturbed condition until final completion.
- B. Do not embed pipes other than non-aluminum electrical conduit or snow melting pipes in any structural concrete. Maximum total dimension of pipes embedded in concrete beams and columns shall not exceed 15% of least section dimension.
- C. Slabs on Grade:
 - 1. Verify subgrade compaction tests have been performed and are accepted.
 - 2. Verify subgrade is level and within acceptable tolerances.

3. Vapor Barrier Placement:

- a. Installation shall be in accordance with manufacturer's instructions and ASTM E 643-04.
 - 1) Unroll vapor barrier with longest dimension parallel with the direction of the pour.
 - 2) Lap over footings and seal to foundation walls with vapor proofing mastic.
 - 3) Overlap joints 6 inches and seal with manufacturers tape.
 - 4) Seal all penetrations (including but not limited to pipes, conduits, steel columns) with pipe boots or per manufacturer's instructions. No unsealed penetrations will be allowed.
 - 5) Repair damaged areas by applying patches of vapor barrier, overlapping damaged area 6" inches and taping all four sides with tape.
4. Verify subgrade is substantially dry with no freestanding water, muddy spots, or soft spots and is free from snow or ice.
5. Verify completion of all underfloor mechanical and electrical work.
6. Provide 3 inch minimum cover bottom and 3 inch minimum cover sides at electrical conduits and other embedded items.

3.02 FORMWORK ERECTION AND INSTALLATION

- A. Provide forms for all concrete work. Construct forms to slopes, lines and dimensions shown, plumb and straight and sufficiently tight to prevent leakage.
- B. Securely brace and shore forms to prevent displacement and to safely support construction loads.
- C. Lay out all work and check general building lines and levels established. Coordinate layout and measurements and if discrepancies arise, report them to the Architect.
- D. Keep wood forms wet as necessary to prevent shrinkage.
- E. Thoroughly clean all forms of debris immediately before concrete is placed.
- F. Inserts, Embedded Part And Openings
 1. Build in sleeves, thimbles and other items furnished or set in place by other trades. Accurately position and support these items. Fill voids with a readily removable material to prevent entry of concrete into voids.

3.03 INSTALLATION – REINFORCEMENT

- A. Lap wire mesh in slabs on grade so that full, uncut squares of mesh of both sheets lap each other at least 1-1/2 times or 6", whichever is greater.

3.04 JOINTS

- A. Locate slab on grade construction and control joints as given on Drawings and submit drawings showing proposed locations. Cut joints as soon as concrete has hardened sufficiently to prevent aggregate dislodgement. Cut to a depth of one-fourth the slab thickness or as shown on the drawings. Complete sawing within 12 hours of placement.
- B. Where new concrete is to be placed against concrete that has set, roughen and clean the existing surfaces. Thoroughly wet the existing surfaces and slush with a neat cement grout immediately before placing new concrete.

3.05 CONCRETE MIXING

- A. Use cooled or heated water in accordance with ACI 306 and 305.
- B. Air-entraining and chemical admixtures, if approved, shall be charged into mixer as a solution and dispensed by an automatic dispenser or similar metering device. Powdered admixtures shall be weighted or measured by volume as recommended by the manufacturer. Superplasticizer may be added at the job site to maintain the slump requirement.
- C. Two or more admixtures may be used in same concrete, provided such admixtures are added separately during batching sequence. Admixtures used in combination shall retain full efficiency and have no deleterious effect on concrete or on properties of each other.
- D. Ready mixed concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of rated capacities. Schedule and dispatch trucks from the batching point so that they shall arrive at the site of the work just before the concrete is required to avoid excessive mixing of concrete while waiting.
- E. Discharge at the site shall begin within one (1) hour after charging. Concrete may be used as long as it is of such slump that it can be placed and properly consolidated without the addition of water to the batch (other than water added prior to the start of discharge as given below). If elapsed time since batching exceeds 90 minutes, or if drum has revolved more than 300 revolutions since batching, test air content, slump, and temperature for conformance to this specification prior to placing. In no case shall the time between batching and complete discharge exceed 120 minutes. Do not permit retempering of concrete. Discard concrete that has obtained its initial set.
- F. Do not add water after the initial introduction of the mixing water for the batch, except at the start of discharge, subject to the conditions below. In this case, the producer may add water in an amount not exceeding that allowed to achieve the design water/cement ratio. The drum blades shall then be turned an additional 30 revolutions minimum at mixing speed. Water shall not be added to the batch at any later time. Reject concrete if water is added and these conditions are not met.
 - 1. The measured slump of the concrete is less than that specified in the mix design.
 - 2. No more than 60 minutes have elapsed from the time of batching.
 - 3. The ready-mix plant is notified and approves.
 - 4. Truck tickets indicate maximum amount of water to be added.
 - 5. Water is added in a manner to control volume.
 - 6. Special Inspector is notified, if concrete placement requires inspection.
- G. Maximum concrete temperature delivered to Project site shall be 85 degrees F.
- H. If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished by the Vendor, the Architect may order such changes in the proportions or materials, or both, as may be necessary to secure the desired properties, subject to the stated requirements. Make any changes so ordered without extra compensation.

3.06 PLACING

- A. Do not place concrete until all reinforcement is in place, forms have been cleaned, formwork and reinforcing inspections made, all discrepancies corrected, and Architect's permission has been given.
- B. Do not place in rain, sleet or snow unless exposed concrete surface is protected from moisture.
- C. Place concrete in accordance with ACI 301, unless modified herein.
- D. Follow recommended practices of ACI 304, unless modified herein.

- E. Protect existing concrete work to be exposed to view and other finished materials from damage and staining resulting from concreting operations. Handle concrete carefully to avoid dripping and spillage. Cover sills, ledges and other surfaces with protective coverings as necessary to protect the work.
- F. Place concrete as continuously as possible until pour is complete so that no concrete is placed against concrete that has attained its initial set, except at authorized joints. If, for any reason, the concrete pour is delayed for more than 45 minutes, bulkhead pour at last acceptable construction joint. Immediately remove excess concrete and clean all forms and insitu concrete surfaces.
- G. Place concrete as near as possible to its final position to prevent segregation. Do not use vibrators to transport concrete.
- H. Immediately remove concrete spilled on existing surfaces.

3.07 FINISHING

- A. Unformed Surfaces: Provide finishes per ACI 301 as scheduled and to the following tolerances. Conformance shall be determined by placing a freestanding straightedge on the surface. The gap beneath the straightedge shall not exceed that specified at more than 10% of the samples. Samples shall be evenly distributed over the surface and taken in an equal number of perpendicular directions with at least one sample per 100 square feet. No gap shall exceed that specified by more than ¼".
 - 1. Troweled Finish: Conventional straightedged tolerance per ACI 117. Slope slab to floor drains.
 - 2. Scratched Finish: Bullfloated tolerance per ACI 117.
 - 3. Broom Finish: Conventional straightedged tolerance per ACI 117.
 - 4. Floated Finish: Conventional straightedged tolerance per ACI 117.
- B. Finish Schedule
 - 1. As-cast rough form finish: slabs.
 - 2. Troweled finish: Exposed interior concrete floors and floors to receive carpeting, resilient flooring, or thin set tile finishes.
 - 3. Floated finish: Floors to receive sand bed terrazzo.
 - 4. Scratched finish: Floors to receive topping, or mortar setting beds for ceramic tile, quarry tile, pavers, etc.
 - 5. Broom finish: Exterior platforms, aprons, ramps, loading docks, garage slabs.
 - 6. Non-slip finish: Exposed concrete stair treads.
- C. Clean exposed concrete to remove laitance, efflorescence and stains.

3.08 CONCRETE CURING AND PROTECTION

- A. Cure concrete according to ACI 308.1 as amended by the following requirements.
- B. Freshly deposited concrete shall be protected from premature drying and excessively hot or cold temperatures, and shall be maintained with a minimal moisture loss at a relatively constant temperature above 55°F for a total of 7 days for normal concrete or 3 days for high-early strength concrete.
- C. Curing may be terminated earlier under the following conditions:
 - 1. At least 4 field cylinders for each pour, prepared and cured according to ASTM C31 alongside the concrete they represent, reach 70% of the specified 28-day strength.
 - 2. The concrete temperature is maintained above 50°F and laboratory cylinders reach 85% of the specified 28-day strength.

- D. Protect concrete from excessive changes in temperature during the curing period and at the termination of the curing process. Changes in the temperature of the concrete shall be as uniform as possible and shall not exceed 5 degrees F in any one hour or 50°F in any 24-hour period.
- E. Unformed Surfaces:
1. Cure interior floors and stairs exposed in the finished work using an acrylic curing and sealing compound. Provide a second coat of acrylic curing and sealing compound immediately prior to substantial completion. Clean floors, and apply sealer strictly according to manufacturer's instructions.
 2. Cure exterior concrete using exterior concrete curing compound.
 3. Cure all other unformed surfaces using a curing compound or by covering with waterproof paper or polyethylene film.
- F. Apply waterproof paper or polyethylene film as soon as finishing operations are complete and the concrete is sufficiently hard to be undamaged by the covering. Use appropriate color of film based on ambient temperature. Sprinkle concrete with water as necessary during application of covering. Lap edges and ends at least 6 inches, and seal laps. Weight down covering to prevent movement. Patch holes and tears that occur during the curing period.
- G. Apply curing compounds strictly according to the manufacturer's instructions using low pressure spray equipment. Apply curing compounds as soon as finishing operations are complete, free water on the surface has disappeared and no water sheen can be seen. Apply two coats at right angles to each other where necessary to achieve proper coverage.

3.10 HOT WEATHER CONCRETING

- A. Apply recommended practices of ACI 305R when temperature and humidity will affect placing and finishing or may cause plastic shrinkage cracking.
- B. The following additional requirements apply when the temperature exceeds 70° F.
1. Provide concrete meeting the following temperature requirements:

Wind Speed (mph)	Min. Relative Humidity (%)	Maximum Concrete Temperature (° F)
0-10	30	80
10-15	30	75
15-20	30	70
20-25	30	65

2. Do not place concrete if the relative humidity is less than 30%
3. Do not place concrete without windbreaks if the wind speed at the slab elevation is greater than 25 mph.
4. Maintain surface moisture during the initial curing period between placement and final finishing by using fog sprayers, evaporation reducing materials, or shade (individually or in combination).

3.11 COLD WEATHER CONCRETING

- A. Concrete placed during cold weather shall conform to the requirements of ACI 306.1.
- B. Cold weather is defined as 3 or more successive days when the average daily outdoor temperature is less than 40 degrees F.
- C. Do not place concrete on frozen subgrades.

- D. Maintain protection for the entire curing period defined above and for a minimum of 48 hours after placement of concrete.
- E. Submit detailed procedures for cold weather concreting. Review shall be for information only.
- F. Follow recommended practices of ACI 306R.

3.12 FIELD QUALITY CONTROL

A. Testing

- 1. The Owner will provide the following tests and inspections:
 - a. Tests for cast in place concrete.
 - i. Compression test specimens: ASTM C31. One set of four standard cylinders of concrete for each compressive strength test. Mold and store cylinders for laboratory cured specimens.
 - ii. Compressive strength tests: ASTM C39. One set of four cylinders for each day's pour between one and 25 cubic yards. If a day's pour exceeds 25 cubic yards, one set of four cylinders for each additional 50 cubic yards, or fraction thereof. One specimen tested at seven days, two at 28 days, and one specimen retained in reserve for later testing if required. For post tensioned concrete, make and test an additional cylinder at three days to verify strength prior to stressing. (When frequency of testing will provide less than five strength tests for a given class of concrete, conduct at least five strength tests from randomly selected batches. If fewer than five batches are used, conduct one test from each batch.)
 - iii. Slump: ASTM C143. One test at point of discharge for each set of compression test specimens; additional tests when concrete consistency appears to have changed.
 - iv. Air entrainment: ASTM C231. Test the first batch of air entrained concrete and one additional test for each set of compression test specimens.
 - v. Concrete temperature: Test hourly when air temperature is below 40°F or above 80°F and each time a set of compression test specimens is made.

B. Contractor Requirements:

- 1. Provide services of an independent laboratory to perform the following:
 - a. Make and test additional cylinders to determine termination of curing procedures.
 - b. Make and test additional cylinders to determine termination of cold weather practices.

END OF SECTION 03 30 13

