

**SECTION 3100
CAST-IN-PLACE CONCRETE**

1.00 GENERAL

1.01 Scope. Work to be completed under this section shall include all labor, equipment, plant and materials necessary to furnish and install all poured-in-place concrete, together with all miscellaneous and appurtenant items, as shown on the Drawings and as specified herein.

1.02 Related Work Specified Elsewhere.

Section 2110 - Excavation and Embankment
Section 2120 - Excavation and Backfill For Structures
Section 2140 - Embedment and Base Course Aggregate
Section 2520 - Concrete Curb & Gutter, Sidewalk and Curbwalk

1.03 Reference Standards. Except as modified or supplemented herein, all Work shall conform to the following standards. Refer to standards for detailed requirements.

ACI 318 - Building Code Requirement for Reinforced Concrete
ACI 301 - Specifications for Structural Concrete for Buildings
ACI 347 - Recommended Practice for Concrete Framework
ACI 305 - Recommended Practice for Hot Weather Concreting
ACI 306 - Recommended Practice for Cold Weather Concreting

Publication SP-2, ACI Manual for Concrete Inspection

ASTM A 615 - Standard Specifications for Deformed and Plain Billet
Steel Bars for Concrete Reinforcement

ASTM A 185 - Specifications for Welded Steel Fabric for Concrete
Reinforcement

1.04 Submittals.

A. Lab Design Mix. Prior to the start of Work, Contractor to submit a statement of the proportions for the concrete mixture. Statement to include:

1. Location & identification of aggregate source.
2. Batch quantities for one (1) cubic yard of concrete, including:
 - a. Weight of fine aggregate in a saturated surface dry condition.
 - b. Weight of coarse aggregate in a saturated surface dry condition.
 - c. Weight or number of 94 pound bags of cement.
 - d. Weight or gallons of water.
 - e. Amount and description (including manufacturer, specific product name, and number) of all admixtures.
3. Test results on trial batch concrete made from the proposed mix design, including:

- a. Cement factor in bags per cubic yard based on yield tests.
 - b. Water-cement ratio.
 - c. Percent of entrained air.
 - d. Consistency in inches of slump.
 - e. At least three 7-day compressive strength tests.
4. Brand, type and place of manufacture of cement.
 5. Aggregate test results for grading, deleterious substances and physical properties using test procedures developed by AASHTO.
- B. Reinforcing Steel. Product data sheet and statement of manufacturer's compliance with applicable standards.

1.05 Record of the Work. Contractor to keep a record of time, date and location of each concrete pour and submit these records to the Engineer.

1.06 Notice of Intention to Pour. Contractor shall notify the Engineer at least 48 hours before an intended cast-in-place concrete pour. No structural cast-in-place concrete shall be poured until all reinforcing, forms and foundation soils have been inspected by the Engineer.

1.07 Protection of the Work. Contractor to be responsible for protection of all Work prior to acceptance. In place concrete shall not be subjected to loadings or stress prematurely.

1.08 Storage of Materials. Cement and aggregate shall be stored in such a manner as to prevent deterioration or intrusion of foreign matter. Any material which has deteriorated or which has been damaged shall not be used for concrete.

All reinforcing steel shall be stored in a dry location and protected from excessive accumulation of rust or scale.

2.00 MATERIALS

2.01 Cement. All cement shall be Portland Cement Type II conforming to "Specifications for Portland Cement" (ASTM C 150-62). Type III cement may not be used except upon written approval of the Engineer. The same brand cement for all exposed cast-in-place concrete shall be used.

2.02 Stone Aggregate. Fine and course aggregate shall conform to "Specifications for Concrete Aggregates" (ASTM C33-61T). Fine aggregates shall be clean, hard, natural and free from all foreign matter. Course aggregate shall be sound, crushed rock or gravel, free from adherent coating, organic water or injurious amounts of flat or friable pieces. The aggregate shall comply with Concrete Class BZ, Reference Specification.

2.03 Water. Water used in mixing shall be potable, cleaned and free from deleterious amounts of oil, acids, alkalis and organic material.

2.04 Admixtures. "Protex" as manufactured by Protex Industries, Inc. and conforming to Specifications of Air-Entraining Admixtures for Concrete (ASTM C260) is an approved air-entraining admixture. Other admixtures for retarding or accelerating concrete may be used in strict accordance with manufacturer's recommendations and ASTM Specifications upon approval of the Engineer.

2.05 Form Material. For unexposed concrete surfaces, forms may be undressed lumber free from excessive knots. For exposed surfaces, use wood or metal forms as required to give finish as specified.

2.06 Reinforcing Steel. Reinforcing steel shall be deformed bars conforming to "Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement" (ASTM A615) and shall be Grade 60 for #5 bars and larger and Grade 40 or 60 for bars smaller than #5.

2.07 Welded Wire Fabric. Welded wire fabric shall conform to "Specifications for Welded Steel Fabric for Concrete Reinforcement" (ASTM A185) and shall have a minimum wire yield strength of 60,000 psi.

3.00 METHODS AND PROCEDURES

3.01 Concrete Mix.

- A. Proportions. Concrete is to be proportioned according to laboratory designed mixes using the type of aggregate specified and producing the minimum of twenty-eight (28) day ultimate compressive strength of 3,750 psi for all concrete Work. All concrete shall be made with stone aggregate unless specifically noted, and no concrete shall have a 28 day compressive strength of less than 3,750 psi.
- B. Cement and Water Content. The minimum quantity of cement used per cubic yard of concrete shall be 580 pounds. Water content shall not exceed 0.48 pounds water/pounds cement.
- C. Air Entrainment. An air-entraining agent shall be added to all stone concrete so as to entrain 5%-8% by volume. Air-entraining agents shall be in strict accordance with the recommendations of the manufacturer and the testing laboratory for the design mix to assure strength requirements are being fully met or exceeded.
- D. Mixing of Materials. The concrete shall be mixed until there is a uniform distribution of the materials and shall be discharged completely before the mixer is recharged. For job-mixed concrete, the mixer shall be rotated at the speed recommended by the manufacturer.

For stone concrete, mixing shall continue for at least one minute after all materials are in the mixer. Ready mixed concrete shall be mixed and delivered in accordance with "Standard Specifications for Ready Mixed Concrete" (ASTM C94-69).

Sufficient time shall be allowed for proper mixing on the concrete to provide uniformity throughout the batch. Long delays in concrete placement shall be avoided and any concrete which has not been placed within one (1) hour after water has been added to the mix shall be rejected. Over wet mixes shall be rejected and shall not be corrected by the addition of either aggregate or cement to the mixer. Mix not less than ten minutes in transit mix trucks after addition of the mixing water.

- E. Consistency. Slumps shall be minimum, consistent with placing requirements. Slump test shall be made in accordance with "Slump Test for Consistency of Portland Cement Concrete" (ASTM C143-58). Unless written approval is obtained from the Project Engineer or the Town, the maximum slump shall be three (3" ±1") inches. No water shall be added on site unless authorized by the project engineer.

3.02 Concrete Forms.

- A. Forms shall conform to the shape, lines, grades and dimensions of the concrete as detailed on the Drawings. All forms for exposed finished surfaces shall be built with the material needed to produce the form, texture and design specified in Concrete Finishes of this section.
- B. Design of Forms. Forms shall be sufficiently tight to prevent leakage of mortar and shall be properly braced or tied together so as to maintain the desired position. The form work shall be designed for the loads outlined in Part 3, Section 102 of "Recommended Practice for Concrete Form Work" (ACI 347-78). The forms shall be oiled for ease of removal of forms after setting of concrete.
- C. Form Ties and Incidentals. Form ties shall be bolts and rods (adjustable for tightening) arranged so that no metal is within 3'4" of surface after removal of forms. Ordinary wire ties will be allowed with the specific approval of the Engineer. No ties through exposed concrete will be allowed. Set forms for all required anchors, bolt inserts, slots, sleeves, supports, etc., furnished under portions of this Specification and installed under this section.
- D. Removal of Forms. Forms shall not be disturbed until concrete has hardened sufficiently to permit their removal with safety. The removal of the forms shall be carried out in such a manner as to insure the safety of the structure. Unless otherwise permitted by the Engineer, forms shall not be removed until 24 hours after pouring.

3.03 Construction and Expansion Joints. Expansion and control joints shall be constructed in accordance with plan details. Unless otherwise indicated on the Drawings, install one inch (1") thick asphalt impregnated fiberboard expansion joint filler (ASTM D1752) wherever concrete slabs abut buildings or footings or as shown on the plan details. All expansion joint filler shall extend the full depth of the slab.

3.04 Concrete Placement.

- A. Preparation for Placing. Before placing concrete, all equipment for mixing and transporting concrete shall be cleaned and all debris and ice shall be removed from places to be occupied by concrete. Forms shall be properly treated and all reinforcement cleaned of ice and other coatings. Water shall be removed from place of deposit before concrete is placed.
- B. Conveying. Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of the materials. Equipment for chuting, pumping, or pneumatically conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery and without separation of the materials.
- C. Other Trades. Install by way of example, anchor bolts, reinforcing steel, pipe and conduit openings and sleeves, bearing plates, and knockouts as provided by other trades and as required by other trades. Provide minimum 7 days notice to Engineer, Owner, or other trades prior to requiring materials or detailing information. Installation to meet location, dimension and alignment requirements of other trades.

- D. Depositing. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. The concreting shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the space between the bars. No concrete that has been partially hardened or been contaminated by foreign matter shall be deposited on the Work, nor shall re-tempered concrete be used. When concreting is once started, it shall be carried on as a continuous operation until the placing of the panel or section is completed. Place concrete in approximately horizontal layers avoiding displacement of reinforcement above fresh concrete and formation of seams and planes of weakness in sections. When construction joints are necessary, they shall be located as specified in this section under Construction Joints. For bonding fresh concrete, roughen and clean exposed surface and brush with neat cement grout. Place new concrete before grout takes initial set.
- E. Compaction. Place concrete in layers not over 24" deep; compact each layer by mechanical internal vibrating equipment supplemented by hand spading, rodding, tamping, as directed. Vibrators shall not be used to transport concrete inside forms. Limit vibration duration to the time necessary to produce satisfactory consolidation without causing objectionable segregation. Do not insert vibrator into lower courses that have begun to set.
- F. Weather Conditions. Unless adequate protection is provided and the Engineer's approval is obtained, concrete shall not be placed during rain, sleet, or snow. When the mean temperature falls below 40°F for 3 successive days, concreting shall conform to "Recommended Practice for Cold Weather Conditions: (ACI 306 R-78). Concrete placed in hot weather shall meet the standards of "Recommended Practice for Hot Weather Concreting (ACI 305R-77). Concrete is not to be placed under water. A suitable means shall be provided for lowering the water level below surfaces upon which concrete is to be placed. This may require excavating approximately 12 inches below the bottom of the concrete surface and refilling with gravel and compacting. The groundwater shall not be allowed to rise to the bottom of the concrete until 24 hours after the concrete has been completed. Water shall not be allowed to fall upon or run across the concrete during this period.
- G. Protection and Curing. Concrete protection and curing shall be in conformance with ACI 308-71. Immediately after placing or finishing, concrete surfaces not covered by forms shall be protected from loss of surface moisture. All concrete shall be kept in a moist condition for at least five (5) days after placement. Curing compounds may be used upon approval of the Engineer.

3.05 Slabs on Grade. All slabs on grade shall be poured directly on the vapor barrier and prepared gravel subgrade where shown on the Drawings. Construction joints shall be placed such that no section of slab is greater than 25 feet on a side. Finishes, Expansion & Control Joints & Protection shall be as specified under other sections of this section.

Minimum six inch (6") Class 6 aggregate base course shall be installed under the entire slab unless otherwise directed by the Engineer. The grading requirements as per Section 2140 for the aggregate course shall apply.

3.06 Concrete Finishes.

- A. Patching. Patching shall be done on all concrete surfaces immediately after stripping forms; all exposed surfaces shall have fins and other projections carefully removed, offsets leveled, and voids saturated with water and patched to a true and even surface with a wood float. Patch all holes left by the removal of the form ties or bolts. Patching material shall be a stiff mixture of sand and cement, the color of which matches the concrete being patched. Any major area of faulty or honey-combed concrete shall be completely removed and patched at the direction of the Engineer.
- B. Floor slabs. All concrete slabs shall be screened to levels or grades indicated and float finished monolithically completely free from humps or pits. Slabs shall not show surface deviation in excess of one quarter inch ($\frac{1}{4}$ ") when tested with a 10 ft. straight-edge. Before the finish has set, the surface cement film shall be removed with a fine brush in order to have a fine-grained, smooth but sanded texture.
- C. Rubbed finish. All exposed concrete surfaces shall have a rubbed finish. After removal of forms, rubbing of all exterior surfaces shall be started as soon as its condition will permit. Immediately before starting this Work, the concrete shall be kept thoroughly saturated with water. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing to thoroughly set. Surfaces to be finished shall be rubbed with a medium course carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in the same proportions as the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place.

After all concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color.

After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and objectionable marks.

- D. Chamfer. All exterior corners shall receive $\frac{3}{4}$ " chamfer.

3.07 Reinforcing.

- A. Placing Reinforcement. Reinforcing steel, at the time concrete is placed, shall be free from scale, rust or other coatings that will destroy or reduce bond. Reinforcement shall be accurately placed as shown on the Drawings and shall be adequately secured in position by concrete or metal chairs and spacers.

Reinforcing shall be furnished in the full lengths indicated on the Drawings unless otherwise authorized by the Engineer. Splicing of bars, except where shown on the Drawings or specified, shall not be permitted without written approval by the Engineer. Reinforcement placed in any member shall be inspected before any concrete is placed and the Engineer shall be notified 24 hours in advance before any concrete placement.

The placing, fastening, splicing and supporting of reinforcing steel and welded wire fabric shall be in accordance with the Drawings and the latest edition of the CRSI

"Recommended Practice for Placing Reinforcing Bars" and in accordance with ACI 318-77. Bars shall be placed around all corners to splice steel in adjacent walls, footers and slabs (such detailing may not be shown on Drawings).

B. Concrete Protection & Reinforcement. Where not otherwise indicated on the Drawings, the minimum thickness of concrete over the reinforcement shall be as follows:

1. Concrete deposited against earth - 3"
2. Slabs and walls not exposed to weather or earth - 3/4"
3. All other concrete placed in forms:

For bars larger than #5 - 2"
For bars #5 or smaller - 1½"

C. Bearing Plates, anchor bolts, etc. Place all bearing plates, anchor bolts, reinforcing rods and other structural items furnished by other trades. Contractor to provide 7-day notice to all such trades prior to affected pour. Installation to be within tolerances required by other trades.

4.00 FIELD QUALITY CONTROL

4.01 Concrete Tests. 6" x 12" cylinders shall be taken at the point of placing in the forms, shall be job cured and tested in accordance with ASTM Standards by the Engineer. For each strength of concrete used, one set of four (4) cylinders for each day's pour, but not less than one (1) set of cylinders for each 100 cubic yards poured shall be taken. Two (2) cylinders at seven (7) days and two (2) cylinders at twenty-eight (28) days shall be tested. In addition, when in the opinion of the Engineer there is a possibility of the surrounding air temperature falling below 40° F, additional specimens to be cured under job conditions may be required.

4.02 Enforcement of Strength Requirements. Should the strengths shown by the test specimens fall below the specified values, the Engineer shall have the right to require changes in proportions to apply on the remainder of the Work.

If concrete fails to meet the strength requirements of this specification, the Engineer may order the Contractor to have a testing laboratory, acceptable to the Engineer, take and test core samples of questionable concrete. The Engineer may order all low-strength concrete removed and replaced if core strengths are below specified strengths. All costs connected with concrete coring and removal and replacement of low-strength concrete shall be borne by the Contractor.

Contractor shall repair all core holes at his expense.

4.03 Slump Tests. Project Engineer to conduct slump tests on each day's pour and on individual trucks whenever concrete consistency varies. Test failure shall be grounds for rejection of individual or batch loads.

4.04 Air Content. The Project Engineer to conduct air tests on each day's pour and on individual trucks as determined by the Town. Test failure shall be grounds for rejection of entire batch until satisfactory tests are obtained.

End of Section