

## SECTION 033000 - CAST-IN-PLACE CONCRETE

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Supplementary General conditions and Division 1, General Requirements apply to the work specified in this section. Note also all Addenda.

## 1.2 DESCRIPTION OF WORK

- A. This contract includes all labor, materials, equipment and appliances necessary to complete all cast-in-place concrete as indicated on the drawings or hereinafter specified.
- B. Anchor bolts, leveling plates, sleeves, inserts, hangers, etc. furnished under other divisions and required to be cast into the concrete shall be set by this Contractor where required.
- C. Provide all concrete bases, curbs, mats, pads, trenches, slots, openings, etc., as required by any or all of the drawings; Architectural, Site, Structural, Plumbing, Heating and Ventilating, and Electrical, and to accommodate equipment or work of all the divisions of these specifications.
- D. Provide thickened slabs on grade with flush top surfaces where required to accommodate conduit, piping, etc... Consult structural and mechanical drawings for conditions and maintain minimum 1 ½" thickness of concrete below conduit and full slab on grade thickness above conduit. Provide required thickness of gravel below such thickened slabs.

## 1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Concrete Formwork: Section 031000  
Concrete Reinforcement: Section 032000

## 1.4 QUALITY ASSURANCE

- A. Materials and work shall conform to the requirements of all standards, codes, and recommended practices required in this section. In conflicts between standards, required standards and this specification and the local building code, the more stringent requirements shall govern.
- B. Applicable Standards:
  - 1. "Specifications for Structural Concrete for Buildings" ACI 301 (Latest Edition)
  - 2. "Building Code Requirement for Structural Concrete" ACI 318 (Latest Edition)
  - 3. "Standard Specification for Ready-Mixed Concrete" ASTM C 94 (Latest Edition)
- C. Testing and Inspection:
  - 1. Materials and operations shall be tested and inspected as work progresses. Failure to detect defective work shall not prevent rejection when defect is discovered, nor shall it obligate the Architect for final acceptance.

2. Testing agencies shall meet the requirements of "Recommended Practices for Inspection and Testing Agencies for Concrete and Steel in Construction" ASTM E 329 (Latest Edition).
3. The following testing services shall be performed by the designated agency, paid for by the Owner.
  - a. Secure composite samples in accordance with "Method of Sampling Fresh Concrete" ASTM C 172 (Latest Edition).
  - b. Mold and cure three specimens from each sample in accordance with "Method of Making and Curing Concrete Test Specimens in the Field" ASTM C 31 (Latest Edition).
  - c. Test Specimens in accordance with "Method of Test for Compressive Strength of Cylindrical Concrete Specimens" ASTM C 39 (Latest Edition). Two specimens shall be tested at 28 days for acceptance and one shall be tested at 7 days for information.
  - d. Make one strength test for each 50 cu. Yd. or fraction thereof, of each mix design of concrete placed in any one day.
  - e. Determine slump for each strength test and whenever consistency of concrete appears to vary, using "Method of Test for Slump of Portland Cement Concrete". ASTM C 143 (Latest Edition).
  - f. Determine total air content of normal-weight concrete sample for each strength test in accordance with "Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method". ASTM C 231 (Latest Edition).
  - g. Determine temperature of concrete sample for each strength test.
  - h. Unit weight, yield and air content (gravimetric) of concrete. ASTM C 138.
4. The contractor shall provide and pay for the necessary testing services of the following:
  - a. Qualification of proposed materials and the establishment of mix design in accordance with "Building Code requirements for Structural Concrete" ACI 318 (Latest Edition).
  - b. Other testing services needed or required by the Contractor.
5. To facilitate testing and inspection, the contractor shall:
  - a. Furnish necessary labor to assist testing agency in obtaining and handling samples at the job-site.
  - b. Advise the testing agency in advance of operations to allow for the assignment of testing personnel and testing.
  - c. Provide and maintain for the use of the testing agency adequate facilities for proper curing of concrete test specimens on the project site in accordance with "Method of Making and Curing Concrete Test Specimens in the Field" ASTM C 31 (Latest Edition).

D. Evaluation and Acceptance:

1. The strength level of the concrete will be considered satisfactory if 90% of the strength test results and the averages of all sets of three consecutive strength test results equal or exceed specified strength and no individual test result is below specified strength by more than 500 psi.

## 1.5 SUBMITTALS

- A. Submit copies of two laboratory trial mix designs proposed in accordance with Method 1, ACI 301(Latest Edition), or copies each of 30 consecutive test results and the mix design used from a record of past performance in accordance with ACI 301 (Latest Edition), Method 2.
- B. Submit copies of all concrete cylinder test results.

- C. Submit copies of fine and coarse aggregate sieve analysis showing conformance to this specification.
- D. Submit copies of specifications for each product proposed for use as listed in Part 2 of this section.

## PART 2 - PRODUCTS

### 2.1 CONCRETE AND RELATED MATERIALS

- A. Portland Cement; Type I conforming to ASTM C 150 (Latest Edition). Cement used in the work shall correspond to that upon which the selection of concrete proportions was based.
  - 1. Only one brand and manufacturer of approved cement shall be used for exposed concrete.
  - 2. Type III cement shall be used only with prior written approval from the Architect.
- B. Aggregates; conforming to ASTM C 33 (Latest Edition).
  - 1. Fine aggregate: clean, sharp, natural sand free from loam, clay, or other deleterious matter.
  - 2. Coarse aggregate, clean, uncoated, graded aggregate containing no clay, loam or foreign matter.
- C. Water; shall be fresh, and drinkable.
- D. Concrete admixtures; provide admixtures used in compliance with manufacturers recommendations.
  - 1. Air-entraining agent; conforming to ASTM C 260 (Latest Edition), MB-AE 10, or MB-VR, manufacturer by Master Builders, or approved equal as manufactured by Sonneborn, Euclid, or W. R. Grace Companies.
  - 2. Water-reducing; set-controlling admixture; conforming to ASTM C 494 (Latest Edition), Type A (water-reducing), Type D (water-reducing and retarding) and Type E (water-reducing, acceleration), manufacturer by Master Builders, Sonneborn, Euclid or W. R. Grace Companies.
- E. Metal Accessories; shall conform to the requirements of the Concrete Reinforcing Steel Institute (CRSI) "Manual Construction".
- F. Expansion Joint; conforming to ASTM D 1751 or ASTM D 1752.
- G. Curing Materials; exceeding the requirements of ASTM C 309 (Latest Edition) "Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete". "MB-429" manufactured by Master Builders, or approved equal manufactured by Sonneborn, Euclid or W. R. Grace Companies.
  - 1. Material providing water retention not exceeding loss of  $.055 \text{ gm/cm}^2$  when used at a coverage of 450 sq. ft. per gallon and tested in accordance with ASTM C 156.
- H. Grout: Non-shrink, "SETGROUT" as manufactured by Master Builders.
- I. Vapor retarder: shall be installed under concrete slabs on grade and shall be 10 mil polyethylene. It shall be installed in widest practical width. All joints shall be lapped a minimum of six (6) inches, and all breaks or holes shall be patched prior to pouring the concrete.
  - 1. Vapor retarder must have the following qualities:
    - a. Minimum WVTR as tested by ASTM E 96 of 0.037 perms.
    - b. Water vapor retarder ASTM E-1745 that meets or exceeds Class C.

2. Vapor retarders:
  - a. Stego Wrap (10 mil) Vapor Retarder by Stego Industries, LLC, San Juan Capistrano, CA.
  - b. SealTight Vapor-Mat by W.R. Meadows.
  - c. Moistop Ultra "C" by Fortifiber Building Services Group, Reno, Nevada.

## 2.2 SELECTION OF CONCRETE PROPORTIONS

- A. Concrete shall be composed of Portland Cement, fine and Coarse aggregate, water, Pozzoloth admixture, and as specified, an air-entraining admixture. Proportions of ingredients shall produce concrete which will work readily into corners and angles of forms, bond to reinforcement, without segregation or excessive bleed water forming on the surface. Proportioning of materials shall be in accordance with ACI 211.1(Latest Edition), "Recommended Practice for Selecting Proportions for Normal Weight Concrete".
  1. Proportions of ingredients shall be selected by past field experience or by laboratory trial mixes to produce placability, durability, strength and the additional properties specified.
- B. Required average strength above specified strength shall be determined in accordance with ACI 318 (Latest Edition) "Building Code Requirements for Structural Concrete" and evaluations of compressive strength results of field concrete shall be in accordance with ACI 214 (Latest Edition) "Recommended Practice for Evaluation of Strength Test Results of Concrete".
  1. Past field Experience; proportions shall be established on the actual field experience of the ready-mix produced with the materials proposed to be employed. Standard deviation shall be determined by 30 consecutive tests (or two groups of tests totaling 30 or more).
    - a. Average strength used for selecting proportions shall exceed specified strength ( $f'c$ ) by at least:  
  
400 psi - standard deviation is less than 300  
  
550 psi - standard deviation is 300 to 400  
  
700 psi - standard deviation is 400 to 500  
  
900 psi - standard deviation is 500 to 600  
  
1200 psi - standard deviation is above 600 or unknown
  2. Trial Mixes; when the ready-mix producer does not have a record of past performance, the combination of materials and the proportions selected shall be selected from trial mixes having proportions and consistencies suitable for the work based on ACI 211.1 (Latest Edition), using at least three different water-cement ratios which will produce a range of strengths encompassing those required.
    - a. Average strength required shall be 1200 psi above specified strength.

## 2.3 CONCRETE QUALITIES REQUIRED

- A. Specified compressive strength at 28 days shall be 3,000 psi for footings and foundations walls, 4,000 psi for interior slabs and 4,000 psi for exterior slab-on-grades unless noted on the drawings.

- B. Concrete subject to exposure shall be air-entrained. Total air content required (air-entrained and entrapped air) shall be:

<u>Nominal Max. Size Coarse Aggregate</u>	<u>Total Air Content</u>
¾"	6% + or - 1
1"	5% + or - 1
1 ½"	4% + or - 1

- C. Concrete shall be proportioned and produced to have a slump, not to exceed 4 in. if consolidation is by vibration or 5 in. if consolidation is by other means.
- D. Slump for concrete flatwork shall be 1" less than specified above.
- E. Maximum size of coarse aggregate shall not exceed one-third the thickness of slabs, and one-fifth the narrower dimension between forms.
- F. Concrete shall be adjusted to produce the required rate of hardening for varied climatic and job-site conditions.
1. Under 50°F ambient temperature - Accelerate (Approval in Writing Required from the Architect) (Type E Admixture - ASTM C 494-Latest Edition)
  2. Between 50°F and 80°F - Normal rate of Hardening (Type A Admixture - ASTM C 494-Latest Edition)
  3. Over 80°F ambient temperature - Retard (Type B Admixture - ASTM C 494-Latest Edition)

### PART 3 - EXECUTION

#### 3.1 PRODUCTION OF CONCRETE

- A. Concrete shall be ready-mixed batched, mixed, and transported in accordance with ASTM C 94 (Latest Edition) "Specifications for Ready-Mixed Concrete".

#### 3.2 PLACING

- A. Preparation - contractor shall provide access for delivery and provide sufficient equipment and manpower to rapidly place all concrete.
1. All work shall be in accordance with ACI 304 (Latest Edition) "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete".
  2. Formwork shall have been completed; snow, ice, water, & debris removed from within forms.
  3. Expansion joint material, anchors and all embedded items shall have been positioned.
  4. Concrete shall not be placed on frozen ground.
  5. Subgrades shall be sprinkled sufficiently to eliminate water loss from concrete.
- B. Conveying - concrete shall be handled from mixer to final placement rapidly by methods which will prevent segregation or loss of ingredients to maintain required quality of concrete.
- C. Depositing - concrete shall be deposited continuously; when continuous placement is not possible, construction joints shall be located as approved by the architect. Concrete shall be placed as nearly as possible to its final position; avoid rehandling or flowing.

1. Concrete shall be consolidated by vibration, spading, rodding, or forking. Work concrete around reinforcement, embedded items, and into corners, eliminating all air and stone pockets, and other sources of honeycombing and planes of weakness.
2. Internal vibration shall have a minimum frequency of 8000 v/min with amplitude to consolidate effectively.
  - a. Vibrators shall be operated by competent workmen.
  - b. Use of vibrators to transport concrete shall not be allowed.
  - c. Vibrators shall be inserted and withdrawn approximately every 18 in. for 5 o 15 sec.

### 3.3 WEATHER CONDITIONS:

- A. Cold Weather - temperature of concrete delivered at the job site shall conform to the following minimum:

<u>Air Temperature</u>	<u>Concrete Temperature</u>
30 to 45°F	55°F to 90°F
0 to 30°F	60°F to 90°F
Below 0°F	65°F to 90°F

- B. Water heated to above 100°F shall be combined with the aggregates before cement is added. Cement shall not be added to water or aggregated having a temperature greater than 100°F.
1. All work shall be in accordance with ACI 306 (Latest Edition) "Recommended Practice for Cold Weather Concreting". Contractor shall maintain a copy of this on the project site.
  2. When the outdoor temperature is less than 40°F temperature of the concrete shall be maintained at not less than 50°F for the required curing time.
    - a. Arrangements shall be made before placement to maintain required temperature without injury from excessive heat.
    - b. Combustion heaters shall not be used during the first 48 hours without precautions to prevent exposure of concrete and workmen to exhaust gases containing carbon dioxide and carbon monoxide.
- C. Hot Weather - temperature of concrete delivered at the job-site shall not exceed 90°F. Cool materials before mixing as required.
1. All work shall be in accordance with ACI 305 (Latest Edition) "Recommended Practice for Hot Weather Concreting". Contractor shall maintain a copy of this on the contract site.
  2. Provisions shall be made for windbreaks, shading, fog, spraying, sprinkling or wet cover when necessary.

### 3.4 CURING AND PROTECTION

- A. Immediately following placement, concrete shall be protected from premature drying, hot and cold temperatures, rain, flowing water and mechanical injury.
- B. Materials and method of curing shall be approved by the Architect. Final curing shall continue for not less than 7 days.

1. Applications of Waterproof sheet material shall conform to ASTM C 171 (Latest Edition) "Specifications for Waterproof Sheet Materials for curing concrete".
  2. Application of liquid membrane-forming compound shall conform to ASTM C 309 (Latest Edition) "Specifications for Liquid Membrane-Forming Compounds for curing Concrete."
- C. Forms for walls shall be left in place for a minimum of 3 days.
- D. Grout cleaning of exposed walls: Exposed exterior concrete walls shall be patched as required and shall have a grout cleaned finish as indicated on drawings or as instructed by the Architect.
- E. No cleaning operations shall be undertaken until the walls of the building are entirely completed. Cleaning portions of the walls as the work progresses will not be permitted.
- F. The Contractor shall use the following method for grout cleaning of exposed concrete:
1. Mix 1 part Portland Cement and 1 ½ parts fine sand with enough water to produce a grout having the consistency of thick paint. White Portland cement shall be used for all or part of the cement in the grout, as directed by the Architect, to give the color desired. Wet the surface of the concrete and apply the grout with brushes or a spray gun uniformly, completely filling air bubbles and holes.
  2. Immediately after applying the grout, float the surface with a wood float, and scour the wall vigorously. The grout shall then be allowed to set partially for an hour or two depending on weather conditions. In hot, dry weather, the wall shall be kept damp during this period, using a fine fog spray. When grout has hardened so it can be scraped from the wall with the edge of a steel trowel without removing the grout from the small air holes cut off all that can be removed with a trowel. Next allow surface to dry thoroughly and rub it vigorously with a dry burlap to completely remove any dried grout. There shall be no visible film of grout remaining after this rubbing. The entire cleaning operation for any area must be completed the day it is started. No grout shall be left on the wall overnight and sufficient time shall be allowed for the grout to dry after it has been cut with the trowel so it can be wiped off clean with the burlap.
  3. After the entire building has been grout cleaned, if any slightly dark spots or streaks remain, they shall be wiped off lightly with a fine abrasive hone. The rubbing with the hone shall not be enough to change the texture of the concrete. This final operation shall be included as a part of the grout cleaning.
- G. Slab Finishing:
1. All interior concrete floor slabs shall be steel troweled to a smooth uniform finish, free from defects and blemishes, nothing to be added to either wet or dry finish. Steel troweling shall not be done until concrete has hardened sufficiently to prevent excess fine material from working to the surface.
  2. All exterior concrete floor slabs shall have a broom finish.

### 3.5 SLAB FLATNESS/LEVELNESS TOLERANCES

- A. Finished surfaces shall be smooth, free from blemishes and trowel marks, with a maximum variation in finish elevation as defined by ACI FF/FL requirements.
- B. All floor slabs shall conform to the following ACI F-number requirements::
1. Specified overall value of flatness, FF-35; and of levelness, FL-25; with minimum local values of flatness, FF-24; and of levelness, FL-17; for slabs-on-grade.

- C. Floor slab flatness and level tests on the slabs shall be conducted in accordance with the provisions set forth in ASTM E 1155.

3.6 PROTECTION OF WORK:

- C. Concrete shall be protected from damage. Damaged concrete shall be replaced at the Contractor's expense.
- B. This Contractor shall be responsible for the protection of concrete slabs on grade through winter weather. If they should heave due to cold weather, they shall be removed and replaced. All fill below the slabs shall be removed and replaced.

END OF SECTION 033000