

## SECTION 033053

## MISCELLANEOUS CAST-IN-PLACE CONCRETE

## PART 1 GENERAL

## 1.1 SUMMARY

Perform all work in accordance with **ACI MCP PACK** Parts 2 and 3.

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ACI INTERNATIONAL (ACI)

**ACI MCP PACK** (2010) Manual of Concrete Practice

## ASTM INTERNATIONAL (ASTM)

**ASTM A185/A185M** (2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

**ASTM A615/A615M** (2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

**ASTM C 1064/C 1064M** (2008) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

**ASTM C 143/C 143M** (2010) Standard Test Method for Slump of Hydraulic-Cement Concrete

**ASTM C 150/C 150M** (2009) Standard Specification for Portland Cement

**ASTM C 171** (2007) Standard Specification for Sheet Materials for Curing Concrete

**ASTM C 173/C 173M** (2010b) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

**ASTM C 309** (2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

**ASTM C 31/C 31M** (2010) Standard Practice for Making and Curing Concrete Test Specimens in the Field

**ASTM C 33/C 33M** (2011) Standard Specification for Concrete Aggregates

ASTM C 39/C 39M	(2010) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 494/C 494M	(2010a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 685/C 685M	(2010) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C 920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM C 94/C 94M	(2010a) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(2010) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C172/C172M	(2010) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM D 1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 75/D 75M	(2009) Standard Practice for Sampling Aggregates
ASTM E 1155	(1996; R 2008) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E 96/E 96M	(2010) Standard Test Methods for Water Vapor Transmission of Materials

#### U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
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### 1.3 SYSTEM DESCRIPTION

The Owner retains the option to sample and test joint sealer, joint filler material, aggregates and concrete to determine compliance with the specifications. Provide facilities and labor as may be necessary to assist the Owner in procurement of representative test samples. Obtain samples of aggregates at the point of batching in accordance with **ASTM D 75/D 75M**. Sample concrete in accordance with **ASTM C172/C172M**. Determine slump and air content in accordance with **ASTM C**

143/C 143M and ASTM C231/C231M, respectively, when cylinders are molded. Prepare, cure, and transport compression test specimens in accordance with ASTM C 31/C 31M. Test compression test specimens in accordance with ASTM C 39/C 39M. Take samples for strength tests not less than once each shift in which concrete is produced from each class of concrete required. Provide a minimum of three specimens from each sample; two to be tested at 28 days (90 days if pozzolan is used) for acceptance, and one will be tested at 7 days for information.

### 1.3.1 Strength

Acceptance test results are the average strengths of two specimens tested at 28 days (90 days if pozzolan is used). The strength of the concrete is considered satisfactory so long as the average of three consecutive acceptance test results equal or exceed the specified compressive strength, f'c, and no individual acceptance test result falls below f'c by more than 500 psi.

### 1.3.2 Construction Tolerances

Apply a Class "C" finish to all surfaces except those specified to receive a Class "D" finish. Apply a Class "D" finish to all post-construction surfaces which will be permanently concealed. Surface requirements for the classes of finish required are as specified in Part 4 of ACI MCP PACK.

### 1.3.3 Concrete Mixture Proportions

Concrete mixture proportions are the responsibility of the Contractor. Mixture proportions shall include the dry weights of cementitious material(s); the nominal maximum size of the coarse aggregate; the specific gravities, absorptions, and saturated surface-dry weights of fine and coarse aggregates; the quantities, types, and names of admixtures; and quantity of water per cubic yard of concrete. Provide materials included in the mixture proportions of the same type and from the same source as will be used on the project. Specified compressive strength f'c shall be 4,000 psi at 28 days (90 days if pozzolan is used). The maximum nominal size coarse aggregate is 3/4 inch, in accordance with ACI MCP PACK Part 3. The air content shall be between 4.5 and 7.5 percent with a slump between 2 and 5 inches. The maximum water cement ratio is 0.45. Submit the applicable test reports and mixture proportions that will produce concrete of the quality required, ten days prior to placement of concrete.

## 1.4 SUBMITTALS

Submit the following in accordance with Section 013300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings

SD-03 Product Data

Air-Entraining Admixture  
Water-Reducing or Retarding Admixture  
Curing Materials  
Expansion Joint Filler Strips, Premolded  
Joint Sealants  
Formwork

Forms  
Ready-Mix Concrete  
Mix Design Data  
Air-Entraining Admixtures  
Fly Ash  
Accessories  
Curing Compound

#### SD-06 Test Reports

Aggregates  
Concrete Mixture Proportions  
Compressive Strength Testing  
Slump

#### SD-07 Certificates

Cementitious Materials  
Aggregates  
Bill of Lading

## 1.5 QUALITY ASSURANCE

Indicate specific locations of Concrete Placement, Forms, Steel Reinforcement, Accessories, Expansion Joints, Construction Joints, Contraction Joints, and Control Joints on **installation drawings** and include, but not be limited to, square feet of concrete placements, thicknesses and widths, plan dimensions, and arrangement of cast-in-place concrete section.

### 1.5.1 Regulatory Requirements

The state statutory and regulatory requirements: FDOT form a part of this specification to the extent referenced. Submit **CPG for recycled materials or appropriate Waiver Form**.

### 1.5.2 Flatness and Levelness of Floor Slabs

Conduct floor flatness and levelness test, (FF and FL respectively), on floor slabs in accordance with the provisions set forth in **ASTM E 1155**. Also Zi calculation to be used shall be  $N \min. = A/10$ . Make floor tolerance measurements by the approved laboratory and inspection service within 24 hours after completion of final troweling operation and before forms and shores have been removed. Take measurements with a Dipstick Auto-Read floor profiler instrument. Provide results of floor tolerance tests, including formal notice of acceptance or rejection of the work, to the Owner/Engineer within 24 hours after data collection.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Submit manufacturer's literature from suppliers which demonstrates compliance with applicable specifications for the specified materials.

### 2.1.1 Cementitious Materials

Provide cementitious materials that conform to the appropriate specifications listed:

#### 2.1.1.1 Portland Cement

ASTM C 150/C 150M, Type I, or II.

#### 2.1.1.2 Pozzolan

Provide pozzolan that conforms to ASTM C 618, Class C or F, including requirements of Tables 1A and 2A.

### 2.1.2 Aggregates

Fine and coarse aggregates shall meet the quality and grading requirements of ASTM C 33/C 33M Class Designations 4M or better. Submit certificates of compliance and test reports for aggregates showing the material(s) meets the quality and grading requirements of the specifications under which it is furnished.

### 2.1.3 Admixtures

Admixtures to be used, when required or approved, shall comply with the appropriate specification listed. Retest chemical admixtures that have been in storage at the project site, for longer than 6 months or that have been subjected to freezing, at the expense of the Contractor at the request of the Owner/Engineer and will be rejected if test results are not satisfactory.

#### 2.1.3.1 Air-Entraining Admixture

Provide air-entraining admixture that meets the requirements of ASTM C260/C260M.

#### 2.1.3.2 Water-Reducing or Retarding Admixture

Provide water-reducing or retarding admixture meeting the requirements of ASTM C 494/C 494M, Type A, B, or D. High-range water reducing admixture Type F may be used only when approved, approval being contingent upon particular placement requirements as described in the Contractor's Quality Control Plan.

### 2.1.4 Water

Use fresh, clean, potable water for mixing and curing, free from injurious amounts of oil, acid, salt, or alkali, except that unpotable water may be used if it meets the requirements of COE CRD-C 400.

### 2.1.5 Reinforcing Steel

Provide reinforcing bars conforming to the requirements of ASTM A615/A615M, Grade 60. Welded steel wire fabric shall conform to the requirements of ASTM A185/A185M. Details of reinforcement not shown shall be in accordance with ACI MCP PACK Part 3, Chapters 7 and 12.

### 2.1.6 Expansion Joint Filler Strips, Premolded

Expansion joint filler strips, premolded shall be sponge rubber conforming to ASTM D 1752, Type I.

### 2.1.7 Joint Sealants - Field Molded Sealants

Joint sealants - field molded sealants shall conform to **ASTM C 920**, Type M, Grade NS, Class 25, use NT for vertical joints and Type M, Grade P, Class 25, use T for horizontal joints. Provide polyethylene tape, coated paper, metal foil, or similar type bond breaker materials. The backup material needs to be compressible, nonshrink, nonreactive with the sealant, and a nonabsorptive material such as extruded butyl or polychloroprene foam rubber. Immediately prior to installation of field-molded sealants, clean the joint of all debris and further cleaned using water, chemical solvents, or other means as recommended by the sealant manufacturer or directed.

### 2.1.8 Formwork

The design and engineering of the formwork as well as its construction, will be the responsibility of the Contractor.

### 2.1.9 Form Coatings

Coat forms, for exposed surfaces, with a nonstaining form oil to be applied shortly before concrete is placed.

### 2.1.10 Vapor Barrier

Provide polyethylene vapor barrier sheeting with a minimum thickness of 10 mils or other equivalent material having a vapor permeance rating not exceeding 0.5 perms as determined in accordance with **ASTM E 96/E 96M**.

### 2.1.11 Curing Materials

Provide curing materials conforming to the following requirements.

#### 2.1.11.1 Impervious Sheet Materials

Impervious sheet materials, **ASTM C 171**, type optional, except polyethylene film, if used, shall be white opaque.

#### 2.1.11.2 Membrane-Forming Curing Compound

**ASTM C 309**, Type 1-D or 2, Class A or B.

## 2.2 READY-MIX CONCRETE

- a. Concrete shall be ready-mix concrete with **mix design data** conforming to **ACI MCP PACK Part 2. Bill of Lading** for each ready-mix concrete delivery shall be in accordance with **ASTM C 94/C 94M**.
- b. Non-exposed concrete elements: 4,000 psi minimum compressive strength.
- c. Direct-exposed concrete elements (including air-conditioned rooms): 4,000 psi minimum compressive strength as determined in 28 calendar days.
- d. Slump: 2 to 5 inch according to **ASTM C 143/C 143M** and **ACI MCP PACK Part 1**.
- e. Portland Cement conforming to **ASTM C 150/C 150M**, Type I or II.
- f. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

- g. **Air-Entraining Admixtures** conforming to **ASTM C260/C260M**. Exterior concrete exposed to freezing needs to be air-entrained 5 to 6 percent by volume. Nonair-entrained interior concrete shall have a total air content of 2 to 4 percent by volume.
- h. Water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and accelerating admixtures, and water-reducing and retarding admixtures shall conform to **ASTM C 494/C 494M**.
- i. **Fly Ash** is required as an admixture and shall conform to **ASTM C 618**, Class C or F with 4 percent maximum loss on ignition and 35 percent maximum cement replacement by weight.
- j. Ground granulated blast furnace slag is required as an admixture and shall conform to **ASTM C 989**, Grade 120 with between 25 to 50 percent maximum cement replacement by weight.

## 2.3 STEEL REINFORCEMENT

### 2.3.1 Deformed Steel Bars

Provide steel bars conforming to **ASTM A615/A615M**, Grade 60 **ACI MCP PACK** Parts 2 and 3.

### 2.3.2 Welded Wire Fabric

Provide welded wire fabric conforming to **ASTM A185/A185M**.

## 2.4 FORMS

Forms shall be of wood, steel, or other approved material and conform to **ACI MCP PACK**, Parts 2 and 3.

Provide form release conforming to **ACI MCP PACK**, Part 4.

## 2.5 ACCESSORIES

### 2.5.1 Chemical Floor Hardener

Provide hardener which is a colorless aqueous solution containing a blend of magnesium fluorosilicate and zinc fluorosilicate combined with a wetting agent. Provide solution that contains not less than 2 pounds of fluorosilicates per gallon. An approved proprietary chemical hardener may be used provided hardener is delivered ready for use in manufacturer's original containers.

### 2.5.2 Curing Compound

Provide curing compound conforming to **ASTM C 309**.

## PART 3 EXECUTION

### 3.1 PREPARATION

Prepare construction joints to expose coarse aggregate. The surface shall be clean, damp, and free of laitance. Construct ramps and walkways, as necessary, to allow safe and expeditious access for

concrete and workmen. Remove snow, ice, standing or flowing water, loose particles, debris, and foreign matter. Earth foundations shall be satisfactorily compacted. Ensure spare vibrators are available. The entire preparation shall be accepted by the Owner prior to placing.

### 3.1.1 Embedded Items

Secure reinforcement in place after joints, anchors, and other embedded items have been positioned. Arrange internal ties so that when the forms are removed the metal part of the tie is not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structures. Embedded items shall be free of oil and other foreign matters such as loose coatings or rust, paint, and scale. The embedding of wood in concrete is permitted only when specifically authorized or directed. All equipment needed to place, consolidate, protect, and cure the concrete shall be at the placement site and in good operating condition.

### 3.1.2 Formwork Installation

Forms shall be properly aligned, adequately supported, and mortar-tight. Provide smooth form surfaces, free from irregularities, dents, sags, or holes when used for permanently exposed faces. Chamfer all exposed joints and edges, unless otherwise indicated.

### 3.1.3 Vapor Barrier Installation

Apply vapor barriers over gravel fill. Lap edges not less than 6 inches. Seal all joints with pressure-sensitive adhesive not less than 2 inches wide. Protect the vapor barrier at all times to prevent injury or displacement prior to and during concrete placement.

### 3.1.4 Production of Concrete

#### 3.1.4.1 Ready-Mixed Concrete

Provide ready-mixed concrete conforming to **ASTM C 94/C 94M** except as otherwise specified.

#### 3.1.4.2 Concrete Made by Volumetric Batching and Continuous Mixing

Concrete made by volumetric batching and continuous mixing shall conform to **ASTM C 685/C 685M**.

## 3.2 CONVEYING AND PLACING CONCRETE

Perform conveying and placing concrete in conformance with the following:

### 3.2.1 General

Concrete placement is not permitted when weather conditions prevent proper placement and consolidation without approval. When concrete is mixed and/or transported by a truck mixer, deliver the concrete to the site of the work completing the discharge within 1-1/2 hours. Convey concrete from the mixer to the forms as rapidly as practicable by methods which prevent segregation or loss of ingredients. Concrete shall be in place and consolidated within 15 minutes after discharge from the mixer. Deposit concrete as close as possible to its final position in the forms and regulate it so that it may be effectively consolidated in horizontal layers 18 inches or less in thickness with a minimum of lateral movement. Carry on the placement at such a rate that the formation of cold joints will be

prevented. Submit Methods and equipment for transporting, handling, depositing, and consolidating the concrete prior to the first concrete placement.

### 3.2.2 Consolidation

Consolidate each layer of concrete by rodding, spading, or internal vibrating equipment. Systematically accomplish internal vibration by inserting the vibrator through the fresh concrete in the layer below at a uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator and overlay the adjacent, just-vibrated area by approximately 4 inches. Ensure that the vibrator penetrates rapidly to the bottom of the layer and at least 6 inches into the layer below, if such a layer exists. Hold vibrator stationary until the concrete is consolidated and then withdraw it slowly at the rate of about 3 inches per second.

### 3.2.3 Cold-Weather Requirements

No concrete is to be mixed or placed when the ambient temperature is below 36 degrees F or if the ambient temperature is below 41 degrees F and falling. Provide suitable covering and other means as approved for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing and at a temperature above freezing for the remainder of the curing period. Do not mix salt, chemicals, or other foreign materials with the concrete to prevent freezing. Remove and replace concrete damaged by freezing at the expense of the Contractor.

### 3.2.4 Hot-Weather Requirements

When the rate of evaporation of surface moisture, as determined by use of Figure 1 of **ACI MCP PACK** Part 2, is expected to exceed 0.2 psf per hour, provisions for windbreaks, shading, fog spraying, or covering with a light-colored material shall be made in advance of placement, and such protective measures taken as quickly as finishing operations will allow.

### 3.2.5 Lifts in Concrete

Deposit concrete in horizontal layers not to exceed 24 inches in thickness. Carry on placement at a rate that prevents the formation of cold joints. Place slabs in one lift.

## 3.3 FORM REMOVAL

Do not remove forms before 24 hours after concrete placement, except as otherwise specifically authorized. Do not remove supporting forms and shoring until the concrete has cured for at least 5 days. When conditions require longer curing periods, forms shall remain in place.

## 3.4 FINISHING

### 3.4.1 General

Do not finish or repair concrete when either the concrete or the ambient temperature is below 50 degrees F.

### 3.4.2 Finishing Formed Surfaces

Remove all fins and loose materials, and surface defects including filling of tie holes. Repair all honeycomb areas and other defects. Remove all unsound concrete from areas to be repaired. Surface defects greater than 1/2 inch in diameter and holes left by removal of tie rods in all surfaces not to receive additional concrete shall be reamed or chipped and filled with dry-pack mortar. Brush-coat the prepared area with an approved epoxy resin or latex bonding compound or with a neat cement grout after dampening and filling with mortar or concrete. The cement used in mortar or concrete for repairs to all surfaces permanently exposed to view shall be a blend of portland cement and white cement so that the final color when cured is the same as adjacent concrete.

### 3.4.3 Finishing Unformed Surfaces

Float finish all unformed surfaces, that are not to be covered by additional concrete or backfill, to elevations shown, unless otherwise specified. Surfaces to receive additional concrete or backfill shall be brought to the elevations shown and left as a true and regular surface. Slope exterior surfaces for drainage unless otherwise shown. Carefully make joints with a jointing tool. Finish unformed surfaces to a tolerance of 3/8 inch for a float finish and 5/16 inch for a trowel finish as determined by a 10 foot straightedge placed on surfaces shown on the drawings to be level or having a constant slope. Do not perform finishing while there is excess moisture or bleeding water on the surface. No water or cement is to be added to the surface during finishing.

#### 3.4.3.1 Float Finish

Provide float finished surfaces, screeded and darried or bullfloated to eliminate the ridges and to fill in the voids left by the screed. In addition, the darby or bullfloat shall fill all surface voids and only slightly embed the coarse aggregate below the surface of the fresh concrete. When the water sheen disappears and the concrete supports a person's weight without deep imprint, complete floating. Floating shall embed large aggregates just beneath the surface, remove slight imperfections, humps, and voids to produce a plane surface, compact the concrete, and consolidate mortar at the surface.

#### 3.4.3.2 Trowel Finish

Apply a trowel finish as indicated on plans. Trowelling shall be done immediately following floating to provide a smooth, even, dense finish free from blemishes including trowel marks. Protect finished surfaces from damage during the construction period.

#### 3.4.3.3 Flat Floor Finishes

In accordance with **ACI MCP PACK** Part 2, construct in accordance with one of the methods recommended in Table 7.15.3, "Typical Composite FF/FL Values for Various Construction Methods." **ACI MCP PACK** Part 1 for tolerances tested by **ASTM E 1155**. These requirements are based upon the latest FF/FL method. Floor slabs shall conform to the following ACI F-number requirements unless noted otherwise:

- a. Slab on Grade: As indicated on plans

#### 3.4.3.4 Measurement of Floor Tolerances

Test floor slabs within 24 hours of the final troweling. Submit test results to Owner within 12 hours after collecting data. Floor flatness inspector shall provide a tolerance report which includes:

- a. Name of Project
- b. Name of Contractor
- c. Date of Data Collection
- d. Date of Tolerance Report
- e. A Key Plan Showing Location of Data Collected
- f. Results Required by [ASTM E 1155](#)

#### 3.4.3.5 Broom Finish

Apply a broom finish to indicated surfaces. Screed and float the concrete to required finish plane with no coarse aggregate visible. After surface moisture disappears, broom or brush the surface with a broom or fiber bristle brush in a direction transverse to that of the main traffic or as directed.

#### 3.4.3.6 Contraction Joints

Make contraction joints in accordance with the details shown or as otherwise specified. Provide contraction joints at a maximum spacing of 6 linear feet in sidewalks. Cut contraction joints at a minimum of 1 inch deep with a jointing tool after the surface has been finished.

### 3.5 CURING AND PROTECTION

Beginning immediately after placement, and continuing for at least 7 days, cure and protect all concrete from premature drying, extremes in temperature, rapid temperature change, freezing, mechanical damage, and exposure to rain or flowing water. Provide all materials and equipment needed for adequate curing and protection at the site of the placement prior to the start of concrete placement. Accomplish moisture preservation of moisture for concrete surfaces not in contact with forms by one of the following methods:

- a. Continuous sprinkling or ponding.
- b. Application of absorptive mats or fabrics kept continuously wet.
- c. Application of sand kept continuously wet.
- d. Application of impervious sheet material conforming to [ASTM C 171](#).
- e. Application of membrane-forming curing compound conforming to [ASTM C 309](#), Type 1-D, on surfaces permanently exposed to view. Accomplish Type 2 on other surfaces in accordance with manufacturer's instructions.

Accomplish the preservation of moisture for concrete surfaces placed against wooden forms by keeping the forms continuously wet for 7 days. If forms are removed prior to end of the required curing period, use other curing methods for the balance of the curing period. Do not perform protection removal if the temperature of the air in contact with the concrete may drop more than 60 degrees F within a 24 hour period.

### 3.6 TESTS AND INSPECTIONS

#### 3.6.1 Field Testing Technicians

The individuals who sample and test concrete, as required in this specification, shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.

### 3.6.2 Inspection Details and Frequency of Testing

#### 3.6.2.1 Preparations for Placing

Inspect foundation or construction joints, forms, and embedded items in sufficient time prior to each concrete placement by the Contractor to certify that it is ready to receive concrete.

#### 3.6.2.2 Air Content

Check air content at least twice during each shift that concrete is placed for each class of concrete required. Obtain samples in accordance with [ASTM C172/C172M](#) and tested in accordance with [ASTM C231/C231M](#).

#### 3.6.2.3 Slump

Check slump twice during each shift that concrete is produced for each class of concrete required. Obtain samples in accordance with [ASTM C172/C172M](#) and tested in accordance with [ASTM C 143/C 143M](#).

#### 3.6.2.4 Consolidation and Protection

Ensure that the concrete is properly consolidated, finished, protected, and cured.

### 3.6.3 Action Required

#### 3.6.3.1 Placing

Do not permit placing to begin until the availability of an adequate number of acceptable vibrators, which are in working order and have competent operators, has been verified. Do not continue placing if any pile is inadequately consolidated.

#### 3.6.3.2 Air Content

Whenever an air content test result is outside the specification limits, adjust the dosage of the air-entrainment admixture prior to delivery of concrete to forms.

#### 3.6.3.3 Slump

Whenever a slump test result is outside the specification limits, adjust the batch weights of water and fine aggregate prior to delivery of concrete to the forms. The adjustments are to be made so that the water-cement ratio does not exceed that specified in the submitted concrete mixture proportion.

### 3.6.4 Reports

Report the results of all tests and inspections conducted at the project site informally at the end of each shift. Submit written reports weekly. Deliver within 3 days after the end of each weekly reporting period.

### 3.7 FORM WORK

Form work shall conform to **ACI MCP PACK** Parts 2 through 5.

#### 3.7.1 Preparation of Form Surfaces

Forms shall be true to line and grade, mortar-tight, and sufficiently rigid to prevent objectionable deformation under load. Form surfaces for permanently exposed faces shall be smooth, free from irregularities, dents, sags, or holes. Chamfer exposed joints and exposed edges. Arrange internal ties so that when the forms are removed, the form ties are not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structure.

#### 3.7.2 Form Coating

Coat forms, for exposed surfaces, with a nonstaining form release coating applied before the steel case is added to avoid contaminating the reinforcing steel. Forms for unexposed surfaces may be wetted in lieu of coating immediately before the placing of concrete, except that in freezing weather form release coating shall be used.

#### 3.7.3 Removal of Forms

Remove forms carefully to prevent damage to the concrete. Do not remove forms before the expiration of the minimum time indicated below:

Arches, beams and deck-type slabs	144 hours
Columns and walls (lifts 15 feet and under)	24 hours

### 3.8 STEEL REINFORCING

Reinforcement shall be free from loose, flaky rust and scale, and free from oil, grease, or other coating which might destroy or reduce the reinforcement's bond with the concrete.

#### 3.8.1 Fabrication

Shop fabricate steel reinforcement in accordance with **ACI MCP PACK** Parts 2 and 3. Shop details and bending shall be in accordance with **ACI MCP PACK** Parts 2 and 3.

#### 3.8.2 Splicing

Perform splices in accordance with **ACI MCP PACK** Parts 2 and 3.

#### 3.8.3 Supports

Secure reinforcement in place by the use of metal or concrete supports, spacers, or ties.

### 3.9 EMBEDDED ITEMS

Before placing concrete, take care to determine that all embedded items are firmly and securely fastened in place. Provide embedded items free of oil and other foreign matter, such as loose coatings

of rust, paint and scale. Embedding of wood in concrete is permitted only when specifically authorized or directed.

### 3.10 CHEMICAL-HARDENER TREATMENT

Apply Liquid-Chemical Floor Hardener where indicated, after curing and drying concrete surface. Dilute liquid hardener with water and apply in three coats. First coat shall be one-third strength, second coat one-half strength, and third coat two-thirds strength. Apply each coat evenly and allow it to dry 24 hours before applying next coat. Apply proprietary chemical hardeners in accordance with manufacturer's printed directions.

### 3.11 FIELD TESTING

- a. Provide samples and test concrete for quality control during placement. Sampling of fresh concrete for testing shall be in accordance with [ASTM C172/C172M](#).
- b. Test concrete for compressive strength at 7 and 28 days for each design mix. Concrete test specimens shall conform to [ASTM C 31/C 31M](#). Perform [Compressive strength testing](#) conforming to [ASTM C 39/C 39M](#).
- c. Test [Slump](#) at the site of discharge for each design mix in accordance with [ASTM C 143/C 143M](#).
- d. Test air content for air-entrained concrete in accordance with [ASTM C231/C231M](#). Test concrete using lightweight or test extremely porous aggregates in accordance with [ASTM C 173/C 173M](#).
- e. Determine temperature of concrete at time of placement in accordance with [ASTM C 1064/C 1064M](#).

END OF SECTION 033053