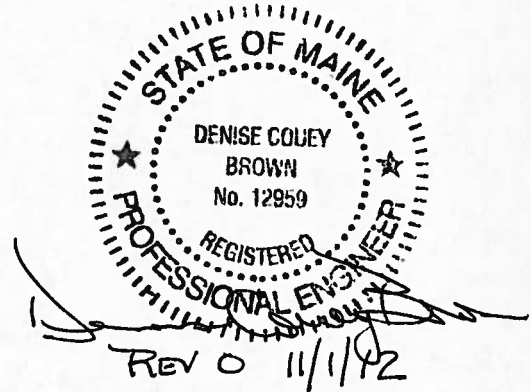


SECTION 03 30 53

MISCELLANEOUS CAST-IN-PLACE CONCRETE  
04/08



PART 1 GENERAL

1.1 SUMMARY

Perform all work in accordance with ACI MCP SET 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 SET (2009) Manual of Concrete Practice

ASTM INTERNATIONAL (ASTM)

ASTM A 185/A 185M (2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

ASTM A 615/A 615M (2009) 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 (2009) 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

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|                   |  |
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| ASTM C 172        | (2008) Standard Practice for Sampling Freshly Mixed Concrete   |
| ASTM C 231        | (2009a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method            |
| ASTM C 309        | (2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete                  |
| ASTM C 31/C 31M   | (2009) Standard Practice for Making and Curing Concrete Test Specimens in the Field                      |
| ASTM C 33/C 33M   | (2008) Standard Specification for Concrete Aggregates  |
| ASTM C 39/C 39M   | (2005e1e2) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens               |
| ASTM C 494/C 494M | (2008a) 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 | (2007) Concrete Made by Volumetric Batching and Continuous Mixing  |
| ASTM C 94/C 94M   | (2009) Standard Specification for Ready-Mixed Concrete   |

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

The Government retains the option to sample and test aggregates and concrete to determine compliance with the specifications. Sample concrete in accordance with ASTM C 172. Determine slump and air content in accordance with ASTM C 143/C 143M and ASTM C 231, 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. Provide a minimum of four specimens from each sample; two to be tested at 28 days for acceptance, and two will be tested at 5 days for information to allow equipment placement on foundations.

1.3.1 Strength

Acceptance test results are the average strengths of two specimens tested at 28 days. The strength of the concrete is considered satisfactory so long as the average of three consecutive acceptance test results equal or exceed 4,000 psi, and no individual acceptance test result falls below f'c

by more than 500 psi. The specified compressive strength f'c of 5,000 psi at 28 days is being specified to allow earlier setting of modules and equipment. The 5 day test of compressive strength shall be a minimum of 2,500 psi in order to allow setting of modules or empty equipment no earlier than 7 days following placement of the foundation.

#### 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 SET.

#### 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 5,000 psi at 28 days. The maximum nominal size coarse aggregate is 3/4 inch, in accordance with ACI MCP SET 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 0.50.

#### 1.4 SUBMITTALS

The following submittals are required for approval:

##### SD-02 Shop Drawings

Reinforcing steel

Reproductions of contract drawings are unacceptable.

##### SD-06 Test Reports

Concrete Mixture Proportions

The mixture proportions that will produce concrete of the quality required, ten days prior to placement of concrete. Applicable test reports to verify that the concrete mixture proportions selected will produce concrete of the quality specified.

Compressive Strength Testing

##### SD-07 Certificates

Cementitious Materials

Manufacturer's certificates of compliance, accompanied by mill test reports, attesting that the concrete materials meet the requirements of the specifications in accordance with the Special

Clause "CERTIFICATES OF COMPLIANCE".

Aggregates

Certificates of compliance stating that the material(s) meet the quality and grading requirements of the specifications under which it is furnished.

PART 2 PRODUCTS

2.1 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 Fly Ash

Provide fly ash 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.

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 Site Manager and will be rejected if test results are not satisfactory.

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 A 615/A 615M, Grade 60. Welded steel wire fabric shall conform to the requirements of ASTM A 185/A 185M. Details of reinforcement not shown shall be in accordance with ACI MCP SET Part 3, Chapters 7 and 12.

2.1.6 Form Coatings

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

### 2.1.7 Curing Materials

Provide curing materials conforming to the following requirements.

#### 2.1.7.1 Impervious Sheet Materials

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

#### 2.1.7.2 Membrane-Forming Curing Compound

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

### 2.2 READY-MIX CONCRETE

a. Concrete shall be ready-mix concrete with mix design data conforming to ACI MCP SET Part 2.

b. Concrete foundations and pedestals: 5000 psi minimum compressive strength as determined in 28 calendar days.

c. Slump: 2 to 5 inch according to ASTM C 143/C 143M and ACI MCP SET Part 1.

d. 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.

e. Fly Ash used as an admixture 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.

### 2.3 STEEL REINFORCEMENT

#### 2.3.1 Deformed Steel Bars

Provide steel bars conforming to ASTM A 615/A 615M, Grade 60 ksi ACI MCP SET Parts 2 and 3.

### 2.4 FORMS

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

Provide form release conforming to ACI MCP SET, Part 4.

## PART 3 EXECUTION

### 3.1 PREPARATION

Construct ramps and walkways, as necessary, to allow safe and expeditious access for concrete and workmen. Earth foundations shall be satisfactorily compacted. Ensure spare vibrators are available. The entire preparation shall be accepted by the Site Manager 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. 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 Production of Concrete

#### 3.1.3.1 Ready-Mixed Concrete

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

#### 3.1.3.2 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

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 or 45 minutes when the placing temperature is 86 degrees F or greater unless a retarding admixture is used. 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. Perform conveying and placing concrete in conformance with the following requirements.

### 3.2.1 Consolidation

Consolidate each layer of concrete by 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.

### 3.2.2 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.

### 3.2.3 Hot-Weather Requirements

When the rate of evaporation of surface moisture, as determined by use of Figure 1 of ACI MCP SET 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.

### 3.3 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 Temperature Requirement

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. Finish unformed surfaces to a tolerance of 3/8 inch for a float 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 darbied 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 Broom Finish

Apply a broom finish to slabs and pads. 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.

3.5 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 impervious sheet material conforming to ASTM C 171.
- d. 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 Slump

Check slump once during each shift that concrete is produced. Obtain samples in accordance with ASTM C 172 and tested in accordance with ASTM C 143/C 143M.

#### 3.6.2.3 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 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 SET 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. 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.

### 3.8 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 SET Parts 2 and 3. Shop details and bending shall be in accordance with ACI MCP SET Parts 2 and 3.

#### 3.8.2 Splicing

Perform splices in accordance with ACI MCP SET 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 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 C 172.
- b. Test concrete for compressive strength at 5 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. Determine temperature of concrete at time of placement in accordance with ASTM C 1064/C 1064M.

-- End of Section --