
USACE / NAVFAC / AFCEC / NASA UFGS-03 30 53 (April 2008)

Preparing Activity: USACE Superseding
UFGS-03 30 04 (April 2006)
UFGS-03 30 53.00 40 (July 2007)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2014

SECTION TABLE OF CONTENTS

DIVISION 03 - CONCRETE

SECTION 03 30 53

MISCELLANEOUS CAST-IN-PLACE CONCRETE

04/08

PART 1 GENERAL

- 1.1 SUMMARY
- 1.2 UNIT PRICES
 - 1.2.1 Concrete Payment
 - 1.2.2 Measurement
 - 1.2.3 Unit of Measure
- 1.3 REFERENCES
- 1.4 SYSTEM DESCRIPTION
 - 1.4.1 Strength
 - 1.4.2 Construction Tolerances
 - 1.4.3 Concrete Mixture Proportions
- 1.5 SUBMITTALS
- 1.6 QUALITY ASSURANCE
 - 1.6.1 Regulatory Requirements
 - 1.6.2 Flatness and Levelness of Floor Slabs

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Cementitious Materials
 - 2.1.1.1 Portland Cement
 - 2.1.1.2 Blended Hydraulic Cement
 - 2.1.1.3 Pozzolan
 - 2.1.2 Aggregates
 - 2.1.3 Admixtures
 - 2.1.3.1 Air-Entraining Admixture
 - 2.1.3.2 Accelerating Admixture
 - 2.1.3.3 Water-Reducing or Retarding Admixture
 - 2.1.4 Water
 - 2.1.5 Reinforcing Steel
 - 2.1.6 Expansion Joint Filler Strips, Premolded
 - 2.1.7 Joint Sealants - Field Molded Sealants
 - 2.1.8 Waterstops
 - 2.1.9 Formwork

- 2.1.10 Form Coatings
- 2.1.11 Vapor Barrier
- 2.1.12 Curing Materials
 - 2.1.12.1 Impervious Sheet Materials
 - 2.1.12.2 Membrane-Forming Curing Compound
- 2.2 READY-MIX CONCRETE
- 2.3 STEEL REINFORCEMENT
 - 2.3.1 Deformed Steel Bars
 - 2.3.2 Welded Wire Fabric
- 2.4 FORMS
- 2.5 ACCESSORIES
 - 2.5.1 Waterstops
 - 2.5.2 Chemical Floor Hardener
 - 2.5.3 Curing Compound

PART 3 EXECUTION

- 3.1 PREPARATION
 - 3.1.1 Embedded Items
 - 3.1.2 Formwork Installation
 - 3.1.3 Vapor Barrier Installation
 - 3.1.4 Production of Concrete
 - 3.1.4.1 Ready-Mixed Concrete
 - 3.1.4.2 Concrete Made by Volumetric Batching and Continuous Mixing
 - 3.1.4.3 Batching and Mixing Equipment
 - 3.1.5 Waterstops
- 3.2 CONVEYING AND PLACING CONCRETE
 - 3.2.1 Consolidation
 - 3.2.2 Cold-Weather Requirements
 - 3.2.3 Hot-Weather Requirements
 - 3.2.4 Lifts in Concrete
- 3.3 FORM REMOVAL
- 3.4 FINISHING
 - 3.4.1 Temperature Requirement
 - 3.4.2 Finishing Formed Surfaces
 - 3.4.3 Finishing Unformed Surfaces
 - 3.4.3.1 Float Finish
 - 3.4.3.2 Trowel Finish
 - 3.4.3.3 Flat Floor Finishes
 - 3.4.3.3.1 Floor Slabs
 - 3.4.3.3.1.1 Slab on Grade
 - 3.4.3.3.1.2 Level Suspended Slabs Shored Until After Testing
 - 3.4.3.3.1.3 Unlevel Shored Suspended Slabs and Unshored Suspended Slabs
 - 3.4.3.3.2 Subject to Vehicular Traffic
 - 3.4.3.3.2.1 Slab on Grade
 - 3.4.3.3.2.2 Level Suspended Slabs Shored Until After Testing
 - 3.4.3.3.2.3 Unlevel Shored Suspended Slabs and Unshored Suspended Slabs
 - 3.4.3.4 Measurement of Floor Tolerances
 - 3.4.3.5 Broom Finish
 - 3.4.3.6 Expansion and Contraction Joints
- 3.5 CURING AND PROTECTION
- 3.6 TESTS AND INSPECTIONS
 - 3.6.1 Field Testing Technicians
 - 3.6.2 Inspection Details and Frequency of Testing
 - 3.6.2.1 Preparations for Placing
 - 3.6.2.2 Air Content
 - 3.6.2.3 Slump

3.6.2.4	Consolidation and Protection
3.6.3	Action Required
3.6.3.1	Placing
3.6.3.2	Air Content
3.6.3.3	Slump
3.6.4	Reports
3.7	FORM WORK
3.7.1	Preparation of Form Surfaces
3.7.2	Form Coating
3.7.3	Removal of Forms
3.8	STEEL REINFORCING
3.8.1	Fabrication
3.8.2	Splicing
3.8.3	Supports
3.9	EMBEDDED ITEMS
3.10	CHEMICAL-HARDENER TREATMENT
3.11	FIELD TESTING
-- End of Section Table of Contents --	

USACE / NAVFAC / AFCEC / NASA UFGS-03 30 53 (April 2008)

Preparing Activity: USACE Superseding
UFGS-03 30 04 (April 2006)
UFGS-03 30 53.00 40 (July 2007)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2014

SECTION 03 30 53

MISCELLANEOUS CAST-IN-PLACE CONCRETE
04/08

NOTE: This guide specification covers the requirements for projects involving amounts of concrete less than 380 cubic meters (500 cubic yards). This section was originally developed for USACE Civil Works projects.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

NOTE: This specification requires furnishing all material and equipment, and performing all labor for the manufacturing, transporting, placing, finishing, and curing of concrete for recreation sites, road relocations, or other structures such as culvert headwalls, comfort stations, residences, or low head gate structures. Consideration should be given to using Section 03 31 01.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS when the quantity of concrete is 380 cubic meters (500 cubic) or greater per structure.

1.1 SUMMARY

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

1.2 UNIT PRICES

NOTE: If Section 01 22 00.00 10 MEASUREMENT AND
PAYMENT is included in the project specifications,
this paragraph title (UNIT PRICES) should be deleted
from this section and the remaining appropriately
edited subparagraphs below should be inserted into
Section 01 22 00.00 10.

1.2.1 Concrete Payment

Payment will cover all costs associated with[manufacturing,] furnishing, delivering, placing, finishing, and curing of concrete for the various items of the schedule, including the cost of all formwork. Payment for concrete, for which payment is made as a lump sum, [is] [is not] to be included in this unit price payment item. Payment for grout, preformed expansion joints, field-molded sealants, waterstops, reinforcing steel bars or wire reinforcement [is] [is not] to be included in this unit price payment item.

1.2.2 Measurement

Concrete will be measured for payment on the basis of the actual volume of concrete within the pay lines of the structures as indicated. Measurement of concrete placed against the sides of any excavation without the use of intervening forms will be made only within the pay lines of the structure. No deductions will be made for rounded or beveled edge, for space occupied by metal work, for electrical conduits or timber, or for voids or embedded items that are either less than 0.14 cubic meter 5 cubic feet in volume or 0.1 square meter 1 square foot in cross section.

1.2.3 Unit of Measure

Unit of measure: cubic meter yard.

1.3 REFERENCES

NOTE: This paragraph is used to list the
publications cited in the text of the guide
specification. The publications are referred to in
the text by basic designation only and listed in
this paragraph by organization, designation, date,
and title.

Use the Reference Wizard's Check Reference feature
when you add a RID outside of the Section's
Reference Article to automatically place the
reference in the Reference Article. Also use the
Reference Wizard's Check Reference feature to update
the issue dates.

References not used in the text will automatically
be deleted from this section of the project
specification when you choose to reconcile
references in the publish print process.

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.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI MCP SET (2013) Manual of Concrete Practice

ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M (2013) Standard Specification for
Carbon-Steel Wire and Welded Wire
Reinforcement, Plain and Deformed, for
Concrete

ASTM A615/A615M (2013) Standard Specification for Deformed
and Plain Carbon-Steel Bars for Concrete
Reinforcement

ASTM C1064/C1064M (2011) Standard Test Method for
Temperature of Freshly Mixed
Hydraulic-Cement Concrete

ASTM C1260 (2007) Standard Test Method for Potential
Alkali Reactivity of Aggregates
(Mortar-Bar Method)

ASTM C143/C143M (2012) Standard Test Method for Slump of
Hydraulic-Cement Concrete

ASTM C150/C150M (2012) Standard Specification for Portland
Cement

ASTM C1567 (2013) Standard Test Method for Potential
Alkali-Silica Reactivity of Combinations
of Cementitious Materials and Aggregate
(Accelerated Mortar-Bar Method)

ASTM C171 (2007) Standard Specification for Sheet
Materials for Curing Concrete

ASTM C172/C172M (2010) Standard Practice for Sampling
Freshly Mixed Concrete

ASTM C173/C173M (2012) Standard Test Method for Air
Content of Freshly Mixed Concrete by the
Volumetric Method

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 C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2012) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2013) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2012) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C494/C494M	(2013) Standard Specification for Chemical Admixtures for Concrete
ASTM C595/C595M	(2013) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C685/C685M	(2011) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM C94/C94M	(2013a) Standard Specification for Ready-Mixed Concrete
ASTM C989/C989M	(2012a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C990M	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants (Metric)
ASTM D1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D2628	(1991; R 2011) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D75/D75M	(2009) Standard Practice for Sampling Aggregates

ASTM D98	(2005) Calcium Chloride
ASTM E1155	(1996; R 2008) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E1155M	(1996; R 2008) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers (Metric)
ASTM E96/E96M	(2012) 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
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)	
40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.4 SYSTEM DESCRIPTION

The Government retains the option to sample and test [joint sealer, joint filler material, waterstop,] aggregates and concrete to determine compliance with the specifications. Provide facilities and labor as may be necessary to assist the Government in procurement of representative test samples. Obtain samples of aggregates at the point of batching in accordance with [ASTM D75/D75M](#). Sample concrete in accordance with [ASTM C172/C172M](#). Determine slump and air content in accordance with [ASTM C143/C143M](#) and [ASTM C231/C231M](#), respectively, when cylinders are molded. Prepare, cure, and transport compression test specimens in accordance with [ASTM C31/C31M](#). Test compression test specimens in accordance with [ASTM C39/C39M](#). 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.

1.4.1 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 [3.4 MPa 500 psi](#).

1.4.2 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](#).

1.4.3 Concrete Mixture Proportions

NOTE: The nominal maximum size of the coarse aggregate is as specified in ACI 318, paragraph 3.3.2 and ACI 318M.

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 meter 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 [20.7] [] MPa [3,000] [] psi at 28 days (90 days if pozzolan is used). The maximum nominal size coarse aggregate is [19] [25] [37.5] mm [3/4] [1] [1-1/2] 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 50 and 125 mm 2 and 5 inches. The maximum water cement ratio is [0.50] []. Submit the applicable test reports and mixture proportions that will produce concrete of the quality required, ten days prior to placement of concrete.

1.5 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings

SD-03 Product Data

Air-Entraining Admixture
Accelerating Admixture
Water-Reducing or Retarding Admixture
Curing Materials
Expansion Joint Filler Strips, Premolded
Joint Sealants - Field Molded Sealants
Waterstops
Batching and Mixing Equipment
Conveying and Placing Concrete
Formwork
Forms
Ready-Mix Concrete
Mix Design Data
Air-Entraining Admixtures
Fly Ash
Accessories
Curing Compound
Measurement of Floor Tolerances

SD-06 Test Reports

Aggregates
Concrete Mixture Proportions
Compressive Strength Testing
Slump

SD-07 Certificates

Cementitious Materials
CPG for recycled materials or appropriate Waiver Form
Aggregates
[Bill of Lading]

1.6 QUALITY ASSURANCE

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

1.6.1 Regulatory Requirements

NOTE: This section relates to the implementation of RCRA of 1976 as amended (42 USC 6901) which requires that EPA designated items be used to the maximum extent practicable.

One of the requirements of 40 CFR 247 is that agencies promote the use of products containing recycled materials. Parts of this guide specification are only promotional in nature in that they recommend or encourage, in lieu of requiring, the Contractor to use products containing recycled materials. Coordinate this section with Section 01 62 35 RECYCLED/RECOVERED/BIOBASED MATERIALS in every project where 40 CFR 247 is applicable.

Include the applicable state highway department document title in which an acceptable gradation for the concrete aggregate is presented.

The state statutory and regulatory requirements: [_____] form a part of this specification to the extent referenced. Submit [CPG for recycled materials or appropriate Waiver Form](#).

1.6.2 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 E1155M](#) [ASTM E1155](#). 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 Contracting Officer 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](#)

Submit 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". Also, certificates for all material conforming to EPA's Comprehensive Procurement Guidelines (CPG), in accordance with [40 CFR 247](#). Provide cementitious materials that conform to the appropriate specifications listed:

2.1.1.1 Portland Cement

NOTES: Limit the use of air-entraining cement to concrete placements where separate batching of air-entraining admixture is not practical.

Tricalcium aluminate, for sulfate resistance, is limited to Type III cement. If high early strength is not required, specify Type II rather than Type I when moderate sulfate resistance is required, or Type V when high sulfate resistance is required.

Specify low-alkali cement when the aggregate is either silica or carbonate reactive.

ASTM C150/C150M, Type [I, IA, II, IIA, III, IIIA or V], [low alkali] [, except that the tricalcium aluminate of the Type III or IIIA cement shall be limited to [5] [8] percent].

[2.1.1.2 Blended Hydraulic Cement

NOTES: Limit the use of air-entraining cement to concrete placements where separate batching of air-entraining admixture is not practical.

Specify low-alkali cement when reactive aggregates are to be used.

Use the MS suffix when moderate sulfate resistance is needed and the material is available.

Use the MH suffix when the concrete sections are relative massive and heat of hydration may be a problem.

ASTM C595/C595M, Type IS[MS] [MH] [-A], IP[MS] [MH] [-A], P[MS] [LH] [-A], I[PM] [MS] [MH], I[SM] [MS] [MH] [-A] or [_____] [with Table 2 mortar expansion limits].

]2.1.1.3 Pozzolan

Provide pozzolan that conforms to ASTM C618, Class C or F, including requirements of Tables 1A and 2A.

2.1.2 Aggregates

NOTE: This note may be disregarded for regions where Alkali-Silica Reactivity (ASR) is not a concern. Some aggregate sources may exhibit an ASR potential. ASR is a potentially deleterious reaction between alkalis present in concrete and some siliceous aggregates, reference EM 1110-2-2000 paragraph 2-3b(6) and appendix D. Where ASR is known or suspected to pose a concern for concrete durability, it is recommended that aggregates proposed for use in concrete be evaluated to determine ASR potential and an effective

mitigation. EM 1110-2-2000, provides recommendations for evaluating and mitigating ASR in concrete mixtures. Aggregate evaluations may not be practical for projects requiring small quantities of concrete (less than 190 cubic meters (250 cubic yards)).

Section 32 13 11 CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY-DUTY PAVEMENTS MORE THAN 7,700 CUBIC METERS (10,000 CUBIC YARDS), paragraph 2.2.1.2 Alkali-Silica Reactivity, provides a specification method for the Contractor to evaluate and mitigate ASR in concrete mixtures. The expansion limits specified in Section 32 13 11 are requirements for pavements and exterior slab construction. For structural concrete applications the measured expansion must be less than 0.10 percent. It may not be economical or practical to specify different test limit requirements for use on the same project, in which case the lower limit is required by the application

The designer may use the specification method in Section 32 13 11 by incorporating the relevant paragraphs into this specification, or may use the following requirements (retain either the 0.10 or the 0.08 percent expansion limits as appropriate).

Fine and coarse aggregates shall [meet the quality and grading requirements of [ASTM C33/C33M Class Designations 4M or better] [or] [state highway department specification in accordance with paragraph REGULATORY REQUIREMENTS]] "[be tested and evaluated for alkali-aggregate reactivity in accordance with ASTM C1260. Perform evaluation of fine and coarse aggregates separately and in combination, matching the proposed mix design proportioning. All results of the separate and combination testing shall have a measured expansion less than 0.10 (0.08) percent at 16 days after casting. If the test data indicates an expansion of 0.10 (0.08) percent or greater, reject the aggregate(s) or perform additional testing using ASTM C1260 and ASTM C1567. Perform the additional testing using ASTM C1260 and ASTM C1567 using the low alkali portland cement in combination with ground granulated blast furnace (GGBF) slag, or Class F fly ash. Use GGBF slag in the range of 40 to 50 percent of the total cementitious material by mass. Use Class F fly ash in the range of 25 to 40 percent of the total cementitious material by mass]". 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 Contracting Officer 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 Accelerating Admixture

Provide calcium chloride meeting the requirements of **ASTM D98**. Other accelerators shall meet the requirements of **ASTM C494/C494M**, Type C or E.

] 2.1.3.3 Water-Reducing or Retarding Admixture

Provide water-reducing or retarding admixture meeting the requirements of **ASTM C494/C494M**, Type A, B, or D. [High-range water reducing admixture Type F [or G] 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

NOTE: Delete this paragraph if Section
03 20 00.00 10 CONCRETE REINFORCING is to be used.

Also delete this paragraph if fibercrete is accepted
for use by the Contracting Officer.

Provide reinforcing bars conforming to the requirements of **ASTM A615/A615M**, Grade 60. Welded steel wire fabric shall conform to the requirements of **ASTM A1064/A1064M**. Details of reinforcement not shown shall be in accordance with **ACI MCP SET** Part 3, Chapters 7 and 12.

] [2.1.6 Expansion Joint Filler Strips, Premolded

NOTE: Delete this paragraph if Section
03 15 00.00 10 CONCRETE ACCESSORIES
is used.

Expansion joint filler strips, premolded shall be sponge rubber conforming to **ASTM D1752**, Type I.

] [2.1.7 Joint Sealants - Field Molded Sealants

NOTES: Use ASTM C920 for field-molded sealants in
small hydraulic structures.

Delete this paragraph if Section **03 15 00.00 10**
CONCRETE ACCESSORIES is used.

Joint sealants - field molded sealants shall conform to **ASTM C920**, 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 **Waterstops**

NOTE: Delete this paragraph if Section
03 15 00.00 10 CONCRETE ACCESSORIES is used.

Waterstops shall conform to **COE CRD-C 572**.

] [2.1.9 **Formwork**

NOTE: Delete this paragraph if Section
03 11 13.00 10 STRUCTURAL CAST-IN-PLACE CONCRETE
FORMING is used.

The design and engineering of the formwork as well as its construction, will be the responsibility of the Contractor. Submit formwork design prior to the first concrete placement.

] [2.1.10 **Form Coatings**

NOTE: Delete this paragraph if Section
03 11 13.00 10 STRUCTURAL CAST-IN-PLACE CONCRETE
FORMING is used.

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

] [2.1.11 **Vapor Barrier**

Provide polyethylene vapor barrier sheeting with a minimum thickness of **0.15 mm 6 mils** or other equivalent material having a vapor permeance rating not exceeding **30 nanograms per pascal second square meter 0.5 perms** as determined in accordance with **ASTM E96/E96M**.

] 2.1.12 **Curing Materials**

Provide curing materials conforming to the following requirements.

2.1.12.1 **Impervious Sheet Materials**

Impervious sheet materials, **ASTM C171**, type optional, except polyethylene film, if used, shall be white opaque.

2.1.12.2 Membrane-Forming Curing Compound

ASTM C309, Type 1-D or 2, Class [A] [B].

2.2 READY-MIX CONCRETE

- a. Concrete shall be ready-mix concrete with mix design data conforming to ACI MCP SET Part 2. Bill of Lading for each ready-mix concrete delivery shall be in accordance with ASTM C94/C94M.
- b. Non-exposed concrete elements: 20 megapascal 3000 psi minimum compressive strength.
- c. Direct-exposed concrete elements (including air-conditioned rooms): 34.5 megapascal 5000 psi minimum compressive strength as determined in 28 calendar days.
- d. Slump: 25 to 100 mm 1 to 4 inch according to ASTM C143/C143M and ACI MCP SET Part 1.
- [e. Portland Cement conforming to ASTM C150/C150M, Type [____].]
- [f. Blended hydraulic cement conforming to ASTM C595/C595M, Type [____].]
- g. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.
- h. 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.]
- i. Water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and accelerating admixtures, and water-reducing and retarding admixtures shall conform to ASTM C494/C494M.
- j. Fly Ash [is required][used] as an supplementary cementitious material[and] shall conform to ASTM C618, Class [C][or][F] with 4 percent maximum loss on ignition and 35 percent maximum cement replacement by weight.[Submit documentation in compliance with 40 CFR 247.]

NOTE: Ground granulated blast furnace slag and fly ash are materials listed in the EPA's Comprehensive Procurement Guidelines (CPG) (<http://www.epa.gov/cpg/>). If the Architect/Engineer determines that use of certain materials meeting the CPG content standards and guidelines would result in inadequate competition, do not meet quality/ performance specifications, are available at an unreasonable price or are not available within a reasonable time frame, the Architect/ Engineer may submit written justification and supporting documentation for not procuring designated items containing recovered material. Written justification may be submitted on a Request for Waiver Form to the U.S. ARMY ENVIRONMENTAL CENTER (USACE); (<http://aec.army.mil/usaec>)NASA Environmental Program Manager for approval. The Request for Waiver Form

is located in the NASA Procedures and Guidelines
(NPG 8830.1) (<http://nodis3.gsfc.nasa.gov>) U.S.
NAVAL FACILITIES ENGINEERING SERVICE CENTER (NFESC);
(<http://www.nfesc.navy.mil>).

- k. Ground granulated blast furnace slag [is required] [used] as an supplementary cementitious material[and] shall conform to [ASTM C989/C989M](#), Grade [120] with between 25 to 50 percent maximum cement replacement by weight.[Submit documentation in compliance with [40 CFR 247.](#)]

2.3 STEEL REINFORCEMENT

2.3.1 Deformed Steel Bars

Provide steel bars conforming to [ASTM A615/A615M](#), Grade [408 MPa60 ksi] [[_____](#)] [ACI MCP SET](#) Parts 2 and 3.

2.3.2 Welded Wire Fabric

Provide welded wire fabric conforming to [ASTM A1064/A1064M](#).

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.

2.5 ACCESSORIES

2.5.1 Waterstops

- a. Provide waterstops of the flat dumbbell type not less than [5 mm 3/16-inch](#) thick for widths up to [125 mm 5 inches](#) and not less than [10 mm 3/8-inch](#) thick for widths [125 mm 5 inches](#) and over.
- b. [Waterstops shall be made of rubber and conform to [ASTM D1752.](#)]
- c. [Provide waterstops made of polyvinylchloride (PVC) and conforming to [[ASTM C990M ASTM C990](#)] [[ASTM D2628.](#)]]

2.5.2 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 [120 gram of fluorosilicates per liter](#) (approximate [0.5 kilogram per 4 liter](#)) [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.

2.5.3 Curing Compound

Provide curing compound conforming to [ASTM C309](#).

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 Government 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 50 mm 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

**NOTE: Use a vapor barrier only when it is desirable
to prevent migration of moisture through slabs of
buildings.**

Apply vapor barriers over gravel fill. Lap edges not less than 150 mm 6 inches. Seal all joints with pressure-sensitive adhesive not less than 50 mm 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 C94/C94M 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 C685/C685M.

[3.1.4.3 Batching and Mixing Equipment

The Contractor has the option of using an on-site batching and mixing

facility. The facility shall provide sufficient batching and mixing equipment capacity to prevent cold joints. Submit the method of measuring materials, batching operation, and mixer for review, and manufacturer's data for batching and mixing equipment demonstrating compliance with the applicable specifications.. [Provide an Onsite Plant conforming to the requirements of either ASTM C94/C94M or ASTM C685/C685M.]

] 3.1.5 Waterstops

NOTE: Delete this paragraph if Section
03 15 00.00 10 CONCRETE ACCESSORIES
is to be used.

Install and splice waterstops as directed by the manufacturer.

] 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 30 degrees C 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 450 mm 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. Perform conveying and placing concrete in conformance with the following:

3.2.1 Consolidation

Consolidate each layer of concrete by [rodding, spading, or] internal vibrating equipment. [External vibrating equipment may be used when authorized.] 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 100 mm 4 inches. Ensure that the vibrator penetrates rapidly to the bottom of the layer and at least 150 mm 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 75 mm 3 inches per second.

3.2.2 Cold-Weather Requirements

No concrete is to be mixed or placed when the ambient temperature is below 2 degrees C 36 degrees F or if the ambient temperature is below 5 degrees C 41 degrees F and falling. Provide suitable covering and other means as approved for maintaining the concrete at a temperature of at least 10 degrees C 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 1 kg/square meter 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.

3.2.4 Lifts in Concrete

Deposit concrete in horizontal layers not to exceed [600] [_____] mm [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

NOTE: Delete this paragraph if Section
03 11 13.00 10 STRUCTURAL CAST-IN-PLACE CONCRETE
FORMING is used.

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 10 degrees C 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 13 mm 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 10 mm 3/8 inch for a float finish [and 8 mm 5/16 inch for a trowel finish] as determined by a 3 m 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 Trowel Finish

NOTE: A trowel finish is required only on building slabs to be left exposed or covered with tile. Trowel finishing does not prevent dusting. Give all other horizontal surfaces a float finish, except when a nonskid finish is necessary, in which case use a broom finish.

Apply a trowel finish to [_____]. 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

NOTE: Floor flatness and floor levelness affects the appearance and function of finishes applied to the concrete and in situations such as large or long expanses of glossy floor materials. Low tolerances for subsequent finish materials (thin set ceramic and porcelain tile and wood gymnasium floors, etc.) require the designer to specify higher than normal floor flatness requirements. Higher "F" ratings are more stringent and tighter tolerances of F numbers stop at 100. The numbers provided in brackets are typical numbers, but A/E should research and select F numbers high enough to get desired results but not so high as to cause undue cost increases and construction issues. An FF20/FL15 is equivalent to 8 mm in 3 meters (5/16 inches in 10 feet). This test method is not suitable for unshored decks. Fitted partitions need an FL greater than or equal to 25.

The F-numbers are given below for purposes of illustration only.

In accordance with ACI MCP SET 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 SET Part 1 for tolerances tested by ASTM E1155M or ASTM E1155. These requirements are based upon the latest FF/FL method.

3.4.3.3.1 Floor Slabs

Floor slabs shall conform to the following ACI F-number requirements unless noted otherwise:

3.4.3.3.1.1 Slab on Grade

Specified Overall Values	FF30/FL23 minimum [FF____/FL____]
Minimum Local Values	FF17/FL15 minimum [FF____/FL____]

3.4.3.3.1.2 Level Suspended Slabs Shored Until After Testing

Specified Overall Values	FF25/FL20 minimum [FF____/FL____]
Minimum Local Values	FF17/FL15 minimum [FF____/FL____]

3.4.3.3.1.3 Unlevel Shored Suspended Slabs and Unshored Suspended Slabs

Specified Overall Values	FF25 [FF____]
Minimum Local Values	FF17 [FL____]

3.4.3.3.2 Subject to Vehicular Traffic

Floor slabs subject to vehicular traffic or receiving thin-set flooring shall conform to the following ACI F-number requirements:

3.4.3.3.2.1 Slab on Grade

Specified Overall Values	FF35/FL25 minimum [FF____/FL____]
Minimum Local Values	FF25/FL17 minimum [FF____/FL____]

3.4.3.3.2.2 Level Suspended Slabs Shored Until After Testing

Specified Overall Values	FF30/FL20 minimum [FF____/FL____]
Minimum Local Values	FF25/FL15 minimum [FF____/FL____]

3.4.3.3.2.3 Unlevel Shored Suspended Slabs and Unshored Suspended Slabs

Specified Overall Values	FF30 [FF____]
Minimum Local Values	FL25 [FL____]

3.4.3.4 Measurement of Floor Tolerances

Test floor slabs within 24 hours of the final troweling. Submit test results to Contracting Officer 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 E1155M ASTM E1155

[3.4.3.5 Broom Finish

Apply a broom finish to [____]. 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 Expansion and Contraction Joints

NOTES: Refer to ACI/MCP-3 for guidance on expansion joints.

The depth of contraction joints must be 1/4 to 1/3 of the thickness of the slab.

The maximum spacing (in mm) (in feet) between adjacent joints shall be 30 times the concrete thickness (in mm) (in feet) for slabs exposed to the environment.

Delete this paragraph if Section 03 15 00.00 10 CONCRETE ACCESSORIES is used.

Delete this paragraph if Section 03 15 00.00 10 CONCRETE ACCESSORIES is used.

Make expansion and contraction joints in accordance with the details shown or as otherwise specified. Provide 13 mm 1/2 inch thick transverse expansion joints where new work abuts an existing concrete. Provide expansion joints at a maximum spacing of 10 m 30 feet on center in sidewalks [and at a maximum spacing of [____] meters feet in slabs], unless otherwise indicated. Provide contraction joints at a maximum spacing of [2] [____] linear meters [6] [____] linear feet in sidewalks [and at a maximum spacing of [____] meters feet in slabs], unless otherwise indicated. Cut contraction joints at a minimum of [25] [____] mm [1] [____] inch(es) 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, [except for concrete made with Type III cement, at least 3 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 C171.
- e. Application of membrane-forming curing compound conforming to ASTM C309, 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 [, except for concrete made with Type III cement, for 3 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 15 degrees C 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 [once] [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 [once] [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 C143/C143M](#).

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. [See Section 01 45 00.00 10 QUALITY CONTROL.](#)

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 [50 mm 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 [shortly before concrete is placed.] [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 4.5 meter and under) (lifts 15 feet and under)	24 hours
Columns and walls (lifts over 4.5 meter) (lifts over 15 feet)	48 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 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 CHEMICAL-HARDENER TREATMENT

NOTE: Clearly indicate slab surfaces requiring a chemical hardener. Such treatment is suitable for surfaces of concrete floors in equipment rooms and on other floor surfaces that are subject to light foot traffic only and will not be covered with resilient flooring, paint, or other finish coating.

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 C31/C31M](#). Perform [Compressive strength testing](#) conforming to [ASTM C39/C39M](#).
- c. Test [Slump](#) at the [plant] [site of discharge] for each design mix in accordance with [ASTM C143/C143M](#).
- d. Test air content for air-entrained concrete in accordance with [ASTM C231/C231M](#). Test concrete using lightweight or extremely porous aggregates in accordance with [ASTM C173/C173M](#).
- e. Determine temperature of concrete at time of placement in accordance with [ASTM C1064/C1064M](#).

-- End of Section --