****
USACE / NAVFAC / AFCEC / NASA **UFGS-03 30 53 (May 2014)**

Preparing Activity: USACE **Superseding**
UFGS-03 30 53 (April 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
****

SECTION TABLE OF CONTENTS

DIVISION 03 - CONCRETE

SECTION 03 30 53

MISCELLANEOUS CAST-IN-PLACE CONCRETE

05/14

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 SUBMITTALS
1.5 QUALITY ASSURANCE
1.5.1 Regulatory Requirements
1.5.2 Flatness and Levelness of Floor Slabs

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION
2.1.1 Strength
2.1.2 Construction Tolerances
2.1.3 Concrete Mixture Proportions
2.2 MATERIALS
2.2.1 Cementitious Materials
2.2.1.1 Portland Cement
2.2.1.2 Blended Hydraulic Cement
2.2.1.3 Pozzolan
2.2.2 Aggregates
2.2.3 Admixtures
2.2.3.1 Air-Entraining Admixture
2.2.3.2 Accelerating Admixture
2.2.3.3 Water-Reducing or Retarding Admixture
2.2.4 Water
2.2.5 Reinforcing Steel
2.2.6 Expansion Joint Filler Strips, Premolded
2.2.7 Joint Sealants - Field Molded Sealants
2.2.8 Formwork
2.2.9 Form Coatings
2.2.10 Vapor Retarder[and VaporBarrier]

2.2.11 Curing Materials
2.3 READY-MIX CONCRETE
2.4 ACCESSORIES
2.4.1 Waterstops
2.4.1.1 PVC Waterstop
2.4.1.2 Rubber Waterstop
2.4.1.3 Thermoplastic Elastomeric Rubber Waterstop
2.4.1.4 Hydrophilic Waterstop
2.4.2 Chemical Floor Hardener
2.4.3 Curing Compound

PART 3 EXECUTION

3.1 PREPARATION
3.1.1 Embedded Items
3.1.2 Formwork Installation
3.1.3 Vapor Retarder[and 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 Cold-Weather Requirements
3.2.2 Hot-Weather Requirements
3.3 FINISHING
3.3.1 Temperature Requirement
3.3.2 Finishing Formed Surfaces
3.3.3 Finishing Unformed Surfaces
3.3.3.1 Flat Floor Finishes
3.3.3.1.1 Floor Slabs
3.3.3.1.2 Subject to Vehicular Traffic
3.3.3.2 Measurement of Floor Tolerances
3.3.3.3 Expansion and Contraction Joints
3.4 CURING AND PROTECTION
3.5 FORM WORK
3.5.1 Removal of Forms
3.6 STEEL REINFORCING
3.6.1 Fabrication
3.6.2 Splicing
3.6.3 Supports
3.7 EMBEDDED ITEMS
3.8 CHEMICAL FLOOR HARDENER
3.9 TESTING AND INSPECTING
3.9.1 Field Testing Technicians
3.9.2 Preparations for Placing
3.9.3 Sampling and Testing
3.9.4 Action Required
3.9.4.1 Placing
3.9.4.2 Air Content
3.9.4.3 Slump

-- End of Section Table of Contents --

****

USACE / NAVFAC / AFCEC / NASA	**UFGS-03 30 53 (May 2014)**

Preparing Activity: USACE	**Superseding**
	UFGS-03 30 53 (April 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
****

SECTION 03 30 53

MISCELLANEOUS CAST-IN-PLACE CONCRETE
05/14

****
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 item(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 30 00 CAST-IN-PLACE CONCRETE when the quantity of concrete is 380 cubic meters 500 cubic yards or greater per structure.
****

1.1 SUMMARY

Perform all work in accordance withACI 318MACI 318.

1.2 UNIT PRICES

****
NOTE: If Section 01 20 00 PRICE AND PAYMENT PROCEDURES 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 20 00.
****

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 Reference Identifier (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 (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 301	(2016) Specifications for Structural Concrete
ACI 301M	(2016) Metric Specifications for Structural Concrete
ACI 302.1R	(2015) Guide for Concrete Floor and Slab Construction
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2010) Guide to Hot Weather Concreting
ACI 306R	(2016) Guide to Cold Weather Concreting
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)
ACI 318M	(2014; ERTA 2015) Building Code Requirements for Structural Concrete & Commentary
ACI 347R	(2014; Errata 1 2017) Guide to Formwork for Concrete
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31/C31M	(2019a) Standard Practice for Making and Curing Concrete Test Specimens in the Field

ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2020) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94/C94M	(2020) Standard Specification for Ready-Mixed Concrete
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2020) Standard Specification for Portland Cement
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C595/C595M	(2020) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C685/C685M	(2017) Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C989/C989M	(2018a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1064/C1064M	(2017) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1157/C1157M	(2020) Standard Performance Specification

	for Hydraulic Cement
ASTM C1260	(2014) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1567	(2013) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	(2018) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM D75/D75M	(2019) Standard Practice for Sampling Aggregates
ASTM D98	(2015) Calcium Chloride
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D471	(2016a) Standard Test Method for Rubber Property - Effect of Liquids
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials
ASTM E1155	(2020) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E1155M	(2014) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers (Metric)
ASTM E1643	(2018a) Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
ASTM E1745	(2017) Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
ASTM E1993/E1993M	(1998; R 2020) Standard Specification for Bituminous Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513	(1974) Corps of Engineers Specifications for Rubber Waterstops
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 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified 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 Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification 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; G[, [_____]]

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
Chemical Floor Hardener
Batching and Mixing Equipment
Conveying and Placing Concrete
Formwork
Mix Design Data; G[, [_____]]
Ready-Mix Concrete
Curing Compound
Mechanical Reinforcing Bar Connectors

SD-06 Test Reports

Aggregates
Concrete Mixture Proportions; G[, [_____]]
Measurement of Floor Tolerances
Compressive Strength Testing; G[, [_____]]
Slump; G[, [_____]]
Air Content
Water

SD-07 Certificates

Cementitious Materials
Pozzolan
CPG for recycled materials or appropriate Waiver Form
Aggregates
Delivery Tickets

SD-08 Manufacturer's Instructions

Chemical Floor Hardener
Curing Compound

1.5 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.

1.5.1 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 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING 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.

1.5.2 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 E1155M or ASTM E1155. 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. 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 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 strength of concrete required]. Provide a minimum of five specimens from each sample; two to be tested at 28 days (90 days if pozzolan is used) for acceptance, two will be tested at 7 days for information and one held in reserve.

2.1.1 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, but not more than 20 percent, and no individual acceptance test result falls below f'c by more than 3.4 MPa 500 psi.

2.1.2 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 ACI 117.

2.1.3 Concrete Mixture Proportions

****

NOTE: The nominal maximum size of the coarse aggregate is as specified in ACI 318, Chapter 3 and ACI 318M. Guidelines for the maximum water cementitious material ratio and air content can be found in ACI 318 Chapter 4.

****

Concrete mixture proportions are the responsibility of the Contractor. Mixture proportions must 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. The specified compressive strength f'c is [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 304R. The air content must be between 4.5 and 7.5 percent with a slump between 50 and 125 mm 2 and 5 inches. The maximum water-cementitious material 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.

2.2 MATERIALS

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

2.2.1 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:

2.2.1.1 Portland Cement

****

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

If high early strength concrete is required, specify Type III after consulting the agency's Subject Matter Expert in Concrete Materials.

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][II][III][V], [low alkali] [including false set requirements] with tri-calcium aluminates (C3A) content less than 10 percent and a maximum cement-alkali content of 0.80 percent Na2Oe (sodium oxide) equivalent.

[2.2.1.2 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.

****

Provide blended cement conforming to ASTM C595/C595M and ASTM C1157/C1157M, Type IP, IL or IS, including the optional requirement for mortar expansion [and sulfate soundness] and consist of a mixture of ASTM C150/C150M Type I, or Type II cement and a complementary cementing material. The slag added to the Type IS blend must be ASTM C989/C989M ground granulated blast-furnace slag. The pozzolan added to the Type IP blend must be ASTM C618 Class F, interground with the cement clinker. Provide the manufacturer's written statement that the amount of pozzolan in the finished cement will not vary more than plus or minus 5 mass percent of the finished cement from lot-to-lot or within a lot. Do not change the percentage and type of mineral admixture used in the blend from that submitted for the aggregate evaluation and mixture proportioning.

]2.2.1.3 Pozzolan

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

2.2.2 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 14.13 CONCRETE PAVING FOR AIRFIELDS AND OTHER HEAVY DUTY PAVEMENTS, paragraph 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 14.13 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 14.13 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).
****

For fine and coarse aggregates meet the quality and grading requirements of ASTM C33/C33M[and test and evaluate 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 must have a measured expansion less than 0.08 percent at 28 days after casting. If the test data indicates an expansion of 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.

2.2.3 Admixtures

Provide admixtures, when required or approved, in compliance 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.

2.2.3.1 Air-Entraining Admixture

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

[2.2.3.2 Accelerating Admixture

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

]2.2.3.3 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.]

2.2.4 Water

Mixing and curing water in compliance with the requirements of ASTM C1602/C1602M; [potable, and] free of injurious amounts of oil, acid, salt, or alkali. Submit test report showing water complies with ASTM C1602/C1602M.

[2.2.5 Reinforcing Steel

****
NOTE: 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, deformed. Provide welded steel wire reinforcement conforming to the requirements of ASTM A1064/A1064M. Detail reinforcement not indicated in accordance with ACI 301M ACI 301 and ACI SP-66. Provide mechanical reinforcing bar connectors in accordance with ACI 301M ACI 301 and provide 125 percent minimum yield strength of the reinforcement bar.

][2.2.6 Expansion Joint Filler Strips, Premolded

Expansion joint filler strips, premolded of sponge rubber conforming to ASTM D1752, Type I.

][2.2.7 Joint Sealants - Field Molded Sealants

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

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.

][2.2.8 Formwork

Design and engineer the formwork as well as its construction in accordance with ACI 301M ACI 301 Section 2 and 5 and ACI 347R. Fabricate of wood, steel, or other approved material. Submit formwork design prior to the first concrete placement.

][2.2.9 Form Coatings

Provide form coating in accordance with ACI 301M ACI 301.

][2.2.10 Vapor Retarder[and VaporBarrier]

[ASTM E1745 Class [C] [A] [B] polyethylene sheeting, minimum [0.25] [0.38] mm [10] [15] mil thickness or other equivalent material with a maximum permeance rating of 0.04 perms per ASTM E96/E96M.] [ASTM E1745 Class [C] [A] [B] polyethylene sheeting, minimum [0.25] [0.38] mm [10] [15] mil thickness or ASTM E1993/E1993M bituminous membrane or other equivalent material with a maximum permeance rating of 0.01 perms per ASTM E96/E96M.]

Consider plastic vapor retarders and adhesives with a high recycled content, low toxicity low VOC (Volatile Organic Compounds) levels.

]2.2.11 Curing Materials

Provide curing materials in accordance with ACI 301M ACI 301, Section 5.

2.3 READY-MIX CONCRETE

Provide ready-mix concrete with mix design data conforming to ACI 301M ACI 301 Part 2. Submit delivery tickets in accordance with ASTM C94/C94M for each ready-mix concrete delivery, include the following additional information: .

a. Type and brand cement

b. Cement content in 43 kilogram 94-pound bags per cubic meter yard of concrete

c. Maximum size of aggregate

d. Amount and brand name of admixture

e. Total water content expressed by water cementitious material ratio

2.4 ACCESSORIES

2.4.1 Waterstops

2.4.1.1 PVC Waterstop

Polyvinylchloride waterstops conforming to COE CRD-C 572.

2.4.1.2 Rubber Waterstop

Rubber waterstops conforming to COE CRD-C 513.

2.4.1.3 Thermoplastic Elastomeric Rubber Waterstop

Thermoplastic elastomeric rubber waterstops conforming to ASTM D471.

2.4.1.4 Hydrophilic Waterstop

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water conforming to ASTM D412 as follows: Tensile strength 2.9 MPa 420 psi minimum; ultimate elongation 600 percent minimum. Minimum hardness of 50 on the type A durometer and the volumetric expansion ratio in distilled water at 20 degrees C 70 degrees F; 3 to 1 minimum.

2.4.2 Chemical Floor Hardener

Provide hardener which is a colorless aqueous solution containing a blend of inorganic silicate or siliconate material and proprietary components combined with a wetting agent; that penetrates, hardens, and densifies concrete surfaces. Submit manufactures instructions for placement of liquid chemical floor hardener.

2.4.3 Curing Compound

Provide curing compound conforming to ASTM C309. Submit manufactures instructions for placing curing compound.

PART 3 EXECUTION

3.1 PREPARATION

Prepare construction joints to expose coarse aggregate. The surface must 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. Satisfactorily compact earth foundations. Make spare vibrators available. Placement cannot begin until the entire preparation has been accepted by the Government.

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. Prepare embedded items so they are 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. Provide all equipment needed to place, consolidate, protect, and cure the concrete at the placement site and in good operating condition.

3.1.2 Formwork Installation

Forms must 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 Retarder[and Vapor Barrier] Installation

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

Install in accordance with ASTM E1643. Apply vapor retarder[andbarrier] over gravel fill. Lap edges not less than 300 mm 12 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

Conform to ASTM C685/C685M.

[3.1.4.3 Batching and Mixing Equipment

The option of using an on-site batching and mixing facility is available. The facility must 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

Install and splice waterstops as directed by the manufacturer.

]3.2 CONVEYING AND PLACING CONCRETE

Convey and place concrete in accordance with ACI 301M ACI 301, Section 5.

3.2.1 Cold-Weather Requirements

Place concrete in cold weather in accordance with ACI 306R

3.2.2 Hot-Weather Requirements

Place concrete in hot weather in accordance with ACI 305R

3.3 FINISHING

3.3.1 Temperature Requirement

Do not finish or repair concrete when either the concrete or the ambient temperature is below 10 degrees C 50 degrees F.

3.3.2 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. Ream or chip 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 and fill 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. Use a blend of portland cement and white cement in mortar or concrete for repairs to all surfaces permanently exposed to view shall be so that the final color when cured is the same as adjacent concrete.

3.3.3 Finishing Unformed Surfaces

Finish unformed surfaces in accordance with ACI 301M ACI 301, Section 5.

FINISH	LOCATION
Float	
Trowel	
Broom or Belt	

3.3.3.1 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 (for example, thin set ceramic and porcelain tile and wood gymnasium floors) 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 302.1R, construct in accordance with one of the methods recommended in Table 7.15.3, "Typical Composite FF/FL Values for Various Construction Methods." ACI 117 for tolerances tested by ASTM E1155M or ASTM E1155. These requirements are based upon the latest FF/FL method.

3.3.3.1.1 Floor Slabs

Conform floor slabs on grade to the following ACI F-number requirements unless noted otherwise:

Specified Overall Values	FF30/FL23 minimum [FF_____/FL_____]
Minimum Local Values	FF17/FL15 minimum [FF_____/FL_____]

3.3.3.1.2 Subject to Vehicular Traffic

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

Specified Overall Values	FF35/FL25 minimum [FF_____/FL_____]
Minimum Local Values	FF25/FL17 minimum [FF_____/FL_____]

3.3.3.2 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 mustl 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

[3.3.3.3 Expansion and Contraction Joints

****

NOTES: Refer to ACI 224.3R 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 feet) between adjacent joints shall be 30 times the concrete thickness (in mm feet) for slabs exposed to the environment.

****

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.

]3.4 CURING AND PROTECTION

Cure and protect in accordance with ACI 301M ACI 301, Section 5.

3.5 FORM WORK

Provide form work in accordance with ACI 301M ACI 301, Section 2 and Section 5.

3.5.1 Removal of Forms

Remove forms in accordance with ACI 301M ACI 301, Section 2.

3.6 STEEL REINFORCING

Reinforcement must 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.

3.6.1 Fabrication

Shop fabricate steel reinforcement in accordance with ACI 318 and ACI SP-66. Provide shop details and bending in accordance with ACI 318 and ACI SP-66.

3.6.2 Splicing

Perform splices in accordance with ACI 318 and ACI SP-66.

3.6.3 Supports

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

3.7 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.

3.8 CHEMICAL FLOOR HARDENER

****

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 Chemical Floor Hardener where indicated, after curing and drying

concrete surface. Dilute liquid hardener with water and apply in three coats. First coat is 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.

3.9 TESTING AND INSPECTING

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 three days after the end of each weekly reporting period. See Section 01 45 00.00 10 QUALITY CONTROL.

3.9.1 Field Testing Technicians

The individuals who sample and test concrete must 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.

3.9.2 Preparations for Placing

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

3.9.3 Sampling and Testing

a. Obtain samples and test concrete for quality control during placement. Sample fresh concrete for testing in accordance with ASTM C172/C172M. Make six test cylinders.

b. Test concrete for compressive strength at 7 and 28 days for each design mix and for every 77 cubic meters 100 cubic yards of concrete. Test two cylinders at 7 days; two cylinders at 28 days; and hold two cylinders in reserve. Conform test specimens 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. Check slump [once] [twice] during each shift that concrete is produced [for each strength of concrete required].

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. Check air content at least [once] [twice] during each shift that concrete is placed [for each strength of concrete required].

e. Determine temperature of concrete at time of placement in accordance with ASTM C1064/C1064M. Check concrete temperature at least [once] [twice] during each shift that concrete is placed [for each strength of concrete required].

3.9.4 Action Required

3.9.4.1 Placing

Do not begin placement until the availability of an adequate number of

acceptable vibrators, which are in working order and have competent operators, has been verified. Discontinue placing if any lift is inadequately consolidated.

3.9.4.2 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.

3.9.4.3 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. Make the adjustments so that the water-cementitious material ratio does not exceed that specified in the submitted concrete mixture proportion and the required concrete strength is still met.

-- End of Section --