SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.

B. Concrete building frame members.

C. Concrete for composite floor construction.

D. Elevated concrete slabs.

E. Floors and slabs on grade.

F. Concrete foundation walls.

G. Concrete foundations and anchor bolts.

H. Concrete reinforcement.

I. Joint devices associated with concrete work.

J. Miscellaneous concrete elements, including equipment pads.

K. Concrete curing.

1.02 RELATED REQUIREMENTS

A. Section 03 1000 - Concrete Forming and Accessories: Forms and accessories for formwork.

B. Section 03 2000 - Concrete Reinforcing.

C. Section 07 9200 - Joint Sealants: Products and installation for sealants for saw cut joints and isolation joints in slabs.

D. Section 07 9513 - Expansion Joint Cover Assemblies.

E. Section 32 1313 - Concrete Paving: Sidewalks and curbs.

F. Section _____: Mechanical items for casting into concrete.

G. Section _____: Electrical items for casting into concrete.

1.03 PRICE AND PAYMENT PROCEDURES

A. Cast-in-place concrete work will be paid for by the unit price method.

B. See Section 01 2200 - Unit Prices, for additional unit price requirements.

C. Construction Joint Devices: Includes component, accessories, and installation. Measurement by the linear foot.

1.04 REFERENCE STANDARDS

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).

C. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete; 1998 (Reapproved 2004).

D. ACI 212.3R - Report on Chemical Admixtures for Concrete.

E. ACI 214R - Guide to Evaluation of Strength Test Results of Concrete.

F. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).

G. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).

H. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.

I. ACI 305R - Hot Weather Concreting; 2010.

J. ACI 306R - Cold Weather Concreting; 2010.

K. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).

L. ACI 309R - Guide for Consolidation of Concrete.

M. ACI 311.4R - Guide for Concrete Inspection.

N. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).

O. ACI 347R - Guide to Formwork for Concrete; 2014.

P. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.

Q. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2007b (Reapproved 2014).

R. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2014.

S. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.

T. ASTM C31/C31M - Standard Pratice for Making and Curing Concrete Test Specimens in the Field.

U. ASTM C33/C33M - Standard Specifications for Concrete Aggregates.

V. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.

W. ASTM C42/C42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

X. ASTM C78/C78M - Standard Test Method for Flexural Strength of Concrete (using Simple Beam with Third-Point Loading).

Y. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.

Z. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.

AA. ASTM C127 - Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.

AB. ASTM C138/C138M - Standard Test Method for Density (Unit Weight), Yield, and Air Content (GraviMetric) of Concrete.

AC. ASTM C150/C150M - Standard Specification for Portland Cement; 2016.

AD. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2007.

AE. ASTM C172/C172M - Standard Method of Sampling Freshly Mixed Concrete.

AF. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2014.

AG. ASTM C192 - Standard Pratice for Making and Curing Concrete Test Specimens in the Laboratory.

AH. ASTM C260 - Standard Specification for Air-Entraining Admixture for Concrete.

AI. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.

AJ. ASTM C330 - Standard Specification for Lightweght Aggregates for Structural Concrete.

AK. ASTM C387 - Standard Specification for Package, Dry, Combined Materials for Mortar and Concrete.

AL. ASTM C494 - Standard Specification for Chemical Admixture for Concrete.

AM. ASTM C496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.

AN. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes; 2001 (Reapproved 2012).

AO. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2014.

AP. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2010.

AQ. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2014.

AR. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2010.

AS. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.

AT. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete; 2010a (Reapproved 2015).

AU. ASTM C1315 - Standard Specification for Liquid-Forming Compounds having Special Properties for Curing and Sealing Concrete.

AV. ASTM C1582/C1582M - Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete; 2011.

AW. ASTM D994/D994M - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type); 2011.

AX. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars; 2001 (Reapproved 2007).

AY. ASTM E96 - Standard Test Method for Water Vapor Transmission of Materials.

AZ. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2013).

BA. ASTM E329 - Standard Specification for Agencies engaged in the Testing and/or Inspection of materials used in Construction.

BB. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996 (Reapproved 2008).

BC. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.

BD. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

BE. ASTM E1993/E1993M - Standard Specification for Bituminous Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs; 1998 (Reapproved 2013).

BF. COE CRD-C 513 - COE Specifications for Rubber Waterstops; 1974.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products specified in part 2, showing compliance with specified requirements and installation instructions.
   1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.

C. Mix Design: Submit proposed concrete mix design. Written report in compliance with special inspection requirements of authorities having jurisdiction for each type and strength of concrete mixture. Submit in time as indicated by authorities, or no later than fifteen (15) business days prior to the start of work, whichever is sooner.

1. Indicate proposed mix design complies with requirements of ACI 301 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 301>, Section 4 - Concrete Mixtures.
2. Indicate proposed mix design complies with requirements of ACI 318 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 318>, Chapter 5 - Concrete Quality, Mixing and Placing.

D. Samples: Submit samples of underslab vapor retarder to be used.

E. Samples: Submit two, 12 inch long samples of waterstops and construction joint devices.

F. Special Inspection Report.

G. Field Quality Control Test Reports: If not in conflict with Special Inspections, submit for each test indicated within 24 hours after test is conducted.

H. Sampling Report.

I. Slump Test Reports.

J. Compressive Strength Test Reports.

K. Air Content Test Reports.

L. Shop Drawings for reinforcement (Delegated Design): Prepared by qualified Professional Engineer, showing complete details for size, fabrication, bending, placement, and splicing. Comply with ACI SP-66 "Detailing Manual".

M. Shop Drawings for formwork (Delegated Design): Prepared by qualified Professional Engineer, detailing fabrication, assembly, and support of formwork.

N. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

O. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

P. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 301>, ACI 303.1, and ACI 318 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 318>.
1. Maintain one copy of each document on site.

B. Follow recommendations of ACI 305R <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 305R> when concreting during hot weather.

C. Follow recommendations of ACI 306R <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 306R> when concreting during cold weather.

D. For slabs required to include moisture vapor reduction admixture (MVRA), do not proceed with placement unless manufacturer's representative is present for every day of placement.

1.07 MOCK-UP

A. Construct and erect mock-up panel for .....
1. Panel Size: Sufficient to illustrate full range of treatment.

B. Accepted mock-up panel is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.

C. Mock-up may remain as part of the Work.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Moisture Emission Reducing Curing and Sealing Compound: Provide warranty to cost of flooring delamination failures for 10 years.
   1. Include cost of repair or removal of failed flooring, remediation with a moisture vapor impermeable surface coating, and replacement of flooring with comparable flooring system.

PART 2 PRODUCTS

2.01 FORMWORK

A. Comply with requirements of Section 03 1000.

B. Formwork Design and Construction: Comply with guidelines of ACI 347R <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 347R> to provide formwork that will produce concrete complying with tolerances of ACI 117 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 117>.

C. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
   2. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.02 REINFORCEMENT

A. Comply with requirements of Section 03 2000.

B. Reinforcing Steel: ASTM A615/A615M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM A615/A615M>, Grade 60 (60,000 psi).
   1. Type: Deformed billet-steel bars.
   2. Finish: Epoxy coated in accordance with ASTM A775/A775M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM A775/A775M> , unless otherwise indicated.

C. Steel Welded Wire Reinforcement (WWR): Class A epoxy coated, deformed type, ASTM A884/A884M, ASTM A 884
   1. Form: Flat Sheets.
   2. WWR Style: As indicated on drawings.

D. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide plastic or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M <https://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C150/C150M>, Type I - Normal Portland type.
   1. Acquire all cement for entire project from same source.

B. Fine and Coarse Aggregates: ASTM C 33.
   1. Acquire all aggregates for entire project from same source.

C. Lightweight Aggregate: ASTM C330/C330M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C330/C330M>.

D. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979.
   1. Color(s): To match Architect's sample(s) when incorporated into specified mix design(s).

E. Water: Clean and not detrimental to concrete.

F. Fiber Reinforcement: ASTM C1116/C1116M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C1116/C1116M>.
   1. Fiber Type: Alkali-resistant polypropylene.

2.04 ADMIXTURES

A. Only use admixtures that have been tested and accepted in the mix design, unless otherwise approved in writing by the Architect.

B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

C. Air Entrainment Admixture: ASTM C260/C260M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C260/C260M>.

D. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C494/C494M> Type G.

E. High Range Water Reducing Admixture: ASTM C494/C494M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C494/C494M> Type F.

F. Water Reducing and Accelerating Admixture: ASTM C494/C494M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C494/C494M> Type E.

G. Water Reducing and Retarding Admixture: ASTM C494/C494M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C494/C494M> Type D.

H. Accelerating Admixture: ASTM C494/C494M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C494/C494M> Type C.

I. Retarding Admixture: ASTM C494/C494M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C494/C494M> Type B.

J. Water Reducing Admixture: ASTM C494/C494M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C494/C494M> Type A.

K. Shrinkage Reducing Admixture:
   1. ASTM C494/C494M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C494/C494M>, Type S.

L. Corrosion Inhibitor Admixture:
   1. ASTM C494/C494M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C494/C494M>, Type C.
   2. ASTM C1582/C1582M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C1582/C1582M>.

M. Moisture Vapor Reduction Admixture (MVRA): Liquid, inorganic admixture free of volatile organic compounds (VOCs) and formulated to close capillary systems formed during curing to reduce moisture vapor emission and transmission, with no adverse effect on concrete properties.
   1. Provide admixture in slabs to receive adhesively applied flooring _____.

N. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.
   1. Admixture Composition: Crystalline, functioning by growth of crystals in capillary pores.

2.05 ACCESSORY MATERIALS

A. Underslab Vapor Retarder: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E1745 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM E1745>, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
   1. Installation: Comply with ASTM E1643 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM E1643>.
   2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations in vapor retarder.
   3. Manufacturers:
      a. Fortifiber Building Systems Group ; Moistop Ultra 10: www.fortifiber.com/sle.
      b. Fortifiber Building Systems Group ; Moistop Ultra 15: www.fortifiber.com/sle.
      c. W.R. Meadows, Inc.; PERMINATOR Class A - 15 mils: www.wrmeadows.com.

B. Underslab Waterproofing and Vapor Retarder: Semi-rigid bituminous membrane, seven-ply, complying with ASTM E1993.
   1. Composition: Weather-resistant coated, permanently bonded bituminous core board composed of an inner core, suspended and sealed within high melt point asphalt-impregnated felt, with glass mat liner and polyethylene anti-stick sheet.
   2. Permeance: 0.002 perms, maximum.
   3. Tensile Strength: 140 pounds-force/inch, minimum.
   4. Puncture Resistance: 90 pounds-force, minimum, when tested in accordance with ASTM E154/E154M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM E154/E154M>.
   5. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
   6. Manufacturers:
      a. W.R. Meadows, Inc.; PRECON-Blindside/Underslab Membrane: www.wrmeadows.com.

C. Non-Shrink Cementitious Grout: Concresive liquid LPL with 3 parts sand or equal

D. Sonoguard Aggregate 16-30 mesh or equal
   1. Minimum Compressive Strength at 28 Days, ASTM C109/C109M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C109/C109M>: 7,000 pounds per square inch.
   2. Flowable Products:
      a. Kaufman Products Inc.; SureGrout: www.kaufmanproducts.net.
      b. ProSpec, an Oldcastle brand ; C-1107 Construction Grout: www.prospec.com.
      c. The QUIKRETE Companies ; QUIKRETE® Exterior Use Anchoring Cement: www.quikrete.com.

E. Non-Shrink Epoxy Grout: Moisture-insensitive, two-part; consisting of epoxy resin, non-metallic aggregate, and activator.
   1. Composition: High solids content material exhibiting positive expansion when tested in accordance with ASTM C827/C827M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C827/C827M>.
   2. Minimum Compressive Strength at 7 days, ASTM C579 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C579>: 12,000 pounds per square inch.
   3. Manufacturers:
      a. Five Star Products, Inc ; Five Star DP Epoxy Grout: www.fivestarproducts.com.

2.06 BONDING AND JOINTING PRODUCTS

A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C1059/C1059M>, Type II.
   1. Weld-Crete
   2. Or equal
      a. SpecChem, LLC; Strong Bond Acrylic Bonder: www.specchemllc.com.
      b. W.R. Meadows, Inc.; ACRY-LOK-: www.wrmeadows.com.

B. Epoxy Bonding System:
   1. Complying with ASTM C881/C881M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C881/C881M> and of Type required for specific application.
   2. Manufacturers:
      a. Weld-Crete by Larsen Products Corp.
      b. or equal

C. Waterproofing Admixture Slurry: Slurry coat of Portland cement, sand, and crystalline waterproofing additive, mixed with water in proportions recommended by manufacturer to achieve waterproofing at cold joints in concrete.
   1. Manufacturers:
      a. Aquafin, Inc ; AQUAFIN-2K/M: www.aquafin.net.
      b. W.R. Meadows, Inc.; ADI-CON CW Plus: www.wrmeadows.com.
      c. Xypex Chemical Corporation ; XYPEX Concentrate: www.xypex.com.
      d. or equal

D. Waterstops: PVC, complying with COE CRD-C 572 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=COE CRD-C 572>.
   1. Configuration: As indicated on the drawings.
   2. Size: As indicated on the drawings.

E. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
   1. Size: As indicated on drawings.

F. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
   1. Material: Closed-cell, non-absorbent, compressible polyethylene or polymer foam in sheet form.
   2. Manufacturers:
      a. W.R. Meadows, Inc; Deck-O-Foam Joint Filler with pre-scored top strip: www.wrmeadows.com.
      b. or equal

G. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.
   1. Manufacturers:
      a. W.R. Meadows, Inc; Speed-E-Joint: www.wrmeadows.com.
      b. or equal

H. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with minimum 1 inch diameter holes for conduit or rebars to pass through at 6 inches on center; ribbed steel stakes for setting.

2.07 CURING MATERIALS

A. Curing and Sealing Compound, Moisture Emission Reducing: Liquid, membrane-forming, clear sealer, for application to newly placed concrete; capable of providing adequate bond for flooring adhesives, initially and over the long term; with sufficient moisture vapor impermeability to prevent deterioration of flooring adhesives due to moisture emission.

1. Use this product to cure and seal all slabs to receive adhesively applied flooring or roofing.
2. Comply with ASTM C309 Type 1 Class B <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C309> and ASTM C1315 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C1315> Type I Class A.
3. VOC Content: Less than 100 g/L.
4. Solids Content: 25 percent, minimum.
5. Manufacturers:
   a. Floor Seal Technology, Inc; VaporSeal 309 System: www.floorseal.com.
   b. Sinak Corporation: LITHIUM CURE 1000: www.sinak.com.
   c. or equal

B. Curing Compound, Non-dissipating: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with ASTM C309 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C309>. Type I.
1. Vehicle: Water-based.
2. VOC Content: OTC compliant.

2.08 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 211.1> recommendations.

B. Proportioning Structural Lightweight Concrete: Comply with ACI 211.2 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 211.2> recommendations.

C. Required concrete strengths are indicated in the construction notes on drawing.

D. Design mixtures in compliance with Special Inspection requirements of Authorities having jurisdiction including, but not limited to, those indicated on the drawings.

E. Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 301>.
1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

F. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 211.1> and at rates recommended or required by manufacturer.

G. Fiber Reinforcement: Add to mix at rate of 1.5 pounds per cubic yard, or as recommended by manufacturer for specific project conditions.

H. Normal Weight Concrete:
1. Compressive Strength, when tested in accordance with ASTM C39/C39M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C39/C39M> at 28 days: As indicated on drawings.
2. Water-Cement Ratio: Maximum 40 percent by weight.
3. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C173/C173M>.
4. Maximum Aggregate Size: 5/8 inch.

I. Structural Lightweight Concrete:
1. Compressive Strength, when tested in accordance with ASTM C39/C39M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C39/C39M> at 28 days: 3,000 pounds per square inch.
2. Water-Cement Ratio: Maximum 40 percent by weight.

3. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C173/C173M>.

2.09 MIXING

A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685. Mix each batch not less than 1-1/2 minutes (and not more than 5 minutes) for one cubic yard or smaller. increase mixing time at least 15 seconds for each additional cubic yard or fraction thereof.
   1. Colored Concrete: Add pigments in strict accordance with manufacturer's instructions to achieve consistent color from batch to batch.
   2. Fiber Reinforcement: Batch and mix as recommended by manufacturer for specific project conditions.

B. Transit Mixes: Comply with ASTM C94/C94M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C94/C94M>.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI 301 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 301>. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
   1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
   2. Use latex bonding agent only for non-load-bearing applications.

E. Where new concrete with integral waterproofing is to be bonded to previously placed concrete, prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions. Saturate cold joint surface with clean water, and remove excess water before application of coat of waterproofing admixture slurry. Apply slurry coat uniformly with semi-stiff bristle brush at rate recommended by waterproofing manufacturer.

F. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

G. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
   1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as shown on the drawings. Do not use sand.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Fabricate and handle epoxy-coated reinforcing in accordance with ASTM D3963/D3963M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM D3963/D3963M>.

B. Comply with requirements of ACI 301 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 301>. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

C. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

D. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 304R>.

B. Place concrete for floor slabs in accordance with ACI 302.1R <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 302.1R>.

C. Notify Architect not less than 24 hours prior to commencement of placement operations.

D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 SLAB JOINTING

A. Locate joints as indicated on the drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
   1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.

D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.

3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. Maximum Variation of Surface Flatness:
   1. Exposed Concrete Floors: 1/4 inch in 10 feet.
   2. Under Seamless Resilient Flooring: 1/4 inch in 10 feet.
   3. Under Carpeting: 1/4 inch in 10 feet.

B. Correct the slab surface if tolerances are less than specified.

C. Measure F(F) - Floor Flatness and F(L) - Floor Levelness in accordance with ASTM E1155 <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM E1155>, within 48 hours after slab installation; report both composite overall values and local values for each measured section.

D. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.07 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:

1. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap, and keep moist for 36 hours.

D. Concrete Slabs: Finish to requirements of ACI 302.1R <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 302.1R>, and as follows:
   1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI 302.1R <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 302.1R>; thick floor coverings include quarry tile, ceramic tile, and terrazzo with full bed setting system.
   2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 302.1R>; thin floor coverings include carpeting, resilient flooring, seamless flooring, thin set quarry tile, and thin set ceramic tile.
   3. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 302.1R>, minimizing burnish marks and other appearance defects.

E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

3.08 CURING AND PROTECTION

A. Comply with requirements of ACI 308R <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ACI 308R>. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Comply with requirements of ACI 306R and ACI 305R for Cold Weather Concreting and Hot Weather Concreting protection during Curing.

C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

D. Surfaces Not in Contact with Forms:
   1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
      a. Spraying: Spray water over floor slab areas and maintain wet.
      b. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
   2. Final Curing: Begin after initial curing but before surface is dry.
      a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.
      b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.09 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.

D. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

E. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M <http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM C143/C143M>.

F. Slab Testing: Cooperate with manufacturer of specified moisture vapor reduction admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.

3.10 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.11 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION