SECTION 03.05.05
UNDERSLAB VAPOR BARRIER

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Sheet vapor barrier under concrete slabs on grade.

1.02 RELATED REQUIREMENTS
A. Section 03.10.00 - Concrete Formwork: Forms and accessories for formwork.
B. Section 03.20.00 - Concrete Reinforcing.
C. Section 03.30.00 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

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

1.04 SUBMITTALS
A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturers' data on manufactured products.
C. Test Data: Submit report of tests showing compliance with specified requirements.
D. Samples: Submit samples of underslab vapor barrier to be used.
E. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 PRODUCTS

2.01 MATERIALS
A. Underslab Vapor Barrier:
   1. Water Vapor Permeance: Not more than 0.010 perms, maximum.
   2. Complying with ASTM E1745 Class A.
   3. Thickness: 15 mils.
B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

3.02 INSTALLATION
A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.
C. Lap joints minimum 6 inches.
D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
F. Repair damaged vapor retarder before covering with other materials.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Formwork for cast-in-place concrete, with shoring, bracing and anchorage.
   B. Openings for other work.
   C. Form accessories.
   D. Form stripping.

1.02 RELATED REQUIREMENTS
   A. Section 03.20.00 - Concrete Reinforcing.
   B. Section 03.30.00 - Cast-in-Place Concrete.
   C. Section 04.20.00 - Unit Masonry: Reinforcement for masonry.
   D. Section 05.12.00 - Structural Steel Framing: Placement of embedded steel anchors and plates in cast-in-place concrete.
   E. Section 05.21.00 - Steel Joist Framing: Placement of embedded steel anchors, plates and joist seats in cast-in-place concrete.
   F. Section 05.31.00 - Steel Decking: Placement of steel anchors in composite decking.

1.03 REFERENCE STANDARDS
   B. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010 (Errata 2012).
   C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute; 2011.
   D. ACI 347 - Guide to Formwork for Concrete; American Concrete Institute; 2004.

1.04 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on void form materials and installation requirements.
   C. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.
   D. Delegated Design Data: As required by authorities having jurisdiction.

1.05 QUALITY ASSURANCE
   A. Designer Qualifications: Design formwork under direct supervision of a Professional Structural Engineer experienced in design of concrete formwork and licensed in Tennessee.
   B. Maintain one copy of each installation standard on site throughout the duration of concrete work.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Deliver prefabricated forms and installation instructions in manufacturer's packaging.
B. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.
C. Protect plastic foam products from damage and exposure to sunlight.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL
A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
B. Design and construct to provide resultant concrete that conforms to design with respect to shape, lines, and dimensions.
C. Chamfer outside corners of beams, joists, columns, and walls.
D. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.
E. Comply with relevant portions of ACI 347, ACI 301, and ACI 318.
F. Use the following form types:
   1. Basement Walls Not Exposed To View: Site fabricated plywood.
   2. Walls Exposed to View: Steel forms or coated B/C plywood.

2.02 WOOD FORM MATERIALS
A. Form Materials: At the discretion of the Contractor.

2.03 REMOVABLE PREFABRICATED FORMS
A. Preformed Steel Forms: Minimum 16 gage, 0.0598 inch thick, matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.
C. Pan Type: Glass fiber, of size and profile indicated.
D. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set; 2 inches thick.

2.04 FORMWORK ACCESSORIES
A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, free of defects that could leave holes larger than 1 inch in concrete surface.
B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
   1. Composition: Colorless reactive, mineral oil-based, soy-based, or vegetable-oil based compound.
   2. Do not use materials containing diesel oil or petroleum-based compounds.
   3. VOC Content: None; water-based.
C. Filler Strips for Chamfered Corners: Rigid plastic type; 1 x 1 inch size; maximum possible lengths.
D. Dovetail Anchor Slot: Galvanized steel, at least 22 gage, 0.0299 inch thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
E. Flashing Reglets: Galvanized steel, at least 22 gage, 0.0299 inch thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
F. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

G. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 05.12.00.

H. Waterstops: Rubber, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, 4 inch wide, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 EARTH FORMS

A. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

3.03 ERECTION - FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

D. Align joints and make watertight. Keep form joints to a minimum.

E. Obtain approval before framing openings in structural members that are not indicated on drawings.

F. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.

G. Coordinate this section with other sections of work that require attachment of components to formwork.

H. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

3.04 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.

B. Locate and set in place items that will be cast directly into concrete.

C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

D. Position recessed anchor slots for brick veneer masonry anchors to spacing and intervals specified in Section 04.20.00.
E. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

F. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Heat seal joints so they are watertight.

G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

H. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.06 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.
   1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
   2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.07 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

B. Construct and align formwork for elevator hoistway in accordance with ASME A17.1.

C. Camber slabs and beams in accordance with ACI 301.

3.08 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01.43.25.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

C. Do not reuse wood formwork more than 3 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.09 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Reinforcing steel for cast-in-place concrete.
   B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS
   A. Section 03.10.00 - Concrete Formwork.
   B. Section 03.30.00 - Cast-in-Place Concrete.
   C. Section 04.20.00 - Unit Masonry: Reinforcement for masonry.

1.03 REFERENCE STANDARDS
   A. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010 (Errata 2012).
   B. ACI 318 - Building Code Requirements For Structural Concrete and Commentary; American Concrete Institute International; 2011.
   C. ACI SP-66 - ACI Detailing Manual; American Concrete Institute International; 2004.
   I. CRSI (DA4) - Manual of Standard Practice; Concrete Reinforcing Steel Institute; 2009.

1.04 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
   C. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
   D. Reports: Submit certified copies of mill test report of reinforcement materials analysis.

1.05 QUALITY ASSURANCE
   A. Perform work of this section in accordance with ACI 301.
   B. Welders' Certificates: Submit certifications for welders employed on the project, verifying AWS qualification within the previous 12 months.
PART 2 PRODUCTS

2.01 REINFORCEMENT
   A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
      1. Deformed billet-steel bars.
      2. Epoxy coated in accordance with ASTM A775/A775M.
   B. Stirrup Steel: ASTM A1064/A1064M steel wire, unfinished.
   C. Steel Welded Wire Reinforcement (WWR): Galvanized, deformed type; ASTM A1064/A1064M.
      1. 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 stainless steel components for placement within 1-1/2 inches of weathering surfaces.

2.02 RE-BAR SPLICING:
   A. Coupler Systems: Mechanical devices for splicing reinforcing bars; capable of developing full steel reinforcing design strength in tension and compression.
   B. Dowel Bar Splicer with Dowel-Ins: Mechanical devices for connecting dowels; capable of developing full steel reinforcing design strength in tension and compression.
   C. Taper Tie Hole Plug: Mechanical device for plugging tie holes; anchors optional flush or recessed grout.
   D. Grout: Cementitious, non-metallic, non-shrink grout for use with manufacturer's grout sleeve reinforcing bar coupler system.

2.03 FABRICATION
   A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
   B. Welding of reinforcement is not permitted.
   C. Fabricate and handle epoxy-coated reinforcing in accordance with ASTM D3963/D3963M.
   D. Locate reinforcing splices not indicated on drawings at point of minimum stress.

PART 3 EXECUTION

3.01 PLACEMENT
   A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
   B. Do not displace or damage vapor barrier.
   C. Accommodate placement of formed openings.
   D. Conform to applicable code for concrete cover over reinforcement.
   E. Bond and ground all reinforcement to requirements of Section 26.05.26.

3.02 FIELD QUALITY CONTROL
   A. An independent testing agency, as specified in Section 01.43.25, will inspect installed reinforcement for conformance to contract documents before concrete placement.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Concrete building frame members.
   B. Elevated concrete slabs.
   C. Floors and slabs on grade.
   D. Concrete shear walls, elevator shaft walls, and foundation walls.
   E. Joint devices associated with concrete work.
   F. Miscellaneous concrete elements, including equipment pads, light pole bases, and flagpole bases.
   G. Concrete curing.

1.02 RELATED REQUIREMENTS
   A. Section 03.10.00 - Concrete Formwork: Forms and accessories for formwork.
   B. Section 03.20.00 - Concrete Reinforcing.
   C. Section 07.92.00 - Joint Sealants: Products and installation for sealants for saw cut joints and isolation joints in slabs.
   D. Section 07.95.13 - Expansion Joint Cover Assemblies.

1.03 REFERENCE STANDARDS
   A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).
   B. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010 (Errata 2012).
   C. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2004 (Errata 2007).
   D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
   E. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.
   F. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.
   G. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2001 (Reapproved 2008).
   H. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2011.
T. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2012.
AB. ASTM C1582/C1582M - Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete; 2011.
AF. 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.
AG. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.
AH. COE CRD-C 572 - Corps of Engineers Specifications for Polyvinylchloride Waterstop; Corps of Engineers; 1974.
AI. NSF 61 - Drinking Water System Components - Health Effects; 2014.

1.04 SUBMITTALS

A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturers’ data on manufactured products 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.
1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.

D. Samples for Pigment Color Selection: Submit manufacturer's complete sample chip set, including pigment number and required dosage rate for each color.

E. Verification Samples: Submit sample chips of specified colors indicating pigment numbers and required dosage rates, for subsequent comparison to installed concrete.

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

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

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

I. Sustainable Design Submittal: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.

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

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

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.
   1. Maintain one copy of each document on site.

B. Follow recommendations of ACI 305R when concreting during hot weather.

C. Follow recommendations of 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.

PART 2 PRODUCTS

2.01 FORMWORK

A. Comply with requirements of Section 03.10.00.

2.02 REINFORCEMENT

A. Comply with requirements of Section 03.20.00.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I - Normal Portland type.
   1. Acquire all cement for entire project from same source.

   1. Acquire all aggregates for entire project from same source.

C. Lightweight Aggregate: ASTM C330/C330M.

D. Fly Ash: ASTM C618, Class C or F.

E. Calcined Pozzolan: ASTM C618, Class N.

F. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.
G. Water: Clean and not detrimental to concrete.

2.04 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
B. Air Entrainment Admixture: ASTM C260/C260M.
C. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
E. Accelerating Admixture: ASTM C494/C494M Type C.
F. Retarding Admixture: ASTM C494/C494M Type B.
G. Shrinkage Reducing Admixture:
   1. ASTM C494/C494M, Type S.
H. Corrosion Inhibitor Admixture:
   1. ASTM C494/C494M, Type C.
   2. ASTM C1582/C1582M.
I. 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.
J. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.
   1. Admixture Composition: Hydrophobic polymer waterproofing and corrosion inhibitor, functioning by closing concrete pores and chemical bonding.

2.05 ACCESSORY MATERIALS

A. Underslab Vapor Retarder: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with 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.
   2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations in vapor retarder.
B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. ASTM C1107/C1107M; Grade A, B, or C.
   2. Minimum Compressive Strength at 28 Days: 7,000 psi.
C. 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.
   2. Minimum Compressive Strength at 7 days, ASTM D695: 12,000 pounds per square inch.

2.06 BONDING AND JOINTING PRODUCTS

A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.
B. Epoxy Bonding System:
   1. Complying with ASTM C881/C881M and of Type required for specific application.
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.

D. Waterstops: Bentonite and butyl rubber, complying with NSF 61 and NSF 372.
   1. Configuration: As indicated on drawings.
   2. Size: As indicated on drawings.

E. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
   1. Size: 1/2 inch throat, 1/2 inch deep.

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: ASTM D1752 sponge rubber (Type I).

G. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.

H. Slab Construction Joint Devices: Diamond plate doweling system.

2.07 CURING MATERIALS

   1. Product dissipates within 4 to 6 weeks.

B. Resin Curing Compound: Solvent-based liquid, white pigmented, membrane-forming.
   1. For use on exterior slabs. When slab will be painted, sealed, topped, or receive other applied finish, completely remove curing compound after curing is complete and before finish coatings are applied.
   2. Comply with ASTM C309, Type 2, Classes A and B.
   3. VOC Content: Less than 350 g/L.
   4. Solids Content: 20 percent, minimum.

C. 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 and ASTM C1315 Type I Class A.
   3. VOC Content: Less than 100 g/L.

D. Moisture-Retaining Sheet: ASTM C171.
   1. White-burlap-polyethylene sheet, weighing not less than 10 oz/per linear yd, 40 inches wide.

E. Polyethylene Film: ASTM D2103, 4 mil thick, clear.

F. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
   1. Replace as much Portland cement as possible with fly ash or silica fume as is consistent with ACI recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
   1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

D. Normal Weight Concrete - Interior:
1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 3,000 pounds per square inch.
2. Fly Ash Content: Maximum 25 percent of cementitious materials by weight.
3. Water-Cement Ratio: Maximum 48 percent by weight.
4. Total Air Content: 3 percent maximum, determined in accordance with ASTM C173/C173M.
5. Maximum Slump: 4 inches.

E. Normal Weight Concrete - Exterior Flatwork (Not Paving):
1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 5,000 pounds per square inch.
2. Fly Ash Content: Maximum 25 percent of cementitious materials by weight.
3. Water-Cement Ratio: Maximum 40 percent by weight.
4. Total Air Content: 6 percent maximum, determined in accordance with ASTM C173/C173M.
5. Maximum Slump: 4 inches.

F. Normal Weight Concrete - Exterior Footings:
1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 3,000 pounds per square inch.
2. Fly Ash Content: Maximum 25 percent of cementitious materials by weight.
3. Water-Cement Ratio: Maximum 48 percent by weight.
4. Total Air Content: 2-4 percent, determined in accordance with ASTM C173/C173M.
5. Maximum Slump: 5 inches.

G. Normal Weight Concrete - Exterior Walls:
1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 3,000 pounds per square inch.
2. Fly Ash Content: Maximum 25 percent of cementitious materials by weight.
3. Water-Cement Ratio: Maximum 460 percent by weight.
4. Total Air Content: 6 percent maximum, determined in accordance with ASTM C173/C173M.
5. Maximum Slump: 4 inches.

H. 2.09 MIXING
   A. Transit Mixers: Comply with 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. Verify that forms are clean and free of rust before applying release agent.
   B. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
C. 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.

D. 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.

E. 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.

### 3.03 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

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

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

E. 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.

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

### 3.04 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 1/8 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.

E. Construction Joints: Where not otherwise indicated, use diamond plate dowels system

### 3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. An independent testing agency, as specified in Section 01.40.00, will inspect finished slabs for conformance to specified tolerances.

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

C. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
   1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15, on-grade only.
   2. Under Carpeting: F(F) of 25; F(L) of 20, on-grade only.
   3. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, on-grade only.

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D. Measure F(F) and F(L) in accordance with ASTM E1155, within 48 hours after slab installation; report both composite overall values and local values for each measured section.

E. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.

F. 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.

3.06 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. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.

D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
   1. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, thin set quarry tile, and thin set ceramic tile.
   2. Decorative Exposed Surfaces: "Steel trowel" as described in ACI 302.1R; use steel-reinforced plastic trowel blades instead of steel blades to avoid black-burnish marks; decorative exposed surfaces include surfaces to be stained or dyed, pigmented concrete, surfaces to be polished, and all other slab surfaces.

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

3.07 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than 7 days.

C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

D. Surfaces Not in Contact with Forms:
   1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
   2. 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-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.
   3. 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.
3.08 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01.43.25.
B. Provide free access to concrete operations at project site and cooperate with appointed firm.
C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
D. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
E. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.
F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.
H. 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.

3.09 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.

3.10 PROTECTION

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

END OF SECTION