

## SECTION 033000 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Footings.
  - 2. Foundation walls/Retaining walls
  - 3. Slabs-on-grade.
  - 4. Slab on Deck
  - 5. Building Columns
  - 6. Structural Slabs-on-Grade
  - 7. Grade Beams and Tie Beams
  - 8. Pile caps
- B. Products installed, but not furnished, under this Section include the following:
  - 1. Anchor rods and embed plates indicated to be cast into cast-in-place concrete, furnished under Division 05 Section "Structural Steel Framing"
- C. Related Sections:
  - 1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
  - 2. Division 32 Section "Concrete Paving" for concrete pavement and walks.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Moisture level in finished concrete shall be within limits acceptable to types of finish flooring indicated. Test methods and acceptable limits shall be as specified in Division 09 finish flooring Sections, or as required by finish flooring manufacturer's written product data or certified written statement. General Contractor is responsible for choosing and implementing methods of limiting excessive moisture during construction and curing, or remedial treatment, process, or other means to bring moisture level within acceptable limits, and for assigning and contracting for these responsibilities to installers
- B. Mix Designs indicated to be "Impermeable" shall be integrally waterproofed with a capillary crystalline admixture shall have the following performance characteristics

1. Concrete waterproofing system shall be of the crystalline type that chemically controls and permanently fixes a non-soluble crystalline structure throughout the capillary voids of the concrete.
2. The system shall cause the concrete to become sealed against the penetration of liquids from any direction, and shall protect the concrete from deterioration due to harsh environmental conditions.
3. The concrete shall exhibit no measurable leakage when pressure testing in accordance with U.S. Army Corps of Engineers CRD-C48-92 "Standard Test Method for Water Permeability of Concrete"

#### 1.4 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- B. Mass Concrete: Any placement of structural concrete with a minimum dimension equal to or greater than 36 inches, or other volumes of structural concrete in which the dimensions of the member being cast, the boundary conditions, the characteristics of the concrete mixture, or the ambient conditions can lead to undesirable thermal stresses, cracking, deleterious chemical reactions, or reductions in the long-term strength as a result of elevated concrete temperature due to heat from hydration.

#### 1.5 SUBMITTALS

- A. Contractor's Statement of Responsibility Per Division 01 Section "Quality Requirements"
- B. Product Data:
  1. Bar supports
  2. Mechanical Couplers (As used)
  3. Mechanical End Anchors (As Used)
  4. Form Saving Mechanical Couplers (As used)
  5. Vapor retarders
  6. Epoxy Bonding Adhesive
  7. Cartridge Injection Adhesive
  8. Form materials
  9. Form-release agents
  10. Waterstops
  11. Evaporation retarder
  12. Curing compound
  13. Curing and sealing compound
  14. Semirigid joint filler
  15. Joint-filler strips
  16. Controlled low-strength material, including design mixture.
  17. Admixures
- C. Design Mixtures: For each concrete mixture.
  1. Mix design submittals shall include test results and/or trial batch data that meet or exceed the required average compressive strength as required by ACI 301.

2. Trial batches shall consist of identical cementitious materials, fine and coarse aggregates, and admixtures to be used for mix design.
  3. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Steel Reinforcement Shop Drawings:
1. Drawings that detail fabrication, bending, and placement.
  2. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and bar supports for concrete reinforcement.
  3. Identify all step footing locations and associated reinforcing
  4. Identify and dimension all grade beam and tie beam construction joints
  5. Include slab on grade construction joint reinforcement
  6. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
    - a. Location of construction joints is subject to approval of the Architect.
- E. Mill Test Reports (to be provided to the special inspector with each delivery to the site):
1. Submit mill test reports for ASTM A615 reinforcing steel indicating compliance with the ASTM and additional restrictions
  2. Submit mill test reports for ASTM A706 reinforcing steel indicating compliance with the ASTM.
- F. Qualification Data:
1. For ready-mix concrete manufacturer.
  2. For Cartridge injection adhesive installer. Include manufacturer's training certificates or letter from manufacturer certifying training was complete with a list of individuals that were trained
- G. Material Certificates: For each of the following indicating compliance with the required standards and signed by manufacturers:
1. Vapor retarders
- H. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Granular Base Course
- I. Research/Evaluation Reports:
1. Submit ICC reports for the following:
    - a. Cartridge Injection Adhesive
    - b. Mechanical Couplers (As used)
    - c. Form Saving Mechanical Couplers (As used)
    - d. Mechanical End Anchors (As used)
- J. Hot and Cold Weather Program: Describe in detail procedure for working in Hot and Cold Weather. Included detailed description of methods, materials, and equipment to be used to comply with requirements.
- K. Mass Concrete Thermal Control Plan: Describe in detail procedures for each mass concrete placement to comply with ACI 301 as modified herein. The plan shall have detailed provision control and monitor concrete temperatures to ensure that mass concrete placement does not exceed a temperature of 155° F at

any time after placement, and that the thermal differential between the center and surface of placement does not exceed 35° F at any time after placement.

L. Substitutions for Cartridge Injection Adhesive:

1. Substitution requests may only be made using products with ICC-ESR reports for the product in the specific substrate.
2. Substitution request shall include signed and sealed calculations demonstrating that the product is capable of providing equivalent performance of the specified product for each specific location and condition when calculated using the data in the referenced ESR report and in accordance with the appropriate design procedure and standards required by the building code.
3. Substitution request shall specify the diameter and embedment depth of the substituted product
4. Any increase in material cost resulting from the substitution shall be the responsibility of the contractor.

M. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: The installer shall be experienced placing, finishing, curing, treating and protecting concrete equal in material, design and scope to that required for this project

B. Cartridge Injection Adhesive Installer Training: Conduct a thorough training session with the manufacturer's representative. Each individual responsible for the installation of anchors shall attend the training session. Training shall consist of a review of the complete process for the installation of the anchors and the use of proper equipment for drilling and installing the anchors, to include but not limited to:

1. Hole drilling procedure. Clarify acceptability of rotary hammer drilling and/or core drilling.
2. Hole drilling equipment
3. Type and diameter of drill bits
4. Hole preparation and hole cleaning technique
5. Hole cleaning equipment
6. Adhesive injection technique
7. Adhesive injection equipment
8. Adhesive curing requirements

C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

D. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5 and Section 7, "Lightweight Concrete.
  - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, mass concrete placement requirements, cold and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, granular base course requirements, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, cartridge injection adhesive installer requirements, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement:
  - 1. Deliver, store, and handle steel reinforcement to prevent bending and damage.
  - 2. Maintain reinforcement free of dirt and other deleterious materials.
  - 3. Store reinforcing on dunnage or other supports up off of ground.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Metal, or other approved panel materials.
  - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
  2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
  3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

## 2.2 STEEL REINFORCEMENT

### A. Reinforcing Bars:

1. ASTM A706, Grade 60, deformed
2. ASTM A 615/A 615M, Grade 60, deformed.
  - a. With mill tested yield strength not exceeding specified yield by more than 18,000 psi.
  - b. With mill tested ultimate strength to mill tested yield strength not less than 1.25

### B. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

### C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

## 2.3 REINFORCEMENT ACCESSORIES

### A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

### B. Bar Supports: Concrete Brick, Standees, Bolsters, chairs, spacers, supplementary reinforcing steel and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place including measures for supporting and anchoring reinforcing intermediate and top layers of reinforcing. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. Concrete brick supports are limited to use in supporting the bottom mat of below grade foundation reinforcing steel. Concrete brick supports shall consist of solid units of unit strength equal to or greater than associated foundation concrete. Submit material test reports for approval.

### C. Cartridge Injection Adhesive: A two part adhesive injection system for anchorage of new reinforcing steel to existing concrete construction.

1. Where adhesive manufacturer is not indicated, subject to compliance with requirements and acceptance by the Architect, provide the following or approved equal:

- a. Hilt HIT RE 500 V3 Adhesive Anchorage System, ICC ESR-3814.
- b. Dewalt Pure 110+, ICC ESR 3298
- c. Simpson Set-XP, ICC ESR 2508

D. Mechanical Couplers

- 1. Coupler devices shall have an ICC ESR report.
- 2. Coupler devices shall have been evaluated in accordance with ICC ES-AC133
- 3. Coupler devices shall comply with all requirements for "Type 2" mechanical splices per chapter 25 of ACI 318.
- 4. Positional couplers shall be used as required to properly orient reinforcing bars with hooks or bends

E. Form Saving Mechanical Couplers

- 1. Coupler devices shall have an ICC ESR report.
- 2. Coupler devices shall have been evaluated in accordance with ICC ES-AC133
- 3. Coupler devices shall comply with all requirements for "Type 2" mechanical splices per chapter 25 of ACI 318.
- 4. Positional couplers shall be used as required to properly orient reinforcing bars with hooks or bends
- 5. Couplers shall be internally threaded coupling devices designed to sit flush with the surface of the concrete pour in which the coupler is being embedded.

F. Mechanical End Anchors

- 1. End Anchor devices shall have an ICC ESR report.
- 2. End Anchors shall comply with requirements of "Type 2" mechanical splices per chapter 25 of ACI 318
- 3. End anchors may be shop or field applied to associated reinforcing steel. Special arrangements shall be made to field apply one or both ends where clearance requirements are of concern.
- 4. End anchors shall be fully fabricated and prepared for installation by a single manufacturer. End anchors consisting of multiple parts assembled by multiple manufacturers will not be permitted.

## 2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

- 1. Portland Cement: ASTM C 150, Type I, Type I/II or Type III unless noted otherwise. Supplement with Fly Ash: ASTM C 618, Class F.
  - a. Do not use Type III Portland Cement for Mass Concrete placement.

B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

- 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
- 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Lightweight Aggregate: ASTM C 330, 3/4-inch nominal maximum aggregate size.

D. Water: ASTM C 94/C 94M and potable.

## 2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Accelerating Admixture: Non-Chloride, ASTM C494/494M, Type C.
  - 4. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
  - 8. Crystalline Capillary Waterproofing Admixture: Permeability Reducing Admixture for hydrostatic conditions
- C. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

## 2.6 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, Sized per manufacturer's requirements for the specific application.

## 2.7 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A, minimum 15 mil thickness.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Stego Industries LLC; Stego Wrap 15-Mil Vapor Barrier.
    - b. Fortifiber Corporation; Moistop Ultra A.
    - c. Raven Industries Inc.; Vapor Block 15.
    - d. Reef Industries, Inc.; Griffolyn Type-65G.
    - e. W.R. Meadows, Inc.; Sealtight Vapormat 15.
  - 2. Seam Tape: Manufacturer's recommended adhesive or pressure-sensitive tape.

## 2.8 GRANULAR BASE COURSE:.

- A. A graded aggregate base course (GABC) complying with section 305 of SCDOT Standard Specification for Highway Construction.
  - 1. Compactable and trimmable.



## 2.9 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

## 2.10 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: Provide one of the following.
  - 1. Flexible lightweight, non-staining, polythelene, closed cell, non-absorbent, uv stable, compressible foam with a pre-scored removable strip to allow for clean and uniform sealant joint as follows:
    - a. Density: ASTM D1751
    - b. Compression: ASTM D3575
      - 1) 10% Deflection: 10 psi maximum
      - 2) 80% Deflection: 126 psi maximum
    - c. Water absorption: ASTM D3575, 0.5% volume maximum
  - 2. Resilient, flexible, non-extruding, asphalt-saturated cellulosic fiber with preformed cap to allow for clean and uniform sealant joint
    - a. Density: ASTM D 1751
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
  - 1. Type V, for bonding freshly mixed concrete to hardened concrete.

## 2.11 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

2. For mixes to be used for Mass Concrete placement provide mix designs to comply with the Mass Concrete Performance Criteria as coordinated with the Mass Concrete Thermal Control Plan. Develop mix designs to comply with the recommendations of ACI 301 as modified herein and as follows:
    - a. Recommended Maximum W/C ratio: 0.40
    - b. Recommended Aggregates: Granite, Limestone, or other low thermal expansion aggregates with a maximum nominal aggregate size of 1 ½” inches.
    - c. Supplementary Cementitious Materials: Supplement Portland Cement with supplementary cementitious materials as required to achieve the maximum concrete temperature and maximum thermal differential while achieving the specified strength parameters. Supplement a minimum of 30% of Portland cement with Fly Ash.
    - d. Do not use accelerating admixtures for Mass Concrete Placements.
- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- C. Admixtures: Use admixtures as noted in mix design and according to manufacturer's written instructions.
1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
  2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
  4. Use accelerating admixture in concrete as required for cold weather conditions.
  5. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
  6. Use capillary crystalline admixture in concrete mixtures where indicated.

## 2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
  2. Slump Limit: 4 to 6 inches, 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture plus or minus 1 inch.
  3. Air Content: 5 percent, plus or minus 1.5 percent at point of delivery.
  4. Dry Unit Weight: 145 lb/cu. ft. plus or minus 3 lb/cu. ft.
  5. Comply with any additional requirements for Mass Concrete Placements as occur.
- B. Grade Beams and Tie Beams: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
  2. Slump Limit: 4 to 6 inches, 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture plus or minus 1 inch.
  3. Air Content: 5 percent, plus or minus 1.5 percent at point of delivery.
  4. Dry Unit Weight: 145 lb/cu. ft. plus or minus 3 lb/cu. ft.
  5. Comply with any additional requirements for Mass Concrete Placements as occur.
- C. Pile Caps: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.

2. Air Content: 5 percent, plus or minus 1.5 percent at point of delivery.
3. Dry Unit Weight: 145 lb/cu. ft. plus or minus 3 lb/cu. ft.
4. Comply with any additional requirements for Mass Concrete Placements as occur.

D. Foundation Walls and Retaining Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Air Content: 5 percent, plus or minus 1.5 percent at point of delivery.
3. Dry Unit Weight: 145 lb/cu. ft. plus or minus 3 lb/cu. ft.
4. Mix shall meet the "Impermeable" performance criteria
5. Maximum Water/Cement Ratio: 0.45

E. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Slump Limit: 4 to 6 inches, 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture plus or minus 1 inch.
3. Air Content: 3 percent, plus 0 percent or minus 1.5 percent at point of delivery
4. Minimum Cementitious Materials Content: 540 lb/cu. yd.
5. Dry Unit Weight: 145 lb/cu. ft. plus or minus 3 lb/cu. ft.

F. Structural Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Slump Limit: 4 to 6 inches, 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture plus or minus 1 inch.
3. Air Content: 3 percent, plus 0 percent or minus 1.5 percent at point of delivery
4. Minimum Cementitious Materials Content: 540 lb/cu. yd.
5. Dry Unit Weight: 145 lb/cu. ft. plus or minus 3 lb/cu. ft.

G. Slab on Deck: Proportion structural lightweight concrete mixture as follows:

1. Minimum Compressive Strength: 3500 psi at 28 days.
2. Calculated Equilibrium Unit Weight: 110 lb/cu. ft. plus or minus 3 lb/cu. ft. as determined by ASTM C 567.
3. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery.
4. Include corrosion inhibiting admixture at manufacturer's recommended dosage rate
5. Mix shall meet the "Impermeable" performance criteria
6. Maximum Water/Cement Ratio: 0.45

## 2.13 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. Unless a detailed hot weather concrete plan incorporating the recommendations of ACI 305 has been submitted and approved comply with the following:
  - a. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes.
  - b. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

## 2.15 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting flowable concrete material produced from the following:
  1. Portland Cement: ASTM C 150, [Type I] [Type II] [or] [Type III].
  2. Fly Ash: ASTM C 618, Class C or F.
  3. Normal-Weight Aggregate: ASTM C 33.
  4. Foaming Agent: ASTM C 869.
  5. Water: ASTM C 94/C 94M.
  6. Air-Entraining Admixture: ASTM C 260.
- B. Produce conventional-weight, controlled low-strength material with 80-psi compressive strength when tested according to ASTM C 495.

## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
  1. Smooth-formed finished surfaces: Class A, 1/8 inch
  2. Rough-formed finished surfaces: Class D, 1 inch
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  1. Install keyways, reglets, recesses, and the like, for easy removal.
  2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete as indicated
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
  - 2. Anchor rods and embeds shall be securely fastened in formwork prior to placing concrete, and concrete vibrated around the anchor or embed to ensure proper flow of concrete around anchors and embeds.
  - 3. Anchor rod sleeves (where required) shall be accurately located and fastened in formwork prior to placing concrete.
  - 4. Wet setting of anchor rods and embeds is not permitted.

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.4 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
1. Place vapor retarder with longest dimension parallel to direction of pour and face laps away from the expected direction of placement whenever possible.
  2. Lap joints per manufacturer, but not less than 6 inches and seal with manufacturer's recommended tape or adhesive.
  3. Extend vapor retarder to edge of slab in all cases.
  4. At conditions terminating into a wall turn vapor retarder up wall, extend to top of slab and seal to wall with manufacturer's tape or mastic unless obstructed by dowels, waterstops or other elements or unless specifically required otherwise by manufacturer.
    - a. Where specific conditions prevent turning vapor retarder up and sealing submit specific procedure for turning vapor retarder down and sealing to wall or footing.
  5. Manufacturer's seam tape or mastic shall be applied to clean and dry vapor retarder in strict accordance with manufacturer's recommendations.
  6. Seal all penetrations including pipes and permanent stakes per manufacturer's instructions.
  7. Do not use non-permanent stakes driven through the vapor retarder.
  8. Repair damaged areas with vapor retarder patch of the typical vapor retarder material sealed with manufacturer's tape or mastic in strict accordance with manufacturer's recommendations for repair.

### 3.5 GRANULAR BASE COURSE:

- A. General: Place granular base course on compacted subgraded beneath vapor retarder for all slabs on grade unless noted otherwise.
1. Compact granular base course with mechanical equipment to an elevation tolerance of plus 0 and minus  $\frac{3}{4}$  inch.
  2. Granular base course is not required at structural slabs or where mud slabs and below slab sheet waterproofing are indicated.
  3. Ensure surface of granular base course is uniform to prevent damage to vapor retarders.
  4. Ensure granular base course is compacted to a uniform surface free of ruts, divots or other anomalies from construction traffic. Repair any anomalies immediately prior to concrete placement.

### 3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

- C. Anchorage of reinforcement into hardened concrete using cartridge injection adhesive anchors shall only be used where specifically indicated on plans or with written direction from the Engineer of Record for a specific location.
- D. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. Foundation reinforcing steel may be supported on solid concrete brick units of strength equal to or greater than foundation concrete.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Welded Wire Reinforcement:
  - 1. Install welded wire reinforcement in longest practicable lengths
  - 2. Locate welded wire reinforcement in top 1/3 of slab on grades unless noted otherwise
  - 3. Locate welded wire reinforcement at mid-depth of concrete slab thickness over deck flutes unless noted otherwise.
  - 4. Lap edges and ends of adjoining sheets at least one mesh spacing plus 2", but not less than 6". Lace overlaps with wire.
  - 5. Slabs on Grade 4" or less in thickness: Support welded wire reinforcement on chairs, bolsters or bar supports spaced to minimize sagging, and as required to support construction traffic
    - a. Alternately, welded wire reinforcement may be placed on grade and "hooked"/pulled to the proper location
    - b. Placement of welded wire reinforcement after placement of concrete and "walking in" is not permitted.
  - 6. Slabs on Grade greater than 4" in thickness: Support welded wire reinforcement on chairs, bolsters or bar supports spaced to minimize sagging, and as required to support construction traffic
    - a. Placement of welded wire reinforcement on grade or deck and "hooked"/pulled up into slab as concrete is placed is not permitted.
    - b. Placement of welded wire reinforcement after placement of concrete and "walking in" is not permitted.
  - 7. Elevated slabs: Support welded wire reinforcement on chairs, bolsters or bar supports spaced to minimize sagging, and as required to support construction traffic
    - a. Alternately, welded wire reinforcement may be placed on grade and "hooked"/pulled to the proper location
    - b. Placement of welded wire reinforcement after placement of concrete and "walking in" is not permitted.

### 3.7 CARTRIDGE INJECTION ADHESIVE

- A. Where manufacturer recommends the use of special tools for installation of anchors, such tools shall be used.
- B. All facets of hole drilling, hole cleaning, anchor installation, anchor torquing shall be in strict accordance with the ICC-ESR report and manufacturer's data.

- C. Drill holes perpendicular to substrate surface.
- D. Drill holes with rotary impact hammer drills using carbide-tipped bits or core drills using diamond core bits as indicated in the ICC-ESR report.
- E. Drill bits and core bits shall be of diameters indicated in the ICC-ESR report.
- F. All holes shall be cleaned with compressed air to remove all drilling dust and other deleterious substances.
- G. Remove water from holes to attain a surface dry condition unless specifically permitted otherwise by ICC-ESR report.
- H. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete has achieved full design strength.
- I. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.
- J. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
- K. Follow manufacturer recommendations to ensure proper mixing of adhesive components.
- L. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface.
- M. Remove excess adhesive from the surface.
- N. Shim reinforcement with suitable device to center the reinforcement in the hole.
- O. Do not disturb or load reinforcement before manufacturer specified cure time has elapsed.
- P. Observe manufacturer recommendations with respect to installation temperatures.

### 3.8 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement.
  - 2. Continue reinforcement across construction joints unless otherwise indicated.
  - 3. Provide supplemental reinforcing and/or smooth dowels where indicated at joints.
  - 4. Strip bulkheads from footings, beams, grade beams, tie beams, and slabs and roughen surface of concrete to a minimum 1/4" amplitude while concrete is still plastic.
  - 5. Form keyed joints unless indicated otherwise. Embed keys at least 1-1/2 inches into concrete unless noted otherwise.
  - 6. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.



7. Locate joints in slabs on steel deck as follows:
  - a. Joints parallel to joists (perpendicular to girders) shall be located at the midpoint between two adjacent joists.
  - b. Joints parallel to girders (perpendicular to joists) shall be located at the midpoint of two adjacent girders.
  - c. Stagger and offset joints as required to meet the requirements.
8. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
9. Do not place horizontal joints in foundation or retaining walls.
10. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
11. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least [one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete.
  - a. Cut joints as soon as cutting action will not tear, abrade, or otherwise damage surface, but not more than 12 hours after finished, and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

### 3.9 WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding and or mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

1. Coordinate location of waterstop in concrete cross section with manufacturer's requirements with careful attention given to clear cover requirements and location with respect to reinforcing steel.

### 3.10 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 and as follows.
  - 1. Do not add water to concrete unless the batched water is specifically noted as less than the mix design and is indicated as such on the batch ticket.
  - 2. Do not add more water than the amount of withheld water which is specifically identified on the batch ticket.
  - 3. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 2. Maintain reinforcement in position on chairs during concrete placement.
  - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 4. Slope surfaces uniformly to drains where required.
  - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Concrete placed over metal deck shall be placed and screeded level and flat to the specified tolerances, maintaining at least the minimum specified slab thickness as shown on drawings. The contractor shall increase slab thickness as required to compensate for metal deck deflection, residual beam camber and beam deflection in order to achieve a level and flat floor within the specified tolerance.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Unless a detailed hot weather concrete plan incorporating the recommendations of ACI 305 has been submitted and approved; maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

### 3.11 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view, to be covered with a coating or covering material applied directly to concrete coordinate with Architectural drawings and specifications.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.12 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Finishing Tolerances:
1. Horizontal finishes will be accepted provided:
    - a. Applicable specification requirements are satisfied.
    - b. Water does not pond in areas sloped to drain.
    - c. Floor finish tolerances Ff/FI for each completed floor area conform to the values indicated

- d. Mean Local values for Flatness and Levelness are satisfied at all locations tested.
  - e. Accumulated deviation from intended true plane of finished surface does not exceed 1 inch.
  - f. Accuracy of concrete finish does not adversely affect installation and operation of movable equipment, floor supported items or items fitted to floor (doors, tracks, etc.).
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
- 1. Apply float finish to surfaces to receive trowel finish, trowel and fine broom finish, or to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
  - 2. Apply to mud slabs.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
- 1. Apply to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, or paint.
  - 2. Grind off any defects which would indicate through thin floor covering.
  - 3. Finish surfaces to the following tolerances as measured by ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
    - a. Slabs on Grade: Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
    - b. Unshored Elevated Slabs: Specified overall values of flatness, F(F) 35 with minimum local values of flatness, F(F) 24.
- E. Trowel and Fine-Broom Finish: After applying a first trowel finish, while concrete is still plastic, slightly scarify surface with a fine broom. Provide finish equivalent to ICRI CSP3.
- 1. Apply to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method without cleavage membrane, club level slab and ramps, stair tower slabs, upper concourse slabs.
  - 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- 1. Apply a broom finish to exterior concrete on grade and where indicated.
  - 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- 3.13 MISCELLANEOUS CONCRETE ITEMS
- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

### 3.14 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Foundations:
  - 1. Protect top sides of footings to receive masonry or concrete construction from dirt and debris.
  - 2. Excavations:
    - a. Do not allow excavations directly adjacent to or beneath footings to the absolute greatest extent possible.
    - b. Where excavations must occur beneath in place footings or slabs the area shall be careful excavated as to not damage structural elements. The area shall be backfilled and compacted at the end of the work day.
    - c. Areas excavated below footings shall be backfilled with Controlled Low-Strength Material.
    - d. Areas excavated adjacent to and at or below footing elevation shall be backfilled with Controlled Low-Strength Material unless the area is large enough to be backfilled with control fill in lifts attaining proper compaction between lifts.
- F. Slabs:
  - 1. Protect slabs to remain expose, stained or receive other non-opaque floor coverings or treatments with impervious covers to prevent staining of the slab
  - 2. Do not allow construction equipment or vehicles to drive on slabs.
  - 3. Excavations:
    - a. Do not allow excavations directly adjacent to or beneath slabs on grade to the absolute greatest extent possible.
    - b. Where excavations must occur beneath in place footings or slabs the area shall be careful excavated as to not damage structural elements. The area shall be backfilled and compacted at the end of the work day.

- c. Areas excavated below slabs shall be backfilled with Controlled Low-Strength Material. Areas excavated adjacent to and at or below slab elevation shall be backfilled with Controlled Low-Strength Material unless the area is large enough to be backfilled with control fill in lifts attaining proper compaction between lifts.
- d. Repair vapor retarders per manufacturer's requirements

G. Cure concrete according to ACI 308.1, as follows:

- 1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
  - b. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
- 2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
  - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
- 3. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
  - a. Apply curing and sealing compound to areas of exposed concrete not to receive any floor treatment, staining, painting or floor covering. Coordinate with finish schedule.

### 3.15 CONCRETE REPAIRS

- A. Where deficient concrete is identified on the job all repairs shall be subject to the EOR and AOR approval.
- B. The contractor shall be responsible for enlisting a concrete repair specialists with no less than 5 years of documented concrete repair service and having repaired deficient conditions similar to those identified on no less than 5 projects in the previous five years.
- C. The contractor and repair specialists shall prepare a narrative of the proposed repair including detailed methods and material, and submit for EOR approval prior to commencing with repairs.
- D. Where repair of deficient work is to remain exposed, the deficient work shall be removed and replaced as directed by the EOR.

3.16 JOINT FILLING

- A. Fill all joints in exposed concrete slabs
- B. Prepare, clean, and install joint filler according to manufacturer's written instructions.
  - 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- C. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- D. Install semirigid joint filler full depth in saw-cut joints and at least 1 deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.17 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports in accordance with the schedule of special inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 033000

## SECTION 035000 - CEMENTITIOUS DECKS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Fiber reinforced cement board floor panels.
- B. Related Work:
  - 1. Section 092216 "Non-Structural Metal Framing" for metal stud supports.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include details at supports and attachment to other work.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect cementitious deck units from moisture.
- B. Store units flat on elevated platforms at Project site in a dry, well-ventilated, covered space and stack according to manufacturer's written instructions.
- C. Handle units to prevent chipping, breaking, cracking, staining, soiling, warping, or other physical damage. Discard damaged units at time of installation.

#### 1.5 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit work to be performed according to manufacturers' written instructions and warranty requirements.
- B. Protect cementitious deck from moisture during installation and while exposed to the weather until permanently covered with subsequent construction.



## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 0.
  2. Smoke-Developed Index: 0.

### 2.2 CEMENTITIOUS DECK UNITS

- A. Cementitious Deck: Manufacturer's standard cementitious floor panels shall comply with ASTM C-1186-91 Norm, standard specification for flat non-asbestos fiber-cement sheets, Grade 1.
1. Basis-of-Design Product: Subject to compliance with requirements, provide **Plycem CemDeck Fiber Reinforced Cement Board by U.S. Architectural Products, Inc.** or Architect approved comparable product.
  2. Thickness: 1 inch.
  3. Size: Manufacturer's standard 4'-0" width; manufacturer's standard length as appropriate for application.
  4. Edge Configuration: Square and modified T&G.
- B. Properties: Provide cementitious floor panels with the following minimum properties:
1. Modulus of Elasticity perpendicular to fibers (per ASTM C120) 775,000 psi.
  2. Modulus of Rupture perpendicular to fiber (per ASTM C120) 1,820 psi.
  3. Shear Strength (per ASTM D732) 1,180 psi.
  4. Tensile Strength perpendicular to fibers (per ASTM D209) 690 psi.
  5. Compressive Strength perpendicular to surface (per ASTM C170) 3,860 psi.

### 2.3 ACCESSORIES

- A. Screws: Manufacturer's recommended corrosion-resistant screw fasteners and washers, self-drilling, self-tapping, of length required for deck and structural framing indicated.
1. Use corrosion resistant self-countersinking head screws such as HILTI PWH SD Cement Board Fasteners, part #00372760, or equal. Fasteners to be minimum #8 diameter with S-12 self-drilling 'TEK' points. Length shall be 2 - 3 times the board thickness.
- B. Adhesive: Sikaflex-11 FC (or equal).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine structural support framing for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing cementitious deck.
  - 1. Install fastenings according to manufacturer's written instructions unless otherwise indicated.

### 3.3 FLOOR DECK INSTALLATION

- A. Stagger panel joints in long direction. Panels are to be installed over minimum 2 inch flange width supporting framing members not exceeding 24 inches on centers while limiting deflection to a maximum of  $l/240$ . Install panels with long dimension perpendicular to direction of supporting joists.
- B. Prior to screw fastening boards to joists, apply construction adhesive in the modified T&G joints and at the square edge joints which occur over joists supports. After applying the adhesive, ensure board joints are tight prior to screw fastening the boards to framing.
- C. All field cut edges or penetrations of the cementitious boards must be re-sealed with Sherwin-Williams HC acrylic emulsion concrete sealer. Do not use any oil based sealers on cementitious deck.
- D. Fastening: Maintain minimum  $\frac{3}{4}$ " distance from all board edges. Screw fasteners to maintain minimum of 2" distance from board corners and offset fasteners to avoid 45 degree fastener placement at board corners. Do not overdrive screw heads. Seat screw heads flush with board surface.

### 3.4 CLEANING AND PROTECTION

- A. Protect top surfaces of deck from damage caused by construction operations.
- B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures that cementitious deck is without damage or deterioration at time of Substantial Completion.
- C. Remove and replace deteriorated and damaged deck units.

END OF SECTION 035000