SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section covers cast-in-place concrete including finishing, surface repair and curing.

1.2 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, and Owner Request For Proposal apply to this Section.

B. Section 03 10 00 - Concrete Forming and Accessories

C. Section 03 20 00 - Concrete Reinforcement

D. Section 07 26 00 - Under Slab Vapor Retarder

1.3 REFERENCE STANDARDS

A. Meet the requirements of the following codes, specifications and standards.

1. American Concrete Institute (ACI) Publications, latest versions:
2. ACI 301 - Specifications for Structural Concrete for Buildings
3. ACI 302, Guide for Concrete Floor & Slab Construction
4. ACI 305.1 - Standard Specification for Hot Weather Concreting
5. ACI 306.1 - Standard Specification for Cold Weather Concreting
6. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International (ASTM), latest versions:

1. ASTM A 29, Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought.
2. ASTM A 82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
3. ASTM A 496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
4. ASTM A 615/A 615M Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
5. ASTM A 970, Standard Specification for Headed Steel Bars for Concrete Reinforcement.
6. ASTM A 1064, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
7. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field
8. ASTM C33/C33M - Standard Specification for Concrete Aggregates

9. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
10. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete
11. ASTM C131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
12. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
13. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete
14. ASTM C150/C150M - Standard Specification for Portland Cement
15. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete
16. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete
17. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
18. ASTM C231/C231M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
19. ASTM C260/C260M - Standard Specification for Air Entraining Admixtures for Concrete
20. ASTM C309 - Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete
21. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete
22. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete
23. ASTM C567 - Standard Test Method for Determining Density of Structural Lightweight Concrete
24. ASTM C595 – Standard Specification for Blended Hydraulic Cements
25. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
26. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
27. ASTM C 1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
28. ASTM E1155 – Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers
29. ASTM C 1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
30. ASTM D 1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
31. ASTM D 1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
32. ASTM D 1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
33. ASTM D 2167, Standard Test Method for Density and Unit Weight of Soil

in Place by the Rubber Balloon Method.
34. ASTM D 2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
35. ASTM E 1155, Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
36. ASTM E 1643, Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

1.4 SUMMARY

A. Section Includes:

1. Concrete standards.
2. Concrete materials.
3. Admixtures.
4. Fiber reinforcement.
5. Vapor retarders.
6. Floor and slab treatments.
7. Liquid floor treatments.
8. Curing materials.
9. Accessories.
10. Repair materials.
11. Concrete mixture materials.
12. Concrete mixing.

B. Related Requirements:

1. Section 033500 – “Concrete Finishing”.

C. This Section refers to cast-in-place concrete, including reinforcement, concrete materials, concrete mix design, placement procedures, finishes and pre-packaged grout.

D. The Contractor shall furnish all labor, materials, and equipment necessary to complete all concrete work shown or required by the Drawings or specified herein. This shall include but is not limited to, all footings, slabs, beams, retaining walls, piers, formwork, metal accessories, expansion joints, cement finishes and all work directly related to concrete work, to include compacted stone base if, and as directed, by the Contractor.

E. Furnish and install all reinforcing bars, dowels, mesh, ties, etc., as noted and required for all reinforced concrete work as shown.

1.5 DEFINITIONS

A. Cementitious Materials: Portland cement or blended hydraulic cement alone or in combination with one or more of the following:

1. Fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cementitious Materials (w/cm) Ratio: The ratio by weight of mixing water to cementitious materials.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

B. Pre-Concrete Floor Slab Conference: At least 15 days prior to the start of concrete

slab construction, and as coordinated by Project Manager, the Contractor shall conduct a meeting at the project site to review mix designs, special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures construction, contraction and isolation joints, forms and form removal limitations, shoring and re-shoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, floor and slab flatness and levelness measurement, concrete repair procedures and concrete protection to achieve the requirements of this specification. The Contractor shall send a Pre-concrete Conference Agenda, included at the end of this section, to all attendees 10 days prior to the scheduled date of the conference.

1. The contractor shall require responsible representatives of every party concerned with the concrete work to attend the conference, including but not limited to the following:
   a. General Contractor
   b. Contractor’s Superintendent.
   c. Contractor’s Project Manager
   d. Laboratory responsible for concrete mix design(s).
   e. Laboratory responsible for field quality control.
   f. Concrete subcontractor (Crew Foreman).
   g. Subgrade subcontractor.
   h. Ready-mix concrete producer.
2. Pre-Pour Conference Minutes:
   a. Minutes of the meeting shall be recorded, typed, and distributed by the Contractor to all concerned parties, Project Manager/Owner, the Architect, and the Structural Engineer of Record, within five days of the meeting.
   b. The minutes shall include a statement by the Concrete Supplier stating that the proposed concrete mix design will produce the concrete quality required by these specifications.
   c. The minutes shall include a statement by the Contractor that the proposed concrete mix design will provide appropriate workability and setting times, to ensure that all the requirements of this Specification can be achieved.

1.7 ACTION SUBMITTALS

A. Product Data: For each manufactured material and product indicated.

B. Concrete Mix Design(s)

1. Submit mix designs for each proposed concrete mix.
2. Submit aggregate grading for all aggregates proposed for use in the concrete mixture proportions.
3. Submit items listed in ACI 301, Section 4.

C. Shop Drawings: Include details of steel reinforcement placement including material, grade, bar schedules, stirrup spacing, bent bar diagrams, lap lengths, arrangement, block-outs, knock-outs, blind block-outs, construction joint layout, and supports.

D. Material certificates and test reports.

1. The minutes shall include a statement by the Concrete Supplier stating that the proposed concrete mix design will produce the concrete quality required by these Specifications.
2. The minutes shall include a statement by the Contractor that the proposed concrete mix design will provide appropriate workability and setting times, to ensure that all the requirements of this Specification can be achieved.

1.8 INFORMATIONAL SUBMITTALS

F. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Testing Agency: Include documentation indicating compliance with ASTM E329 or ASTM C1077 and copies of applicable ACI certificates for testing technicians or ACI Concrete Construction Special Inspector - MH, ASCC.
3. For sheet vapor retarder/termite barrier, showing compliance with ICC's Acceptance Criteria AC380.

G. Minutes of preinstallation conference.

1.9 QUALITY ASSURANCE

H. Installer Qualifications: A qualified Installer who employs Project personnel qualified as an ACI-certified Concrete Flatwork Associate and Concrete Flatwork Finisher and a supervisor who is a certified ACI Advanced Concrete Flatwork Finisher/Technician or an ACI Concrete Flatwork Finisher with experience installing and finishing concrete.

I. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

J. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing that performs duties on behalf of the Architect/Engineer.

1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Level 1. Testing agency laboratory supervisor tests to be an ACI-certified Concrete Laboratory Testing Technician, Level 2.

1.10 DELIVERY, STORAGE, AND HANDLING

K. Comply with ASTM C94/C94M and ACI 301.

1.11 FIELD CONDITIONS

L. Cold-Weather Placement: Comply with ACI 301 as follows:

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When air temperature has fallen to, or is expected to fall below 40 deg F during the protection period, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.

M. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed **95 deg F**.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.12 WARRANTY

N. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

1.13 ACTION SUBMITTALS

C. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and admixtures.

D. Concrete Mix Design:

E. Submit mix design in accordance with ACI-301, Section 4.

1. Submit with mix design results of laboratory tests performed within previous 12 months indicating aggregates from the proposed source comply with the requirements of ASTM C 33 or C 330 as applicable.
2. Submit the proposed area of use for each mix design submitted (footings, stemwalls, slabs, walls, pedestals, etc.).

F. Test Reports: Submit copies of test reports for concrete compressive strength, air content, temperature and slump. Submit copies of granular base course test reports.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Testing Agency: Include documentation indicating compliance with ASTM E329 or ASTM C1077 and copies of applicable ACI certificates for testing technicians or ACI Concrete Construction Special Inspector - MH, ASCC.
3. For sheet vapor retarder/termite barrier, showing compliance with ICC's Acceptance Criteria AC380.

B. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified Installer who employs Project personnel qualified as an ACI-certified Concrete Flatwork Associate and Concrete Flatwork Finisher and a supervisor who is a certified ACI Advanced Concrete Flatwork Finisher/Technician or an ACI Concrete Flatwork Finisher with experience installing and finishing concrete.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing that performs duties on behalf of the Architect/Engineer.

1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Level 1. Testing agency laboratory supervisor tests to be an ACI-certified Concrete Laboratory Testing Technician, Level 2.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.7 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 as follows:

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When air temperature has fallen to, or is expected to fall below 40 deg F during the protection period, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed **95 deg F.**

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE STANDARDS

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type of admixture from single source from single manufacturer.

B. Formwork: Furnish formwork and form accessories in accordance with ACI 301.

C. Concrete Materials:

1. Portland cement: Shall conform to ASTM C 150, Type I or II. Use one brand of cement throughout the project.
2. Coarse and Fine Aggregates:
   a. Shall conform to ASTM C 33. Provide aggregates from a single source with documented service record data of at least 10 years satisfactory service in similar applications and materials.
      Maximum aggregate sizes shall be:
      1) 1½" for slabs-on-grade
      2) 1" for footings, piers and walls
      3) ¾" for beams
      4) ¾" minimum max for exterior slabs and pavement
3. Stockpiles of coarse aggregate shall be built in horizontal layers to avoid segregation and shall be stored separately and in such a manner to be free of intrusions of foreign materials.
4. Water: ASTM C 94/C 94M and potable. Mixing water shall be clear and clean. Do not use wash out water from mixer washout operations or recycled water.
5. Blended Hydraulic Cement: ASTM C 595/C 595M, Type I, IL (MS), Portland-limestone cement.

D. Admixtures

1. Air-Entraining Admixtures: Shall conform to ASTM C-260. Admixture manufacturer shall provide written certification that the air-entraining admixture is compatible with other required admixtures. All exterior slabs shall be air-entrained (5% - 7%). Air-Entraining admixtures are only allowed in exterior ABOVE ground applications. Air-Entraining admixtures are NOT allowed in interior slabs, below ground footings, etc. Use one of the admixtures listed below.
   a. AEA-92 or Air 40 by Euclid Chemical;
   b. Micro Air by BASF;
   c. Sika AIR or Sika AEA by Sika;
   d. Daravair 1000 or Darex-II by W.R. Grace.
2. Water Reducing Admixture: Shall conform to ASTM C-494, Type A or Type F. Use one of the admixtures listed below:
   a. "Eucon" Series by Euclid Chemical;
   b. "Pozzolith" Series by BASF;
   c. Sikaplast 500 or Sikament Series by Sika;
   d. WRDA or Daracem Series by W.R. Grace.
3. Water Reducing, Retarding Admixture: Shall conform to ASTM C-494, Type D. Use one of the admixtures listed below:
   a. Retarder 75 by Euclid Chemical;
   b. "Pozzolith" Series or "Delvo" by BASF;
   c. Plastiment Series by Sika;
   d. Daratard 17 by W.R. Grace.

4. High Range Water-Reducing Admixture (Superplasticizer): Shall conform to ASTM C-494, Type F or Type G. Use one of the admixtures listed below:
   a. Eucon 37 or Plastol 341/5000 by Euclid Chemical;
   b. Rheobuild 1000, PS 1466 or “Glenium” Series by BASF;
   c. Sikament Series or ViscoCrete Series by Sika;
   d. Daracem-100 or Adva Flow by W.R. Grace.
5. Water Reducing, Non-Corrosive Accelerating Admixture: Shall conform to ASTM C-494, Type C or Type E. Use one of the admixtures listed below:
   a. Accelguard 80/90 or Accelguard NCA by Euclid Chemical;
   b. NC534 or Pozzutec 20 by BASF;
   c. Sikaset NC or Plastocrete 161FL by Sika;
   d. Polarset by W.R. Grace.
6. Prohibited Admixtures:
   a. Calcium chloride or admixtures containing more than 0.05% chloride ions are not permitted.
7. Certification: Written conformance to the above-mentioned requirements and the chloride ion content of admixtures will be required from the admixture manufacturer prior to mix design review by the Engineer

E. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a No. 4 (4.75-mm) sieve and 10 to 30 percent passing a No. 100 (0.15-mm) sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

F. Vapor Retarder: Shall be Stego Wrap Vapor Barrier or approved substitutions, ASTM E 1745 Class A; not less than 15 mils thick as Manufactured by Stego Industries. Strictly follow manufacturer’s installation requirements.

G. Joint-Filler Strips: Shall Conform to ASTM D 1751, asphalt-saturated cellulosic fiber.

H. Evaporation Retarder: Spray-applied, waterborne, monomolecular film, to aid in the prevention of rapid moisture loss from fresh concrete surfaces during the finishing operations.

   1. “Eucobar” by Euclid Chemical.

I. Non-Shrink, Non-Staining Grout: Shall comply with ASTM C 1107 and shall be furnished where indicated on the drawings.

   1. “Euco NS” by Euclid Chemical;
   2. “Masterflow 555” by BASF;
   3. “Sika Grout 328” by Sika.

J. Curing Materials:

   1. Exterior Curing and Sealing (VOC Compliant, 700g/l): Liquid type membrane-forming curing compound, clear styrene acrylate type, complying with ASTM C1315, Type I, Class B, 25% solids content

minimum. Moisture loss shall be not more than 0.30 Kg/m^2 when applied at 300 sq. ft./gal. Manufacturer's certification is required. Acceptable products: "Super Rez Seal" by The Euclid Chemical Company or "Kure N Seal 30" by BASF.

OR

. Clear Curing and Sealing Compound (350 g/l): Liquid type membrane-forming curing compound, clear styrene acrylate type, complying with ASTM C1315, Type I, Class A, 25% solids content minimum. Moisture loss shall be not more than 0.40 Kg/m^2 when applied at 300 sq. ft./gal. Manufacturer's certification is required. Subject to project requirements provide one of the following products: "Super Diamond Clear VOX" by The Euclid Chemical Company or "Kure-N-Seal WB-30" by Sonneborn.

2. Interior Curing Alternate: All interior concrete slabs shall be protected from premature drying for a minimum of seven days, as required in ACI 301, using moisture-retaining cover. Cover concrete surfaces with moisture-retaining cover, placed in widest practical width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Remove any air bubbles in between the cover and the floor slab. After the minimum seven day curing period, remove moisture-retaining cover and immediately scrub the entire area with auto-scrubber and interior concrete floor cleaner. After interior concrete slab is thoroughly cleaned of all salts, laitance, dirt and debris, allow drying for at least six (6) hours. Single use moisture retaining cover from a previous project shall not be reused for any portion of the interior floor slab.
3. Interior Curing: The floor slab shall be cured using a reduced odor, dissipating liquid membrane forming curing compound that is formulated from hydrocarbon resins. The dissipating liquid membrane forming curing compound shall meet the requirements of ASTM C-309 and VOC contents in accordance to EPA 40cfr, part 59, and table 1, subpart D for concrete curing compounds with a maximum VOC content of 350g/l.

K. Cure-Densifier-Hardener

1. Manufacturer: Curecrete Distribution, Inc. Contact: 1203 Spring Creak Place, Springville, UT 84663-0551; Telephone: (800) 998-5664, (801) 489-5663; Fax: (801) 489-3307; Email: info@ashfordformula.com; Website: www.ashfordformula.com.
2. Cure-Densifier-Hardener: Ashford Formula is a transparent, chemically reactive, water-based treatment that penetrates into the concrete surface, forming a chemical reaction of crystalline growth that fills in the natural pores and voids in the concrete surface.
   a. Abrasion Resistance to Revolving Disks: At least a 32.5% improvement over untreated samples when tested in accordance with ASTM C779.

b. Surface Adhesion: At least a 22% increase in adhesion for epoxy when tested in accordance with ASTM D3359.
c. Hardening: As follows when tested in accordance with ASTM C39:
   1) After 7 Days: An increase of at least 40% over untreated samples.
   2) After 28 Days: An increase of at least 38% over untreated samples.
d. Rebound Number: An increase of at least 13.3% over untreated samples when tested in accordance with ASTM C805.
e. Electrical Resistance: To ASTM F150
f. Electrical Resistance: To ASTM F150.
g. Light Exposure Degradation: No evidence of adverse effects on treated samples when tested in accordance with ASTM G23.
h. Test Method for Measuring Wet SCOF of Common Hard-Surface Floors in accordance with ANSI B101.1.
i. Test Method for Measuring Wet DCOF of Common Hard-Surface Floors in accordance with ANSI B101.3.

F. Joint/Crack Filler:

1. 2-component sealant, designed to fill cracks and saw cuts in horizontal slabs.
   a. Products: Subject to compliance with requirements, provide the following, or an approved equal:
      1) SealBoxx 6500
      2) Euco Qwikjoint UVR
2. Joint Filling all construction and control joints and where shown on Drawings:
   a. Prepare, clean and install joint filler according to manufacturer's written instructions.
   b. Defer joint filling until concrete has aged according to the requirements established by the manufacturer. Do not fill joints until construction traffic has permanently ceased.
   c. Contractor shall grind any floor joints that are not level within ¼" in 10 feet. Grinding shall remove all "curling" or other irregularities. Grinding shall be only in areas that are not considered level. Contactor shall inspect all joint grinding and approve prior to proceeding with joint filling.
   d. Removed Dirt, debris, saw cuttings, curing compounds, sealers and frost from joints; leave contact faces of joints clean and dry.
   e. Installation Instructions:
      1) Clean joints by dustless concrete saw with diamond blade slightly wider than joint.
      2) Surface shall be clean, dry and free of any oils, residues, dust or any other contaminates.
      3) Attach the static mixer to the cartridge per manufacturer.
      4) Purge air from cartridge or container.
      5) Apply mix to joint, until slightly over filled.

6) After joint loses tack, use sharp razor scraper to shave down excess material.

G. Expansion Joint (Column Wrap – Columns below Slab): Flexible foam expansion joint filler shall be ½" thick.

1. Application: Wrap base of columns with appropriate height material to cover top of slab to top of base plate. Product shall be secured to column with sealant as recommended by manufacturer. Additional 4" high wrap shall extend from top of main wrap layer to above slab pour without use of sealant. Exposed portion of additional wrap shall be removed after all floor curing and finishing operations, but prior to painting of columns.

H. Water Stop at raised curb around Riser Room:

1. Equal to Greenstreak Swellstop II
2. Installed continuously as shown on Drawings

2.3 PROPORTIONING AND DESIGN OF MIXES

A. Comply with ACI 301 requirements for concrete mixtures.

B. Prepare design mixes for each type and strength of concrete by either laboratory trial mixture or field experience methods as specified in ACI 301, Section 4. If trial mixture method is used, employ an independent testing facility, acceptable to Architect, for preparing and reporting proposed mix designs.

C. Submit written reports to Architect, or Engineer, of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been approved.

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test results or other circumstances warrant. Both the concrete testing and inspection agency and the Contractor shall satisfy themselves, and Architect or Engineer if required, that the proposed concrete mix design will produce a concrete which will meet the specifications and performance requirements for this project. In addition, the Contractor shall verify that the workability, finishability and setting times are appropriate for slab installations.

1. Equipment Pads: All equipment pads shall have light broom finish parallel with long axis of building.

E. Refer to the General Structural Notes for concrete strengths, water cement ratios and air contents.

F. Slabs-on-ground or on vapor retarder shall have a water/total cementitious ratio not to exceed 0.45.

2.4 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with ASTM C 94. Ready Mix Concrete operations shall meet DOT approval. All mixers shall be in proper operating condition and the drum fins shall be clean of residue.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1½ hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
2. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
3. Batch Tickets: Provide batch ticket for each batch discharged and used in the work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water added. The batch ticket shall state the quantity of water that may be added at the jobsite without violating the submitted mix design criteria, including water/cement ratio. Record approximate location of final deposit in structure. Concrete Laboratory Testing Technician shall be responsible for collecting batch tickets and recording the location of load placement and the associated batch ticket.

2.5 CONCRETE TESTING

A. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 100 cu. yd. or fraction thereof. Water Content and Slump: Verify Water Content in accordance with AASHTO T 318 “Standard Method of Test for Water Content Using Microwave Oven Drying.” Test slump in accordance with ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
2. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture. Interior floor slab: One test for first concrete delivery and one test for every five deliveries thereafter. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
3. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's placement of each concrete mixture.
4. Compression Test Specimens: ASTM C 31/C 31M.
5. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

a. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to the Owners Project Manager, Concrete Producer and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Non-Compliant Test Reports: All test reports indicating non-compliance should be emailed immediately to all parties on the test report distribution list.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted, but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer of Record. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by the Engineer of Record.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 TOLERANCES

A. Comply with ACI 117.

3.4 INSTALLATION OF 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.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel. Set screeds accurately. Embedded items shall be accurately aligned and adequately supported. Verify installation of mechanical, plumbing, and electrical items to be embedded in concrete. Correct any unsatisfactory condition before proceeding further.

3.5 PREPARATION

A. Before placing concrete, clean and roughen surface of previously placed concrete. Clean reinforcing steel. Remove debris, providing clean-outs at bottom of forms when necessary. Moisten surfaces to receive concrete unless otherwise prepared. Remove excess water before placing concrete.

3.6 INSTALLATION OF CAST-IN-PLACE CONCRETE

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Owner's Project Manager and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Comply with requirements in ACI 301 for measuring, mixing, transporting, and placing concrete.

1. Concrete shall be mixed and delivered in accordance with the requirements of ASTM C 94.
2. Cooperate with all other trades. Confer with electrical, mechanical, plumbing, carpenters, steel workers, etc. Make sure that all sleeves, anchor, insert, conduit, floor boxes, pipes, fittings, and other items are installed before placing concrete. Make provisions for door saddles, and thresholds.
3. The Contractor shall ensure the accuracy, placement and alignment of all under-slab work. The placement of all boxes shall be square, level and true in all respects.
4. The Contractor shall notify the testing agency and owner 48 hours before pouring of concrete for inspection of reinforcement layout. No concrete shall be poured unless all reinforcement and installations have been inspected and approved by the testing agency.
5. Transport: From mixer with wheelbarrow or buggy. Dump at point of use and consolidate with a concrete vibrator. Do not allow concrete to become segregated. Maximum free fall for concrete is 3 feet. A vibrator is required for placement of concrete in walls, piers, footings and turndowns.

D. Form-Release Agent: Coat all removable wood and metal forming with a VOC compliant, non-staining, concrete form-release agent and allow excess liquid to drain off before forms are placed.

E. Concrete Placement: Place on firm, undisturbed earth or properly compacted fill as indicated, with vapor barrier directly beneath interior slabs. Consolidate without segregation, by vibrating. Do not place concrete when temperature is 40 degrees F and falling or when freezing weather is predicted within 24 hours.

1. Place concrete within the minimum temperature range as specified in ACI 301
2. Protect concrete as required in ACI 301

3. Type III, high early strength cement, calcium chloride, corrosive accelerators or antifreeze shall not be used.
4. Concrete shall be placed before initial set has occurred and in no event after it has contained its water content for more than 1½ hours.
5. Unless otherwise specified, all concrete shall be placed upon clean, damp, smooth surfaces that are free from running water. Subgrade and base shall be properly consolidated and rut free. Concrete shall not be placed upon soft mud or dry porous earth.
6. Concrete shall be consolidated and worked, in an approved manner, into all corners and angles of the forms and around reinforcement and embedded fixtures in such a manner as to prevent segregation of the coarse aggregate as required in ACI 301.

F. Bar supports for reinforcing steel shall be used in all footings in order to assure proper mechanical strength. Wood or clay brick chairs are not acceptable.

G. Concrete shall not be placed until the forms, reinforcement and other conditions are complete and until all pipes, conduit, sleeves, thimbles, hangers, anchors, and other work required are properly installed.

H. Vibrate concrete without segregating, thoroughly, to insure contact with forms at all points.

I. Carefully protect all masonry walls and metal building walls that are to be exposed by covering them with waterproof paper while concrete is being placed, or turn vapor barrier up walls minimum of 36”.

J. Provide for installation of all block-outs, inserts, reglets, hangers, anchors, sleeves, blocking dowels, angles; nail boards, etc., required for fastening of other work.

K. Water shall only be added at the job site under the direct supervision of a representative from the field quality control testing agency. Water may be added in accordance with ASTM C 94. Do not add more water than is indicated as allowable on the batch ticket. Water added at the job site shall be documented on the batch ticket.

L. Cold-Weather Placement: Comply with ACI 306.1, ACI 306R 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 the average of the highest and lowest ambient temperature from midnight to midnight is expected to be less than 40 degrees F for more than three successive days, deliver concrete to meet the following minimum temperatures immediately after placement:
   a. 55 degrees F for sections less than 12 inches in the least dimension;
   b. 50 degrees F for sections 12 to 36 inches in the least dimension;
   c. 45 degrees F for sections 36 to 72 inches in the least dimension; and

d. 40 degrees F for sections greater than 72 inches in the least dimension.
e. The temperature of concrete as placed shall not exceed these values by more than 20 degrees F.
f. The minimum requirements may be terminated when temperatures above 50 degrees F occur during more than half of any 24 hour duration.
g. When the outdoor temperature is less than 40 degrees F, maintain temperature of placed concrete at not less than 50 degrees F for required curing time.
h. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
i. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

M. Hot-Weather Placement: Comply with ACI 301, ACI 305.1, ACI 305R, and as follows:

1. 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. Precautions to protect fresh concrete from developing plastic shrinkage cracks must be taken in advance of concrete placement when evaporation rate due to any combination of temperature, humidity, and wind velocity is expected to approach 0.2 lb./sq. ft./hr. as determined by ACI 305R. Acceptable precautions to reduce the rate of evaporation include use of wind breaks, fog spray, covering with polyethylene sheeting, or wet cover.

N. Joints: Construct joints true to line with faces perpendicular to surface plane of concrete (refer to drawings).

1. Construction Joints:
   a. Locate and install construction joints so as not to impair strength or appearance of concrete at locations indicated or as approved by Engineer of Record. Refer to Submittal Section.
   b. Construction joints in slab on grade shall be butt joints with dowels. Do not use metal keyways.
2. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   a. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as approved by Engineer of Record and General Contractor/Owner. All contraction joints shall be cut to a depth equal to at least one-fourth of the concrete thickness, as follows:
4. Sawed Joints: All saw cutting shall be accomplished with a “Soff-Cut” saw, by Soff-Cut International, Corona, CA (800-776-3328), equipped with a Soff-Cut color-coded, patented diamond blade and skid plate in new condition. Concrete Subcontractor must have documented successful experience in the use of this method prior to this project. Joints shall be cut as soon as the slab will support the weight of the saw and operator and when cutting action will not tear, abrade, or otherwise damage the concrete surface Cuts must be made before concrete develops random contraction cracks. Use 1/8-inch thick blade, cutting a minimum of 1¼” inch deep into interior floor slab. Chalk lines and concrete dust shall be removed completely and immediately after cutting operation.
    a. Random depth checks shall be performed by an independent testing company to confirm that the specified depth of cut is made. Any cut(s) found to be less than proper depth shall be re-cut to the proper depth and filled with specified joint filler at the Contractor’s expense.
5. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to a radius of 1/8 inch (3 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.

O. Interior Floor Slab on grade Tolerances:

1. Comply with ACI 117, “Specifications for Tolerances for Concrete Construction and Materials.”
2. Unless otherwise noted on drawings, all interior floor slabs shall be constructed as a single course slab with a minimum of three trowelings.
3. Unless otherwise noted on drawings, all interior concrete floor slabs shall be constructed to flatness F-numbers (FF) as follows: Specified Overall Value of FF (SOV) = 75 and Minimum Local Value (MLV) of FF (MLV) = 60.
4. All floated and broomed surface floors shall achieve a Specified Overall Value of FF (SOV)= 20.
5. Slabs shall be measured in accordance with ASTM E 1155 within 24 hours after placement and results reported no later than 72 hours after placement.

3.7 FORMED SURFACE FINISHES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched, and fins and other projections exceeding ¼” in height shall be rubbed down or chipped off.

3.8 INTERIOR FLOOR SLAB FINISH

A. General: Concrete shall be placed, screeded, re-straightened, and finished as necessary to meet the FF requirements. Do not wet concrete surfaces during finishing operations.

1. Laser screeds, vibratory screeds, highway straightedges and wood bull floats shall be used to initiate screeding and floating process to form a uniform and open-textured surface plane before excess moisture or bleed water appears on the surface. A back-up laser screed is required during concrete placement of the interior floor slab. Remove excess water before starting floating operations. Do not further disturb surfaces before starting finishing operations.
2. Highway straightedge operations shall continue before, during and after troweling operation, until specified floor tolerances are achieved.
3. Trowel finish with gas operated troweling machine with adjustable blades on all finishing equipment. Use steel-reinforced blades on ride-on power trowels. Use 6” wide finish style steel-reinforced blades on final passes. Finishing blades shall be in new condition and completely clean of any deleterious materials.
4. Trowel the surface sufficiently to produce a smooth, tight, abrasion resistant surface. Care shall be taken not to overwork or burn the surface.
5. Polished concrete:
   a. Hard-Steel Troweled (3 passes) Concrete: No burn marks. Finish to ACI 302.1R, Class 5 floor.
   b. When placing edges use a 3 foot metal or wooden 2x4 screed and run parallel with a form or edge after initial screed and before floating.
6. Protection: Care shall be taken to protect the interior floor. Entrances shall include clean floor mats to prevent mud stains and all equipment on the floor shall be diapered to prevent spills. Cutting oils, etc., are not allowed on the floor slab at any time during the construction process.

B. New Concrete: Apply cure-densifier hardener to new concrete as soon as the concrete is firm enough to work on after troweling; with colored concrete, wait a minimum of 30 days before application.

1. Spray on at rate of 200 ft2/gal (5 m2/L).
2. Keep surface wet with cure-densifier-hardener for a minimum soak-in period of 30 minutes without allowing it to dry or become slippery. If slipperiness occurs before the 30 minute time period has elapsed, apply additional cure-densifier-hardener, as needed, to keep the entire surface in a non-slippery state for the first 15 minutes; for the remaining 15 minutes, mist the surface as needed with water to keep the material in a non-slippery state. In hot weather conditions, follow manufacturer’s special application procedures.
3. When the treated surface becomes slippery after this period, lightly mist with water until slipperiness disappears.

4. Wait for surface to become slippery again, and then flush entire surface with water to remove all cure-densifier-hardener residue.
5. Squeegee surface completely dry, flushing any remaining slippery areas until no residue remains.
6. Wet vacuum or scrubbing machines can be used in accordance with manufacturer's instructions to remove residue.

C. Existing Concrete: Apply cure-densifier-hardener only to clean, bare concrete.

1. Thoroughly remove previous treatments, laitance, oil and other contaminants.
2. Saturate surface with cure-densifier-hardener; respray or broom excess onto dry spots.
3. Keep surface wet with cure-densifier-hardener for a minimum soak-in period of 30–40 minutes.
4. If most of the material has been absorbed after the 30-minute soak-in period, remove all excess material, especially from low spots, using broom or squeegee.
5. If most of the material remains on the surface after the 30-minute soak-in period, wait until the surface becomes slippery and then flush with water, removing all cure-densifier-hardener residue. Squeegee completely dry, flushing any remaining slippery areas until no residue remains.
6. If water is not available, remove residue using squeegee.

3.8 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling in:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to match color and texture with in-place construction exposed to view.
3. 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 troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases **4 inches** high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: **4000 psi** at 28 days, unless otherwise

indicated on Drawings.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.
   a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   b. Cast anchor-bolt insert into bases.
   c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.9 APPLICATION OF CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305R, before and during finishing operations.

B. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing after finishing concrete.
2. Interior Concrete Floors:
   a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
      1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
         a) Lap edges and ends of absorptive cover not less than 12 inches.
         b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
      2) 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.
         a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
         b) Cure for not less than seven days.
      3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following not in

cold weather:
a) Water.
b) Continuous water-fog spray.

b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
a) Lap edges and ends of absorptive cover not less than 12 inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
2) 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.
a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.
3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
a) Water.
b) Continuous water-fog spray.

c. Floors To Receive Curing and Sealing Compound:
1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.10 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is not cured to manufacture’s recommendation.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
4. Rinse with water; remove excess material until surface is dry.
5. Apply a second coat in a similar manner if surface has received a float

finish or abrasive surface preparation.

3.11 INSTALLATION OF JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least 1 month unless approved by manufacturer..

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.12 INSTALLATION OF CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when requested by Owner Project Manager or Architect.
2. Remove and replace concrete that cannot be repaired and patched to meet specification requirements.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

1. Provide two sample mock-up repairs for Owner review and approval before patching or repairing Project.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks in excess of 0.01 inch spalls, air bubbles exceeding surface finish limits, honeycombs, rock pockets, fins and other projections on the surface exceeding surface finish limits, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
   a. Limit cut depth to 3/4 inch.
   b. Make edges of cuts perpendicular to concrete surface.
   c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
   d. Fill and compact with patching mortar before bonding agent has dried.
   e. Fill form-tie voids with patching mortar or cone plugs secured in

place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
   a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
   b. Compact mortar in place and match surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance, as determined by Architect.

D. Repairing Unformed Surfaces – subject to prior Owner approval.

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
   a. Correct low and high areas.
   b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by adding patching mortar.
   a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
   a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
   b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
   a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
   b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
   a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
   b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
   c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
   d. Place, compact, and finish to blend with adjacent finished concrete.
   e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch or less in diameter with

patching mortar.

a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
b. Dampen cleaned concrete surfaces and apply bonding agent.
c. Place patching mortar before bonding agent has dried.
d. Compact patching mortar and finish to match adjacent concrete.
e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.13 NON-SHRINK, NON-STAIN GROUT

A. Grout shall be placed at flowable consistency and exhibit no visible bleeding two hours after placement and totally non-shrink in 28 days. Do not vibrate grout. Non-shrink grout shall be capable of obtaining a compressive strength of at least 6,000 psi at 28 days.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency to be responsible for providing curing facility for initial curing of strength test specimens on-site and verifying that test specimens are cured in accordance with standard curing requirements in ASTM C31/C31M.
2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
        1) Project name.
        2) Name of testing agency.
        3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
        4) Name of concrete manufacturer.
        5) Date and time of inspection, sampling, and field testing.
        6) Date and time of concrete placement.
        7) Location in Work of concrete represented by samples.
        8) Date and time sample was obtained.
        9) Truck and batch ticket numbers.

10) Design compressive strength at 28 days.
11) Concrete mixture designation, proportions, and materials.
12) Field test results of fresh concrete, including slump or slump flow, air content, temperature and density.
13) Information on storage and curing of samples at the Project site, including curing method and maximum and minimum temperatures during initial curing period.
14) Type of fracture and compressive break strengths at seven days and 28 days.

4. Provide a space and source of power or other resources for curing and access to test specimens by the testing agency.

B. Delivery Tickets: comply with ASTM C94/C94M.

C. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.
6. Batch Plant Inspections: On a random basis, as determined by Architect.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 150 cu. yd. or fraction thereof.
   a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing is to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C143/C143M:
   a. One test at point of delivery for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   b. Perform additional tests as needed.
3. Slump Flow: ASTM C1611/C1611M:
   a. One test at point of delivery for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.
   b. Perform additional tests as needed.
4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;
   a. One test for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C1064/C1064M:

a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample when strength test specimens are cast.

6. Concrete Density: ASTM C138/C138M:
   a. One test for each composite sample when strength test specimens are cast.
7. Compression Test Specimens: ASTM C31/C31M:
   a. Cast and standard cure two sets of four 6 inches by 12-inches or 4-inch by 8-inch cylindrical specimens for each composite sample.
   b. Cast, and field cure 2 sets of 3 standard cylindrical specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C39/C39M.
   a. Test one set of 3 field-cured specimens at seven days and one set of two specimens at 28 days.
   b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests of standard cured cylinders equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests:
    a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
       1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.7.6.3.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness in accordance with ASTM E1155

within 24 hours of completion of floor finishing and promptly report test results to Architect.

3.15 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.

7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03 30 00