

SECTION 03 31 05 - CAST-IN-PLACE CONCRETE SLABS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Non-polished, non colored cast-in-place concrete slabs-on-grade.
 - 2. Non-polished, non-colored cast-in-place suspended concrete slabs on metal deck.
 - 3. Metal stair pan concrete fill.
 - 4. Formwork.
- B. Refer to Division 03 Section "Cast-In-Place Structural Concrete" for concrete used in footers, foundations, and other non-slab applications.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture, provide proportion mixes by either laboratory trial batch or field experience method, complying with ACI 301. Include all admixtures to be used in the concrete. Include field test data from at least 10 tests or a three-point curve generated using trial mixtures.
- C. Material Test Reports: From a qualified testing agency, indicating and interpreting test results for compliance of the materials, and admixtures with requirements indicated, for all materials utilized in the concrete.
- D. Material Certificates: For curing material, stating that material is approved by USDA.
- E. Minutes of pre-installation conference.
- F. Floor finisher ACI certificate and experience.

1.3 QUALITY ASSURANCE

- A. 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."
- B. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design and extent to that indicated for this project on a minimum of five similar

projects, and whose work has resulted in construction with a record of successful in-service performance.

1. The concrete floor finishing installer's lead finisher of the finishing crew shall be certified under the Concrete Flatwork Finisher Training and Certification Program as granted by the American Concrete Institute.
- C. Design Mixture Responsibility: The ready-mix concrete producer shall be responsible for the compatibility of concrete ingredients and admixtures to ensure that the total air (including entrapped air) content in the concrete caused by the chemical reaction of ingredients is not greater than the percentage listed in Article "Concrete Mixtures" in Part 2 of this Section.
- D. American Concrete Institute (ACI) Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 2. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 3. ACI 305R, "Hot Weather Concreting."
 4. ACI 306R, "Cold Weather Concreting."
 5. ACI 347 "Recommended Practice for Concrete Formwork."
 6. ACI 403 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete."
- E. Source Limitations:
1. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
 2. Obtain ready-mixed concrete from the same batch plant.
- F. Mockups: Cast concrete slab-on-grade panel to demonstrate surface finish, texture, and standard of workmanship of anti-slip finish for approval by Owner.
1. Build panel approximately 36 sq. ft. in location directed by Owner.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 00 Section "General Conditions."
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete installer.
 - e. Fibrous reinforcing manufacturer.
 2. Review 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, and joint-filler strips,

semirigid joint fillers, forms and form removal limitations, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

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.
- B. Form-Release Agent: Commercially formulated form-release agent with a maximum of 350 mg/l volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- 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. Tapered Plate Dowels: Diamond shaped load plate for construction joints
 - 1. Basis-of-Design Product: PNA Construction Technologies; Diamond Dowel System.
 - 2. Material:
 - a. Diamond Shaped Load Plate: 1/4 inch thick, saw cut from hot rolled steel plate meeting ASTM A 36.
 - b. Pocket Former: High density plastic with internal collapsible fins and spacer that hold diamond shaped load plate in correct position.
 - 3. Refer to ACI 302.1R-04 for selection of plate size and spacing.

2.3 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 or II.
- B. Normal-Weight Aggregates: ASTM C 33, graded.
- C. Do not use the following concrete materials in the mix design:
 - 1. Fly ash
 - 2. Ground granulated blast furnace slag.
 - 3. Air-entraining admixtures.
- D. Water: ASTM C 94/C 94M and potable.

- E. Internal Curing Admixture: ASTM C 494/C 494M, Type S.
 - 1. Product: E5 Incorporated; E5 Internal Cure.
 - a. Contact Information: E5 Incorporated; 1-888-881-1726; sales@e5nanosilica.com.
 - b. No substitutions allowed.
- F. 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 ACI 301. Do not use calcium chloride or admixtures containing calcium chloride. Proportions and types of admixtures shall be consistent in all placements.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. Mid-Range, Water-Reducing Admixture: ASTM C 494/C 494M.
 - 5. Non-Chloride Accelerating Admixture: ASTM C 494/C 494M, Type C and E.
 - 6. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 7. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 8. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 REPLACEMENT AND PATCHING MATERIALS

- A. Concrete Slab Replacement Materials (Fast Cure)
 - 1. Portland Cement: ASTM C 150, Type III, high early strength
 - 2. Normal-Weight Aggregates: ASTM C 33, graded.
 - 3. Do not use the following concrete materials in the mix design.
 - a. Fly ash
 - b. Ground granulated blast furnace slag.
 - c. Air-entraining admixtures.
 - 4. Water: ASTM C 94/C 94M and potable.
 - 5. Chemical Admixtures:
 - a. 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.
 - b. Do not use calcium chloride or admixtures containing calcium chloride.
 - c. Maintain consistency of proportions and types of admixtures in all placements.
- B. Concrete Slab Patching Material: Portland cement-based, self-drying, fast setting, trowelable patch.
 - 1. Basis of Design Product (For Patches Larger Than 1 inch in Diameter): Ardex Engineered Cements; Ardex SD-P.
 - 2. Basis of Design Product (For Patches 1 inch in Diameter and Smaller): Ardex Engineered Cements; Ardex Feather Finish-Gray.

2.5 VAPOR RETARDERS

- A. Plastic Vapor Retarder and Protective Plastic Sheet: ASTM E 1745, Class A, polyolefin, 10 mils, in areas as indicated. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 - 1. Products:
 - a. Fortifiber Corporation; Moistop Ultra 10; 800-773-4777.
 - b. Insulation Solutions, Inc.; Viper Vaporcheck, 10 mils; 866-698-6562.
 - c. Raven Industries Inc.; Vapor Block 10; 800-635-3456.
 - d. Reef Industries, Inc. Griffolyn 10 mil Green; 800-231-6074
 - e. Stego Industries, LLC; Stego Wrap, 10 mils; 877-464-7834.
 - f. Tex-Trude, LP; X-TREME 10 mils; 281-452-5961.
 - g. Poly-America, L.P.; husky Yellow Guard, 10 mils; 800-527-3322

2.6 CURING AND SEALING MATERIALS

- A. Curing and Sealing Material: Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. Product: Euclid Chemical Company (The); Super Diamond Clear VOX. Specify store number and address when ordering.
 - a. No substitutions allowed.
 - 2. Color: Clear.
 - 3. Federal Agency Approvals: USDA approved for food-processing environments.

2.7 RELATED MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Products:
 - a. BASF Building Systems, MBT Protection and Repair Div.; Confilm; 800-496-6067
 - b. Euclid Chemical Company (The); Eucobar; 800-321-7628.
 - c. L&M Construction Chemicals, Inc.; E-Con. 800-362-3331
 - d. Meadows, W. R., Inc.; Sealtight Evapre; 800-342-5976.
- B. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, lightweight, non-staining, polyethylene, closed cell, chemical-resistant, ultraviolet stable, non-absorbent, low density, compressible foam.
- C. Drainage Fill: As specified in Division 31 Section "Earth Moving."
- D. Joint Filler:

1. Contraction (Sawed) Joints, Construction (Cold) Joints, and Cracks: Two component, 1:1 ratio, polyurea elastomer joint filler of 100 percent solids, Shore 65-67 A hardness, rapid curing self leveling, semi-flexible sealant and UV resistant.
 - a. Products: Specify store number and address when ordering.
 - 1) Euclid Chemical Company; QWIKjoint UVR 65.
 - 2) HI-TECH Systems; HT-PE65 Flexible Control Joint Filler.
 - 3) Metzger/McGuire Co.; Spal-Pro RS-65.
 - 4) No substitutions allowed.
 - b. Color: Match adjacent concrete.
2. Columns and Expansion Joints: Polyurethane, Type S, Class 25, Use T, gun grade or pourable as applicable.
 - a. Products:
 - 1) Gun Grade:
 - a) BASF Building Systems; Sonolastic NP 1.
 - b) Euclid Chemical Company; Eucolastic 1 NS.
 - c) Sika Corporation, Inc.; Sikaflex - 1a.
 - d) Tremco; Vulkem 116.
 - 2) Pourable:
 - a) BASF Building Systems; Sonolastic SL 1.
 - b) Euclid Chemical Company; Eucolastic 1 SL
 - c) Sika Corporation, Inc.; Sikaflex-1CSL.
 - d) Tremco; Vulkem 45.
 - b. Color: Match adjacent concrete.

- E. Cylindrical Sealant Backings for Polyurethane Joint Filler (As Applicable): ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- F. Construction Joint Protective Plastic Sheet: ASTM D 4397, polyethylene sheet, not less than 10 mils thick.

2.8 CONCRETE MIXTURES

- A. Prepare and submit for Owner's testing agency approval 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.
- B. Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength:

- a. Interior Floor Slabs: 3000 psi at 28 days.
2. Aggregate: Normal weight
3. Minimum Cementitious Materials Content: ACI 301.
4. Maximum Water-Cementitious Materials Ratio: 0.50.
5. Internal Curing Admixture: ASTM C 494 Type S with dosage rate of 4 fl. oz. per 100 lbs. added at completion of batch sequence or with tail water.
6. Admixtures:
 - a. Plasticizing: ASTM C 1017
 - b. Water Reducing: ASTM 494 Type A
 - c. Admixtures containing chloride are not permitted in reinforced concrete or concrete containing metals.
7. Slump Limit:
 - a. Take concrete for slump test at point of discharge.
 - b. Standard: 4 inches, plus or minus 1 inch.
 - c. Do not add water on-site to achieve a higher slump.
 - d. With Mid-Range Water Reducer: 6 inches after addition of water reducer to concrete with 4 inch slump.
8. Air Content: Do not allow air content caused by the chemical reaction of ingredients to exceed 3 percent.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information. Provide all ready-mixed concrete from same batch plant.
 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Complete the following requirements prior to concrete placement.
 1. Inspect prepared subgrade for suitability for placing of concrete. No standing water, organic material, debris, or other deleterious materials should be present.
 2. Coordinate concrete work with the work of the other trades to allow reasonable time to set sleeves, inserts and other accessories, which must be in position before concrete is placed.
 3. HVAC system must be operational to maintain proper temperatures for curing throughout entire installation.

- a. If temporary heat must be used, only heaters with sealed combustion chambers and positive venting to the outside are permitted. Venting to the outside, complying with ACI 306, is required to prevent discoloration or inconsistency or carbon dioxide poisoning of the concrete. Use of temporary heat must be approved by Owner.
 - b. Proper Recommended Temperature: 55 degrees F.
4. Employ methods to prevent dust and air-born debris from entering building and settling on slab surface during finishing operations.
5. Conduct a walkthrough with the Owner and concrete installer to determine that the installation of all underground work is complete and accurately placed.
6. Do not install box outs around interior building columns or other floor penetrations.
7. Pre-wet subgrade. Do not place concrete over standing water.

3.2 FORMWORK

- A. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
 1. Clean and adjust forms prior to concrete placement. Apply form release agents.
 2. Provide openings in formwork to accommodate work of other trades.

3.3 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.

3.4 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 1. Place under freezers and other locations as indicated. Extend 2-feet beyond edge of freezers.
 2. Lap joints and seal with manufacturer's recommended tape.

3.5 CONSTRUCTION JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
 1. Locate and install construction, isolation and control joints as indicated or required. Give special attention to reentrant corners.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Owner.

1. Locate construction joints so they do not impair strength and appearance of structure. End placements at control joint saw cut line. Do not end placements at highly visible areas.
2. Dowel construction joints with tapered plate dowels or joint dowel bars at 2 feet on center unless indicated otherwise on Drawings or manufacturer's instructions. Do not key construction joints.
3. Place a 4 foot wide, protective plastic sheet strip on existing slabs (to protect against spillage) when new concrete placement is placed against existing. Remove any new concrete that has overlapped onto previous placement immediately.

3.6 CONCRETE PLACEMENT, GENERAL

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. During placement of slab, a representative of each trade having work in area of placement shall maintain a presence to protect their work.
- 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. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 2. Water may be added to the concrete mix at the jobsite in conformance with ACI 301-10 subject to the following conditions:
 - a. Slump limits set forth in specifications are not exceeded.
 - b. Concrete is discharged within the time limits set forth in the specifications.
 - c. Maximum water-cement ratio is not exceeded.
 - d. Water added is limited to the amount of water withheld during batching. The concrete producer shall note on the delivery ticket how much water can be added without exceeding the water-cement ratio.
- D. Cold-Weather Placement: Comply with 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 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.
- E. Hot-Weather Placement: Comply with ACI 305R and as follows:
 1. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

2. 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.

3.7 FLOOR SLAB PLACEMENT

- A. Thickness: 4 inches minimum unless indicated otherwise on Drawings.
- B. Place floor slabs in sections as large as practical to meet the final finish requirements.
- C. Recess and slope concrete to drains for all food preparation and service areas that are to receive floor finishes as indicated on Drawings.
- D. Sloped Floors:
 1. Form out and place areas of floor, which are to be sloped to floor drains, after level areas of floor have been placed.
 2. Slope floor to floor drains at 1/8 inch per foot in areas indicated on the drawing.
 3. Shape and slope sloped floors as indicated on the Drawings.
- E. Provide concrete mudsill below underfloor raceway for electrical wiring full length of raceway. Refer to Division 28 Section "Raceway and Boxes for Electrical Systems" for additional information.
- F. Provide concrete trenches for refrigerant lines as indicated on Drawings. Building floor to form top of trench, placed after all work has been completed in trench.
 1. After slab placement, cut off PVC or ABS pipes, for refrigeration pipes, flush with concrete slab.

3.8 FINISHING FLOORS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces.
 1. Do not use water on trowels or equipment during finishing.
 2. At Contractor's option, 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.
- B. Finished Appearance:
 1. Smooth Finish: Provide in areas not receiving anti-slip finish unless otherwise indicated.
 - a. Appearance: Dense, smooth, polished finish, uniform in texture free of any trowel marks or other imperfections.
 2. Anti-Slip Finish: Provide in coolers and freezers not to receive resinous flooring or quarry tile finish material and exposed concrete stair treads.

- a. Appearance: Equivalent to the texture of medium #120 - 150 grit sandpaper finish free of any trowel marks or other imperfections to match mock-up.
 - b. See Drawings for limits of anti-slip finish.
- C. Initial Strike-Off:
 1. Perform with a mechanical screed and/or a hand operated straightedge.
 2. After initial strike-off, and in a direction at 90 degrees to it, flatten the surface with a 12-foot minimum straightedge.
 3. Overlap each pass of the straightedge by approximately 50 percent. Do not use bull floats.
- D. Floating:
 1. Equipment: Power trowel machines using float pans.
 2. Timing: Begin floating when the mix has stiffened enough to support the weight of the troweling equipment and operator and surface or bleed water has dissipated.
 3. Perform two power floatings, if required, to bring the surface to the desired condition for power troweling.
- E. Power Troweling:
 1. Timing: Begin power troweling as soon as little or no cement paste clings to the blades.
 2. Provide a minimum of two power trowelings at the correct time interval for the floor surface.
 - a. For the first troweling, keep trowel blades as flat as possible against the surface to avoid a "washboard" or "chatter" surface.
 - b. Continue troweling until surface is dense, smooth, and free of all minor blemishes and trowel marks.
- F. Hand Troweling
 1. General: Provide hand troweling to close any pinholes or eliminate minor blemishes bringing the surface to a dense, smooth, polished finish.
- G. Floor Flatness and Levelness: As determined in accordance with ASTM E 1155 and as follows:
 1. Slabs-on-Grade:
 - a. Specified overall values of flatness $F(f)=30$; and levelness $F(L)=20$.
 - b. Minimum local value of flatness $F(f)=20$; and levelness $F(L)=15$.
 2. Suspended Slabs:
 - a. Specified overall values of flatness $F(f)=25$.
 - b. Minimum local value of flatness $F(f)=20$.
 3. If variations greater than this exist, remove the affected portion of the floor in sections no smaller than 10 ft. by 10 ft. and replace with new concrete to bring the surface within the tolerance requirements.

4. Grinding to achieve required flatness or levelness is not allowed.

3.9 CONCRETE CURING AND SEALING

- 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 in unconditioned spaces.
 1. Keep concrete floor free of all dirt, debris, paint, oil or other matter that might prevent adhesion of the surface material.
 2. Do not use where finish material (tile or resinous flooring) is to be installed on concrete slab.
- B. Cure and seal concrete according to ACI 308.1, by the following method:
 1. Concrete Curing (Immediately After Concrete Finishing):
 - a. 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.
 - b. Properly prepare slab to prevent edge curling due to ambient temperatures at time of placement of curing compounds.
 2. Concrete Sealing (Immediately Prior to Fixture Installation):
 - a. Thoroughly clean floor according to curing and sealing compound manufacturer's recommendations.
 - b. Just prior to installation of fixtures install an additional coat of concrete curing and sealing compound according to manufacturer's installation instructions.
- C. Location: Non-polished concrete slabs and curbs, not receiving resinous or resilient flooring and other areas as indicated on the Drawings.

3.10 JOINTS, CONSTRUCTION AND CONTRACTION

- A. Construction Joints in Slabs-on-Grade: After removing formwork, install plastic protective sheet strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 1. Saw cut joints as specified for contraction joints to receive joint filler.
- B. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated.
 1. Layout: As indicated on Drawings. Do not use colored chalk to mark saw cut lines.
 2. Equipment: Power saws equipped with shatterproof abrasive or diamond-rimmed blades.
 - a. Basis of Design: Husqvarna Corporation; Soff-Cut.

3. Joint Depth: 1/4 the slab thickness or a minimum of 1 inch.
4. Joint Width: 1/8 inch.
5. Timing: Saw joints as soon as saw cut can be made without raveling, but no later than 12 hours after concrete has been placed (typically one hour in hot weather to four hours in cold weather after completing finishing of slab at that joint location).
 - a. Employ sufficient number of saws and workers to complete cutting saw joints before shrinkage produces cracking. Maintain at least two saws on site.
6. Change saw blades as needed to insure a clean and sharp joint and to prevent variances in joint width.
7. Continue joints to column or wall face with hand grinder. Joint width and depth shall match width and depth of joints formed with large saw.
8. Surface of Concrete at Joints: Smooth without grooves at the joints.
9. After saw cutting, immediately vacuum up and clean residues.

3.11 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling as long as possible to allow moisture to escape from concrete slab. Install just prior to installing fixtures.
- B. Chase joints with abrasive blade, remove surface and joint contamination with vacuum. Leave joint faces of clean and dry prior to joint sealant installation.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
 1. Installation shall be by manufacturer certified installer.
 2. Do not use joint back-up material (i.e. backer rod, sand, etc.) except below bottom of saw cut in construction joints.
 3. Install joint filler stain preventing film per manufacturer's instructions. Do not allow stain preventing film to run into joint.
 4. Fill joints in two passes to produce slight crown. Overfill shall not exceed 1 inch total width.
 5. Remove excess filler from exposed concrete surface prior to setting.
 6. Add extra filler prior to setting if needed to prevent depressed areas.
 7. Provide cured filler flush with finished concrete surface by razoring off crown.
 8. Refill joints to flush level on week prior to Grand Opening.
- D. Install flexible joint filler at columns and expansion joints per manufacturer's recommendations.
 1. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Owner. Remove and replace concrete that cannot be repaired and patched to Owner's approval.
- B. Provide test area made of specified materials for Owner's review and approval.
- C. Place concrete patching material as recommended in writing by manufacturer.
- D. Repair excessive cracking in areas receiving floor finishes (tile or resinous flooring) as determined by Owner.
 - 1. Rout cracks (other than hairline shrinkage openings that have maintained their level) with crack chaser 1/2 inch deep by 3/16 inch wide and pack crack with sand.
 - 2. Caulk top 1/2 inch depth with epoxy sealant, using bulk caulking gun.
- E. Excessive cracking in areas receiving tile, epoxy or carpet will receive an anti-fracture membrane (AFM) installed by the tile, epoxy or carpet installer.

3.13 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Field testing to be performed by an ACI certified concrete field testing technician grade I (or equivalent).
- B. Contractor's Responsibilities
 - 1. Notify Owner in advance of concrete placement to allow sufficient time to prepare for required testing.
 - 2. Assist Owner in securing field specimens.
 - 3. Provide and maintain for sole use of Owner's testing laboratory, facilities for safe storage and proper curing of concrete test cylinders at Project site as required by ASTM C31 and acceptable to Owner's testing laboratory.
- 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.
- D. Testing and Inspecting: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - 1. Testing Services: Tests shall be performed according to ACI 301.
 - 2. Sampling: ASTM C-172.

3. Slump: ASTM C-143, one (1) test at discharge point for each day's placement for each type of concrete. Conduct additional tests when concrete consistency appears to have changed.
 4. Compression Test Specimen: ASTM C-31, one set of four standard cylinders for each compressive strength test, unless directed otherwise.
 5. Concrete Temperature: ASTM C-1064
 6. Compressive Strength: ASTM C-39, minimum testing is one set per day for each mix placed for each 100 cubic yards or fraction thereof; one specimen tested at 7 days, one specimen tested at 28 days and one retained for later testing if required.
 7. Test Method for Determining FF Floor Flatness and FL Floor Levelness: ASTM E-1155
 8. Flatness and levelness numbers shall be in accordance with ACI 302.1R. Conduct test within 72 hours of concrete placement.
- E. Moisture vapor emission testing shall be conducted as required by the Owner.
- F. Floor Slab Examination: Prior to acceptance, examine floor slab to ensure floor slab can accept application of surface materials. If excessive cracking is observed repair slab as specified.
- G. 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 Owner. 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 Owner.
1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- H. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents
- I. Owner shall make final acceptance and approval of concrete work.

END OF SECTION 03 31 05

