

SECTION 03315  
SLABS-ON-GRADE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
  - 1. Concrete Slabs-on-Grade as shown on Drawings and as specified.
    - a. See Section 03300 for supported floor slabs.
  - 2. Fibers.
  - 3. Vapor Barrier.
  - 4. Joints and Joint Materials.
  - 5. Surface Treatments.
  - 6. Curing and Protecting Concrete Slabs-on-Grade.
  
- B. Products Installed But Not Supplied Under This Section
  - 1. Reinforcement.
  - 2. Anchor rods built into Slabs-on-Grade.
  - 3. Miscellaneous items built into concrete Slabs-on-Grade.
    - a. Bearing plates.
    - b. Edge angles.
    - c. Cover Frames.
  
- C. Related Sections
  - 1. Earthwork - Section 02200.
  - 2. Cast-in-Place Concrete - Section 03300.

1.2 REFERENCES

- A. ACI Standards
  - 1. ACI 117 Specification for Tolerances for Concrete Construction and Materials.
  - 2. ACI 212 Chemical Admixtures for Concrete.
  - 3. ACI 301 Standard Specifications for Structural Concrete.
  - 4. ACI 302 Guide for Concrete Floor and Slab Construction.
  - 5. ACI 318 Building Code Requirements for Reinforced Concrete.
  - 6. ACI 360 Design of Slabs on Grade.
  
- B. ASTM Standards
  - 1. Reference Standards and cited publications including ACI standards, ASTM standards, AWS standards, other referenced standards, and cited publications referenced in Section 03300 and ACI 301 shall be mandatory unless modified by Section 03300 or this Specification.
  - 2. A185: Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
  - 3. A36: Specification for Structural Steel.

4. A615: Specification for Deformed and Plain Billet steel Bars for Concrete Reinforcement.
5. A616: Specification for rail-steel Deformed and Plain Bars for Concrete Reinforcement.
6. A820: Specification for Steel Fibers for Fiber Reinforced Concrete.
7. C31: Test Methods of Making and Curing concrete Test specimens in the Field.
8. C1017: Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
9. C1077: Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
10. C1116: Specification for Fiber Reinforced Concrete and Shotcrete.
11. C150: Specification for Portland Cement.
12. C171: Specification for Sheet Materials for Curing Concrete.
13. C309: Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
14. C31: Test Methods for Making and Curing Concrete Test Specimens in the Field.
15. C494: Specification for Chemical Admixtures for Concrete.
16. C78: Specification for Flexural Strength of Concrete (Using simple Beam with Third-Point Loading)
17. C979: Specification for Pigments for Integrally Colored Concrete
18. C1018: Standard Test Method for Flexural Toughness and First Crack Strength of Fiber-Reinforced Concrete (Using Beam and Third-Point Loading)
19. E1155: Test Method for Determining Floor Flatness and Levelness Using the F-number System.
20. E329: Practice for Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

C. AASHTO Standards

1. AASHTO T318 Measurement of Water Content of Fresh Concrete Using the Microwave Oven

D. Cited Publications

1. ACI CPI: Technician Workbook for ACI Certification of Concrete Field Testing Technician - Grade 1.
2. ACI-SP-15: Field Reference Manual
3. CRSI MSP-1: Manual of Standard Practice.

E. Field References

1. Keep copies of the following references in Contractor's field office.
  - a. ACI Field Reference Manual SP-15
  - b. Guide for Concrete Floor and Slab Construction (ACI 302) with Selected ACI and ASTM References.

### 1.3 SYSTEM DESCRIPTION

A. Performance Requirements - Acceptance Standards

1. Concrete Strength Evaluation Acceptance
  - a. Test Results Evaluation. Concrete test results shall be reviewed on daily basis by Owner's Representative to verify compliance with Contract Documents. If conducted

- tests are inadequate for evaluation, provide and pay for additional tests in agreement with General Conditions for work where questionable concrete has been placed.
2. Concrete Dimensional Tolerances
    - a. Inaccurately formed concrete surfaces that exceed ACI 117 tolerances may be rejected.
    - b. Finished slabs exceeding specified Tolerances for Slabs may be corrected provided strength or appearances are not adversely affected.
  3. Concrete Appearance.
    - a. Concrete exposed to view with defects that adversely affect specified finish appearance will be rejected.
  4. Concrete Slab-on-Grade Acceptance
    - a. Completed concrete work shall conform to requirements of this Project Manual and Contract Documents.
    - b. Concrete work that fails to meet Contract Document requirements, but subsequently is repaired to bring concrete into compliance may be accepted.
      - 1) To bring non-conforming work into compliance, use repair methods that maintain specified strength and meet applicable requirements for function, durability, dimensional tolerances, and appearance.
    - c. Concrete work that fails to meet Contract Document requirements and cannot be brought into compliance will be rejected.
      - 1) Rejected work shall be removed and replaced with new work.

#### 1.4 SUBMITTALS

##### A. General

1. Furnish submittals for items that are identified in this Section by different typefaces and bracketed code (i.e., *Item [L]*). Refer to section 01340 for definition of codes, types of submittals and administrative requirements governing submittal procedure.
2. Additional submittal requirements connected with this Section are specified under this Article.

##### B. Product Data

1. *Design mix verification [D]*: Design mix shall conform to the following:
  - a. Submit 7 and 28-day compression test results of proposed design mix per ACI 301 requirements for trial mixtures.
  - b. Submit 7 and 28-day flexural beam test results of proposed design mix both with (ASTM C1018) and without (ASTM C78) fibers per ACI 301 requirements for trial mixtures.
  - c. Concrete modulus of rupture shall meet or exceed design requirements.

##### C. Shop Drawings

1. *Reinforcing Steel Placing Drawings [D]*: Submit placing drawings showing sizes, fabricated dimensions, and location for placing reinforcing bars and reinforcement support for review and acceptance before fabrication.

2. *Slab on Grade Jointing [D]*: Submit drawing with joint pattern and placing sequence for slabs on grade and toppings to Architect-Engineer Registered Design Professional.
  - a. Placement shapes and sequence shall be defined by Contractor but shall consider potential shrinkage of each placement and its restraint effect on other placements.
  - b. Joint pattern shall be laid out so that columns do not inhibit concrete floor panels from anticipated shrinkage. Place first adjacent joint parallel to pit walls, maximum distance of one-half typical joint spacing to account for locked effect of slab panel at wall.
  - c. Include details of dowels, dowel-holding devices, and shear transfer devices and all other applicable hardware proposed for use.

D. Quality Assurance/Control Submittals

1. Minutes of Slab On Grade Meeting and Follow-Up Project Meetings
  - 1) *Pre Construction Project Meeting Minutes [R]*: Provide meeting minutes to participating parties. Include attendees and decisions.
    - a) Include statements by admixture manufacturers and Finishing Contractor that proposed mix design and placing procedures are agreed upon and shall produce concrete floors in compliance with Contract Document that can be properly placed and finished to meet specified strength and flatness requirements.
2. Test Reports
  - a. Concrete Strength Tests: Results of cylinder tests and beam tests shall be submitted to Architect-Engineer Registered Design Professional.
  - b. Fibers: Certification and test reports furnished by the fiber manufacturer shall be submitted to Architect-Engineer Registered Design Professional for each shipment of fibers.
  - c. F-Number Testing: Results from F-number testing shall be sent to the Registered Design Professional.
  - d. Mix Design Changes: Changes to mix design shall be submitted to Architect-Engineer Registered Design Professional for approval.
3. Field Reports
  - a. Pouring Schedules, Casting Plan, And Records
    - 1) *Schedules and Records [R]*: Prepare detailed, written event schedules and casting plans, and submit to Owners Representative before starting work.
    - 2) Keep written records of concrete placements including location, date, cubic yards of concrete, ambient air temperature, and unusual occurrences during placement. Keep signed trip tickets for each truck that discharges concrete on site. Permit records inspection by Owners Representative at any time.
4. Repair Methods
  - a. *Repair Method For Defective Work [D]*: Make structural repairs only after Architect-Engineer Registered Design Professional approval concerning materials, methods and procedures.
5. Close Out Submittals
  - a. At Project completion, submit Pouring Schedule summary, Casting Plan, and Records to Owners Representative.

## 1.5 QUALITY ASSURANCE

### A. Qualifications

1. Submit proposed testing agency qualification data for acceptance.
  - a. Testing Agencies that do testing services on concrete materials shall meet ASTM C1077 requirements. Testing Agencies that testing services on reinforcing steel shall meet ASTM E329 requirements. Testing Agencies doing testing shall be acceptable to Registered Design Professional before doing any work. Concrete Field Tests required by Contractor or Owner shall be made by ACI Concrete Field Testing Technician Grade 1 per ACI CPI or equivalent. Equivalent certification programs shall include requirements for written and performance examinations as stipulated in ACI publication CPI.
2. Floor Slab Contractor Qualification
  - a. For floor slab work, use Contractors specializing in this Work. Use skilled workers experienced in this Work, and furnish labor, materials, equipment and services to properly complete this work.
  - b. *Qualifications [Q]*: Submit qualifications to Owners Representative indicative that Contractor is capable of this type of Work. Include five recent projects, summary of type of slab placement, method of construction and finishing, and F-number values obtained for each project.

### B. Pre-Installation Meetings

1. Project Meeting for Slab on Grade Work.
  - a. At least 35 days prior to the start of the concrete construction schedule, the Contractor shall conduct a meeting to review the proposed mix designs and to discuss the required methods and procedures necessary to achieve the required concrete quality and other specific project requirements
  - b. Contractor's Superintendent shall chair the meeting and distribute agenda 21 days prior to the scheduled date of the meeting.
  - c. Invite representatives concerned with concrete slab-on-grade work to meeting. Attendees shall include, but not be limited to, the following:
    - 1) Contractor's Superintendent.
    - 2) Concrete subcontractor.
    - 3) Testing agency responsible for concrete design mix.
    - 4) Testing agency responsible for field quality control.
    - 5) Concrete producer.
    - 6) Admixture manufacturers.
    - 7) Reinforcing foreman.
    - 8) Fiber Product Representative.
    - 9) Concrete finishing foreman.
    - 10) Architect-Engineer Registered Design Professional.
    - 11) Owner's Representative.
  - d. Proposed mix designs, slab-on-grade details, and placement, finishing, and curing procedures shall be distributed one week before meeting.

- e. Provide meeting minutes to attendees and Owner. Include statements by Contractor that proposed mix design and placing procedures shall produce concrete in compliance with Contract Documents.
  - f. Proposed product representatives and equipment representatives are to provide field service to assist in obtaining specified results under prevailing project site conditions.
2. Follow Up Project Meeting For Test Slab On Grade.
- a. At least three days before beginning floor slab-on grade-work, Contractor shall hold follow-up meetings to review test slab placement results. Proposed modifications to materials or procedures to improve final product slabs shall be completed at this time.
  - b. Contractor's Superintendent shall organize meeting, notify attendees, establish and distribute agenda in advance and chair meetings. Attendance shall be at Contractor's discretion, but shall include Owner's Representative. Registered Design Professional shall be notified of meeting.

## 1.6 DELIVERY, STORAGE, AND HANDLING

### A. Reinforcement

- 1. Prevent bending, coating with earth, oil, or other material, or otherwise damaging reinforcement.
- 2. For handling coated reinforcement, use equipment having contact areas padded to avoid damaging coatings. Lift coated reinforcement bundles at multiple pick-up points to prevent bar to bar abrasion from sags in bundles. Do not drop or drag coated reinforcement. Store coated reinforcement on cribbing that prevents damage to coatings.
- 3. Structural fibers - Deliver factory prepared and ready to use in containers showing weight. Store in dry locations.
- 4. Store Welded Wire Fabric Reinforcing Mats to avoid contact with soils, or surface moisture.

### B. Surface Treatment Materials

- 1. Deliver factory prepared, aggregate shake, ready-to-use, proportioned, mixed, and delivered to project site in waterproof bags. Identify each bag with manufacturer and product labels

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### A. Concrete

- 1. Cementitious material
  - a. Refer to Section 03300, Cast-in-Place Concrete, for cementitious material requirements.

#### B. Aggregates

- 1. For aggregates in normal weight concrete, refer to Section 03300, Cast-in-Place Concrete for requirements.
- 2. Maximum size Coarse Aggregate shall be nominal 1.5-inch per ASTM C467.

3. Combined aggregate gradation for slabs shall be 8% -18% for large top size aggregates (1 ½ inch) or 8%-22% for smaller top size aggregates (1 inch or ¾ inch) retained on each sieve below the top size and above the No. 100 sieve.

C. Vapor Barrier

1. Provide vapor barrier that conforms to ASTM E1745, Class A or B. The membrane shall have a water-vapor transmission rate of no greater than 0.006 perms when tested in accordance with ASTM E96. The vapor barrier shall be placed over prepared base material where indicated below slabs o grade. Vapor barrier shall be no less than 10 mils thick in accordance with ACI 302.1R.
  - a. Roof Industries “Griffolyn Vaporguard”
  - b. Stego Industries, LLC “Stego Wrap (15 mil)”
  - c. W.R. Meadows “Premoulded Membrane with Plasmatic Core”

D. Supplementary Cementitious Materials

1. Fly Ash: ASTM C618, Type F may be used up to a maximum of 25% of the total cementitious content.
2. Ground Granulated Blast Furnace Slag: ASTM C989, Grade 100 or 120 may be used up to a maximum of 40% of the total cementitious content.
3. The exact percentages used shall be based on a successful test placement procedure.

E. Admixtures

1. General
  - a. Refer to Section 03300, Cast-in-Place Concrete, for Water Reducing, Water Reducing/Retarding, Accelerating, Mid Range, and High Range Admixture products.

F. Reinforcement

1. Reinforcement shall be deformed bars conforming to ASTM A615, A616 or A617.
2. Wire welded wire fabric shall be furnished in flat mats or sheets, not in rolls, per ASTM A185.

G. Joint Shear Transfer Devices

1. Joint Shear Transfer Devices shall be diamond steel dowels conforming to ASTM A36 of size and lengths as shown on Drawings.
2. Joint Shear Transfer Devices shall be square steel dowels conforming to ASTM A36 of size and lengths as shown on Drawings.
3. Dowels shall have compressible material or otherwise designed to accommodate shrinkage differential between adjacent placements. Alternative devices to accommodate shrinkage movement may be proposed and used subject to Registered Design Professional approval. Support dowels at slab mid-depth in dowel baskets or receptacle to ensure accurate position and alignment.

#### H. Floor Joint Fillers

1. Epoxy Semi Rigid Joint Filler meeting minimum Shore D hardness of 50.
  - a. Subject to compliance with requirements, joint filler products incorporated in Work are limited to the following:
    - 1) Chemrex “Masterfill 300 I”
    - 2) Euclid Chemical Company “Euco 700 or Euco 800”
    - 3) Metzger McGuire Company “MM-80 Gray”
2. Premolded Joint Fillers:
  - a. Subject to compliance with requirements, joint filler products incorporated in Work are limited to the following:
    - 1) Sonneborn “Sonoflex F”
    - 2) W. R. Meadows, Inc. “Ceramar”
3. Polyurethane Joint Sealant ASTM C920, Type S, Grade P, Class 25:
  - a. Subject to compliance with requirements, joint filler products incorporated in Work are limited to the following:
    - 1) Euclid Chemical Company “Eucolastic I”
    - 2) Sika Chemical Corp. “Sikaflex ICSL”
    - 3) Tremco Inc. “Vulkem 45”

#### I. Curing Compounds.

1. Curing products shall conform to ASTM C309 or ASTM C1315.
2. Curing products shall comply with limitations to atmospheric discharges of volatile organic compounds (VOC).
3. Subject to compliance with requirements, curing and protection products incorporated in Work are limited to the following:
  - a. Clear Curing and Sealing Compound (VOC Compliant, 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<sup>2</sup>. Subject to project requirements provide one of the following products:
    - 1) Chemrex “MasterKure 200W”
    - 2) Euclid Chemical Company “Super Diamond Clear VOX or Super Rez Seal VOX”
    - 3) Sonneborn “Kure-N-Seal WB30”
  - b. Dissipating or Strippable Curing Compound conforming to ASTM C309. Subject to project requirements provide one of the following products:
    - 1) Dayton Superior “Day-Chem Rez Cure (J11W)”
    - 2) Euclid Chemical Company “Kurez DR VOX or Kurez W VOX”
    - 3) L & M Construction Chemical, Inc. “L & M Cure R”

#### J. Liquid Sealer/Densifier Compound:

1. High performance, deeply penetrating concrete densifier; odorless, colorless, VOC-compliant, non-yellowing silicate based solution designed to harden, dustproof and protect concrete floors. The compound must contain a minimum solids content of 20% of which 50% is silicate.
  - a. Euclid Chemical Company “Euco Diamond Hard”

- b. L&M Construction Company “Sealhard”
- K. Moisture Evaporation Retardants
- 1. Subject to compliance with requirements, Moisture Evaporation Retardant products incorporated in Work are limited to the following:
    - a. Euclid Chemical Company “Eucobar”
    - b. L & M Construction Chemical, Inc. “E-Con”
    - c. Master Builders, Inc. “ConFilm”
    - d. Sika Corporation “SikaFilm”

## 2.2 MIXES - PROPORTIONING CONCRETE

- A. Refer to Section 03300 Cast-in-Place Concrete for Proportioning requirements and Concrete Production

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Under Slab Preparation.
  - 1. Before placing base course, proof roll subgrade to assure that subgrade is acceptable for placement of base course and slab-on-grade. Proof rolling of subgrade shall be observed and evaluated by Testing Agency. If rutting or pumping occurs during proof rolling, soil subgrade shall be corrected and soft spot repair proof rolled again.
  - 2. Place vapor barrier at the bottom of the base course or below the slab as shown on the drawings. Lap the joints of vapor barrier sheets a minimum of 6 inches, and 9 inches onto adjacent vertical surfaces, and seal vapor-tight. Seal vapor barrier around penetrations, and at damaged areas to maintain vapor-tight seal. Do not puncture vapor barrier during construction operations.
  - 3. Except as indicated, provide minimum 6 inch aggregate base under concrete slabs on grade.
    - a. Inside temperature shall be maintained above 50 degF long enough to remove frost from subgrade before placing base course placing operations.
    - b. Use compaction equipment suited to achieve specified compaction for the base course installed. Use particular care to prevent “bulking” of fine granular fill
    - c. Terminate base course in true planes at correct elevations.
  - 4. Soil support system (subgrade and base course) should be frost free before concrete placing begins.
  - 5. Base course should be moist when placing concrete, but there shall be no freestanding water, nor soft, nor muddy spots on soil support system.
- B. Formwork.
  - 1. General
    - a. Provide to accommodate openings, offsets, haunches, grooves, depressions, curbs and other special shape requirements, in formwork. Besides normal detailing, identify embedded items placed or supported in formwork.

2. Installation - Slab on Grade Edge Forms and Screeds.
  - a. Edge forms and intermediate screed strips shall be set accurately to produce designated finished surface elevations and contours. Forms and screeds shall be sufficiently strong to support vibrating screeds or roller pipe screeds if specified finish requires equipment use. Concrete surface shall be aligned to screed strips contours by using strike off templates or acceptable compacting type screeds.

C. Placing Reinforcement Preparation:

1. To support reinforcement, use 4-inch square concrete block of compressive strength to match placed concrete.
2. Clay, wood, pervious material, or chairs without sand plates shall not be used to support steel reinforcing in slabs.
  - a. Chair supports for reinforcing bars or welded wire installed over ground, shall bear on sand plates.
3. Place additional reinforcing bars at re-entrant corners of pits and openings, and in adjacent panels opposite dead-ended control or construction joints.
4. Refer to Section ACI 301 Standard Specification for Structural Concrete, Section 3.3.

D. Embedded Items

1. Set miscellaneous metal items furnished under other Sections or Contracts, to be embedded in slab-on-grade work. Set sleeves and floor openings to designated and required lines, (elevations) and locations within plus or minus 1/4 inch per ACI 301, TABLE 4.3.1. Set other items to designated and required lines, (elevations) and locations, within plus or minus 1/16 inch.

### 3.2 PRODUCTION OF CONCRETE.

- A. See Section 03300 concerning Concrete.

### 3.3 CONSTRUCTION OF SLABS

A. Placing Concrete - General

1. Furnish, construct, and install Work per ACI 302 and related referenced ACI and ASTM Standards.
2. Notify Owners Representative at least 48 hours in advance of specific, designated placing operations to permit inspection. Placing concrete without Owner Representative notification may be cause for rejection of concrete work placed without notification.
3. Concrete mixing and placing shall be carefully coordinated with finishing.
4. Concrete shall not be placed on grade or in forms more rapidly than it can be spread straight-edged, and darbied or bull floated. Do these operations before bleed water collects on surface.
5. Confirm embedments, reinforcing steel elevations, and bottom slab elevations before placing concrete.
6. Cast concrete slabs on grade in alternate lane pattern with minimum 72-hour interval between casting adjacent lanes.
7. Fill temporary openings with concrete or non-shrink grout after items has been installed.

- B. Refer to Section 03300 Cast-in-Place Concrete for other requirements for Placing, Depositing, and Coordinating Concrete Materials use.
- C. Provide concrete column encasement as shown on Drawings.
- D. Provide concrete washes in steel column webs as shown on Drawings.
- E. Construction and Control Joints and Shear Transfer Devices.
  - 1. Provide construction and control joint devices per approved joint pattern shop drawings. Joint pattern shall conform to typical joint pattern indicated on Drawings, but shall accommodate specific slab-on-grade situations.
    - a. Joint pattern shall be square or nearly square, parallel to walls, and account for discontinuities in slab due to pits, trenches, and equipment foundations. Joint spacing shall not exceed 2 to 1 length to width aspect ratio for any given panel unless otherwise noted.
  - 2. Provide shear transfer devices (dowels) at construction joints and as shown on Drawings.
    - a. Use manufactured dowel holders to accurately place and maintain dowels through concrete placement and finishing operations.
  - 3. Use premolded joint fillers thickness as shown on Drawings along building perimeter, to isolate equipment foundations or pads, at column isolation joints, and other slab isolation. Recess top of joint filler 1/4 inch for sealant.
    - a. Recess top of joint filler 1/4-inch for sealant.
- F. Protection
  - 1. *Loading and concrete support:* Do not allow construction loads to exceed superimposed load which structural members, with necessary supplemental support, are capable of carrying safely and without damage.
  - 2. *Cold weather:* When mean daily outdoor temperature is less than 40 degF, temperature of concrete shall be maintained between 50 and 70 degF for required curing period. When necessary, arrange for heating, covering, insulation, or housing concrete work before placement. Arrangements shall be adequate to maintain required temperature without injury due to concentration of heat. Combustion heaters shall not be used during first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gasses, which contain carbon dioxide.
  - 3. *Hot weather:* When necessary to maintain evaporation control, make provision for windbreaks, shading, fog spraying, sprinkling, ponding, wet covering with light colored materials, or moisture evaporative retardants. Protective measures shall be installed as quickly as concrete hardening and finishing operations allow.
  - 4. *Rate of temperature change:* Changes in temperature of air immediately adjacent to concrete during and immediately following curing period shall be kept as uniform as possible and shall not exceed 5 degF in any 1 hour or 50 degF in any 24-hour period.
  - 5. Protect concrete surfaces from damage against:
    - a. Deicer materials.
    - b. Freezing and other adverse weather conditions.
    - c. Hard Wheeled Traffic
    - d. Heavy construction traffic.

- e. Impact and abrasion
- f. Rain or running water,
- g. Rubber Tire Marks
- h. Stains (grease, oil, chemicals, paints, clay, soil)

### 3.4 SURFACE FINISHES

#### A. Scratched Finish

1. Place, consolidate, strike off, and level concrete, eliminating high spots and low spots, to specified tolerance. Roughen surface with stiff brushes or rakes before final set.

#### B. Floated Finish

1. Place, consolidate, strike off, and level concrete, eliminating high spots and low spots. Do not work concrete further until ready for floating. Begin floating with hand floats, or bladed power float equipped with float shoes, or with powered disc floats when water sheen disappears and when surfaces have stiffened sufficiently to permit finishing operations. During or after first floating, surface planeness shall be checked with 10-foot straightedge applied at not less than two different angles. High spots shall be cut down. Low spots shall be filled. These procedures shall produce surfaces within specified tolerances. Slabs shall be refloated immediately to produce uniform sandy textures and an FF20/FL17 tolerance.

#### C. Broom or Belt Finish.

1. Immediately after concrete has received float finish as specified above, it shall be given coarse transverse scored texture by drawing brooms or burlap belts across surfaces.
  - a. Texture shall be as approved by Registered Design Professional from sample panels.

#### D. Troweled finish

1. Float surfaces as specified above and then power-trowel. Finally, hand-trowel all surfaces. After power floating, first troweling shall produce smooth surfaces, which are relatively defect free but which may still show some trowel marks. Additional troweling shall be done by hand after surface has hardened sufficiently. Final troweling shall be done when ringing sounds are produced as trowel is moved over slab surfaces. Surface shall be thoroughly consolidated by hand troweling operations. Finished surfaces shall be essentially free of trowel marks, uniform in texture and appearance and shall be plane to specified tolerances. On surfaces intended to support floor coverings, any defects of sufficient magnitude to show through floor coverings shall be removed by grinding.

### 3.5 CURING

#### A. General

1. Beginning immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury. Maintain concrete with minimal moisture loss at nearly constant temperatures for periods necessary for hydration of cement and hardening of concrete.

2. Curing shall be continued for at least 7 days.
  - a. Alternatively, if tests are made of cylinders kept adjacent to slab and cured by same methods, moisture retention measures may be concluded when average test compressive strength has reached 70 percent of specified compressive strength.
  - b. Moisture retention measures may also be concluded when temperature of concrete is maintained at least at 50 degF for same length of time that laboratory-cured cylinders, representative of concrete-in-place, require achieving 85 percent of compressive strength.
  - c. If one curing procedure is used initially, it may be replaced by other procedures any time after concrete is 1 day old provided concrete is not permitted to become surface dry during transition.

#### B. Curing Methods

1. Cure slab-on-grade surfaces with water. Apply one of the following procedures immediately after completion of placement and finishing. Do not water cure colored concrete or colored surface treatment.
  - a. Slabs on grade shall be kept continuously wet using covering material of burlap or manufactured absorptive fabric mats conforming to ASTM C171. Keep covering material wet so that moisture film remains continuously in contact with concrete during curing period.
  - b. Slabs-on-grade shall be continuously wetted and covered with moisture retaining coverings of waterproof sheet materials, conforming to ASTM C171.
    - 1) Polyethylene (Plastic) Film or waterproof paper.
      - a) Spread sheets as finishing operations are completed.
      - b) Do not use where slab surface appearance is critical.
      - c) Repair tears to maintain moisture retention.
2. Cure exposed slab-on-grade floor surfaces using specified curing and sealing compounds meeting ASTM C309 or ASTM C1315. Apply curing compound immediately after final finishing operations and after water sheen has disappeared from concrete surface. Apply curing compound in accordance with Manufacturer's instructions but at an application rate not greater than one gallon per 300 square feet.
  - a. Use high-solids (25% solids) curing compound for the following:
    - 1) Exposed, interior slab-on-grades not scheduled to receive another floor finish or liquid sealer/densifier.
    - 2) Slab-on-grades with monolithic, dry shakes if liquid sealer/densifier is not going to be applied later.
    - 3) Slab on grades to receive resilient tile.
    - 4) Slab on grades to receive carpet.
  - b. Use high-solids (25% solids) curing compound for the following:
    - 1) Exposed, interior slabs-on-grade subjected to vehicular traffic and to be cured and sealed.
  - c. Use dissipating or strippable film curing compound that wears off with normal traffic or can be easily stripped by use of the Manufacturer's stripping and cleaning process for the following:
    - 1) Slabs receiving adhesive applied finishes.
    - 2) Slabs receiving liquid sealer/densifier treatment.

- d. Use compatible curing compounds per Manufacturer's recommendations and instructions for the following:
  - 1) Slab on grades to receive epoxy coating.
  - 2) Slab on grades to receive urethane coatings.
  - 3) Slab on grades with spark disseminating dry shake. Cure sparkproof finished floors with manufacturer's special conductive curing compound, applied in number of coats and rates per manufacturer's recommendations.
  - 4) Slab on grades with color dry shake.
3. Curing compound shall not be used on any surface against which additional concrete or other material is bonded unless said curing compound is proven to prevent bonding, or unless positive measures are taken to remove said curing compound completely from areas to receive bonded application. Cure deferred floor finish slabs per Deferred Floor Finish Contractors' recommendations.
4. Cure slab edges that are temporarily exposed after form removal and before placing adjacent slabs.

### 3.6 LIQUID SEALER/DENSIFIER

#### A. Liquid Hardeners

1. Apply this compound on exposed interior floors. Application shall be made in strict accordance with Manufacturer's instructions and just prior to completion of construction. Spray, squeegee or roll on liquid densifier to a clean and dry concrete surface. Scrub liquid into surface with a mechanical scrubber. Keep surface wet with densifier during the application process. When product thickens, but not more than 60 minutes after initial application, squeegee or vacuum surface to remove excess material.

### 3.7 SAWCUTTING JOINTS.

- A. Where saw-cut control or contraction joints are required, or permitted in structural fiber reinforced concrete, cutting shall be timed with concrete set but no later than 4 hours after the slab has been finished. Cutting shall be started when concrete has hardened sufficiently to prevent dislodging aggregates by saw.
  1. Sawcut control or contraction joints one-quarter depth of slab using wet-blade machines.
  2. Sawcut control or contraction joints initially to 1-inch minimum depth using an early entry saw.
- B. Where saw-cut control or contraction joints are required, or permitted in steel fiber reinforced slabs, cutting shall be timed with concrete set but no later than 12 hours after placement. Cutting shall be started when concrete has hardened sufficiently to prevent dislodging aggregates by saw.
  1. Extend sawcuts located over dowels to top of dowels to ensure cracking at these locations.
  2. Sawcuts in areas without dowels shall be one-third slab thickness minimum.
  3. Do not skew sawcuts from column grid to eliminate re-entrant corners.
- C. Trace construction joints for slab-on-grade receiving epoxy joint filler with wet blade machine to 2-inch depth.

- D. Provide control joints in deferred finish by saw cuts as shown with cutting done not later than 24 hours after finish is placed.

### 3.8 JOINT FILLING

- A. Fill construction and control joints with epoxy joint filler unless otherwise noted. Delay filling sawcut joints 90 days minimum after cutting. Fill full joint depth with cold-applied, epoxy compound with minimum Shore D Hardness of 50. Inspect joints 120 days after filling and refill joints where filler has separated from joint face. Fill deferred finish joints with specified epoxy joint filler.
- B. For Joints in Areas not Subjected to Small Hard Wheeled Traffic:
  - 1. Use polyurethane compound joint sealant over premolded joint fillers. Fill void formed at top of premolded joint filler in exposed locations. Clean recessed sides before filling to ensure complete and continuous bond to both recesses' sides. Use sealant and primer as recommended by sealant manufacturer.

### 3.9 REPAIR RESTORATION

- A. Slab Deficiencies
  - 1. Criteria for determining potential strength deficiency. Strength will be considered deficient and concrete work will be rejected when work fails to comply with requirements which control structure's strength including, but not limited to the following conditions:
    - a. Concrete strength failing to comply with required compressive or flexural strength.
    - b. Reinforcing steel size, quantity, strength, position, or arrangement at variance with Contract document's requirements.
    - c. Concrete elements that differ from required dimensions, levelness, flatness, or location.
    - d. Curing not per Contract Documents.
    - e. Inadequate protection from extreme temperature and other environmental conditions during early hardening and strength development stages.
    - f. Mechanical injury, construction fires, accidents, or premature formwork removal resulting in deficient strength.
- B. Strength Deficient Repair Actions
  - 1. Action required when strength is potentially deficient: When structural strength is considered potentially deficient, the following actions may be required by the following Architect-Engineer:
    - a. Replace the deficient concrete slab.
    - b. Structural analysis or additional testing, or both.
    - c. Core testing.
    - d. If testing is inconclusive or impracticable or if structural analysis does not confirm structural safety, load tests may be required and their results evaluated per ACI 318.
    - e. Concrete work rejected by structural analysis or by load test results shall be strengthened with additional construction when required by Architect-Engineer Registered Design Professional, or replaced.

- f. Document repair works proposed to bring strength deficient concrete work into compliance with Contract Documents, and submit documentation to Architect-EngineerRegistered Design Professional for acceptance.
- g. Extend slab-on-grade warranty period.

C. Surface Defects Repair

- a. General
  - 1) Surface defects shall include poor joints, voids, honeycomb, stone pockets, ridges, ledges, pits, pin holes, off set, bulges, high spots, rough areas and other irregularities. Exposed surfaces shall be smooth and even, and free from surface defects. Defect repairs shall be subject to Architect-EngineerRegistered Design Professional approval. Provide special attention to fine honeycomb that occurs when concrete is cast against steel and plastic and at interior and exterior corners.
- b. Repair of defective areas
  - 1) Fill depressions with matching color-patching mixture, approved by Architect-EngineerRegistered Design Professional.
  - 2) Surfaces in exposed locations shall be true, flat planes. Grind down bulges, high spots, ridges and other projecting parts.
- c. For crack repair, use epoxy injection materials approved by Architect-EngineerRegistered Design Professional.
- d. Repair rejected concrete work by removing and replacing with additional construction required by Architect-EngineerRegistered Design Professional.
  - 1) Document repair work to bring concrete work into compliance with Contract Documents and submit documentation to Registered Design Professional for acceptance.

### 3.10 FIELD QUALITY CONTROL

A. Inspection

1. FIELD QUALITY CONTROL

- a. Site tests
  - 1) Concrete testing at Site will be per testing provisions of Section 03300 Cast-in-Place Concrete, except as specified below.
  - 2) Mold and cure four specimens from each sample. Cure three specimens per ASTM C31, and one specimen with, and same as, concrete placed.
  - 3) For slab on grade construction, every other test specimens set shall be concrete beam forms.
  - 4) Test ASTM C31 cured beam specimens per ASTM C78. Number and test time shall be same as specified in Section 03300.
- b. Flatness and Levelness Testing
  - 1) Measure finished concrete floors for flatness and levelness in accordance with ASTM E1155 Determining Floor Flatness and Levelness using F-number System.

- 2) Owner Representative shall direct where to measure F-number values for slab on grade placements.
  - a) Trowel finished floors shall achieve composite FF50/FL35 value and minimum FF35/FL24 value for individual floor section.
  - b) Float finished floors shall achieve composite FF25/FL20 values and minimum FF18/FL13 value for individual floor sections.
  - c) Measurements shall apply across control joints, but not within 2 feet of penetrations. Curling tolerances for these joints shall be limited to 1/8 inch in 2 feet in 6 months.
  - d) Floor measurements shall be taken by Testing Agency within 24 hours to placement and reported to Contractor and Owner Representative within 48 hours and before next slab placement.
  - e) Where F-numbers are less than specified composite, adjust placement operations to ensure compliance. Submit adjusted procedures to Owner Representative before proceeding with additional slab placements.
  - f) Where F-numbers for local conditions are less than minimum specified, submit, in writing, proposed corrective actions to Owner Representative for approval. Do not proceed with further slab placements without Owner Representative's approval.

END OF SECTION

<b>Revision History</b>	
<b>Date</b>	<b>Rev. No.</b>
A	0
B	0
C	0
D	0
E	0
F	0
02-19-09	0

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