

SECTION 03310
CONCRETE WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cast-in-place concrete placement operations for slabs on grade, slabs on fill, structural building frame, and other concrete components.

1.02 REFERENCES

- A. AASHTO M-182: Standard Specification for Burlap Cloth Made from Jute or Kenaf.
- B. ACI 301: Specifications for Structural Concrete for Buildings.
- C. ACI 305: Hot Weather Concreting.
- D. ACI 306: Cold Weather Concreting.
- E. ACI 309: Standard Practice for Consolidation of Concrete.
- F. ACI 315: Details and Detailing of Concrete Reinforcement.
- G. AASHTO M-148: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- H. ASTM C-642: Standard Test Method for Specific Gravity, Absorption, and Voids in Hardened Concrete.

1.03 RELATED WORK

- A. Manufacture of Portland cement concrete and delivery to site, in accordance with Section 03304.

1.04 SUBMITTALS

- A. Record of Placed Concrete: Record date, location of pour, quantity, air temperature, and test samples taken.
- B. Product name, type, and chemical analysis of the following as applicable:
 - 1. Curing compound.
 - 2. Sealing compound.
 - 3. Chemical hardener.

1.05 QUALITY ASSURANCE

- A. Rejection: Concrete work which fails to meet one or more of the following requirements, and which cannot be brought into compliance shall be rejected. Engineer shall determine appropriate modifications or payment adjustments to be made.

1. Appearance: Concrete exposed to view with defects which adversely affect appearance of specified finish.
2. Strength: Strength of concrete fails to comply with any of the following requirements:
 - a. Low compressive or flexural strength.
 - b. Reinforcing steel size, quantity, strength, position, damage, or arrangement at variance with requirements.
 - c. Concrete which differs from required dimensions or location in such a manner as to reduce its strength or load carrying capacity.
 - d. Inadequate protection of concrete from extremes of temperature during the early stages of hardening and strength development.
 - e. Mechanical injury, construction fires, accidents, or premature removal of formwork likely to result in deficient strength development.
 - f. Workmanship likely to result in deficient strength.
3. Slab Tolerance: Field quality control as specified herein.
4. Material Sources: In accordance with Section 03305.

1.06 WARRANTY

- A. Repair or replace defective or damaged work at no additional cost to City.

PART 2 PRODUCTS

2.01 ACCESSORIES

- A. Bonding Compound: Polyvinyl acetate or acrylic base, rewettable type.
- B. Vapor Retarder: 10 mil thick clear polyethylene sheet. Type recommended for below grade application.
- C. Forms: In accordance with Section 03216 and ACI 315.
- D. Reinforcement: In accordance with section 03200.
- E. Covering: Waterproof paper, polyethylene sheet or burlap cloth complying with AASHTO M 182, Class two.

2.02 CONCRETE SURFACE CURING COMPOUND

- A. Liquid membrane, in accordance with AASHTO M-148.
- B. Type of Compound: Engineer to select.
 1. Type 1, clear or translucent without dye.
 2. Type 1-D, clear or translucent with red fugitive dye.
 3. Type 2, white pigmented.
- C. Class of Vehicle: Class A, no restrictions.

- D. Performance Criteria of Compound: Compatible with sealing compound, if sealing compound is to be applied over concrete curing compound.

PART 3 EXECUTION

3.01 PREPARATION

- A. All exposed corners shall be chamfered (3/4" x 3/4").
- B. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not impede placing concrete.
- C. Do not allow construction loads to exceed member capacity.
- D. Prepare previously placed concrete by cleaning with steel brush and applying bonding compound. Apply bonding compound in accordance with manufacturer's instructions.
- E. At locations where new concrete is dowelled to existing work, drill holes in existing concrete work placed at ambient temperatures above 40 degrees F. Use of admixtures will not relax cold weather placement requirements.
- F. Do not disturb reinforcement, inserts, embedded parts, and formed joints.
- G. Do not break or interrupt successive pours such that cold joints occur.
- H. Honeycomb or embedded debris in concrete is not acceptable.

3.02 JOINTS

- A. Saw cut patterns where indicated. Saw cut control joints without raveling of the concrete. A maximum of 24 hours after pouring the concrete and prior to occurrence of any surface cracking.

3.03 CONSOLIDATION

- A. In accordance with ACI 309.
- B. Keep spare vibrator available during concrete placement operations.

3.04 FINISHING

- A. Do not add water or retemper concrete unless Engineer's approval is secured.
- B. Slab Finishing Tolerances: When tolerance is not indicated, use Straightedge Tolerance.
 - 1. Very Flat Tolerance: True plane with maximum variation of 1/8-inch in 10 feet when measured with a 10-foot straightedge placed anywhere on the slab in any direction.
 - 2. Flat Tolerance: True plane with maximum variation of 3/16-inch in 10 feet when measured with a 10-foot straightedge placed anywhere on the slab in any direction.
 - 3. Straightedge Tolerance: True plane with maximum variation of 5/16-inch in 10 feet when measured with a 10-foot straightedge placed anywhere on the slab in any direction.

4. Bullfloated Tolerance: True plane with maximum variation of 1/2-inch in 10 feet when measured with a 10-foot straightedge placed anywhere on the slab in any direction.
- C. Finishes: In accordance with Section 03345. When type of finish is not indicated, use following finishes as applicable:
1. Sidewalks, garage floors, and ramps: Broom or belt finish.
 2. Exterior concrete pavement: Broom or belt finish.
 3. Exterior platforms, steps, and landings, exterior and interior pedestrian ramps, not covered by other finish materials: Nonslip finish.
 4. Surfaces intended to receive bonded applied cementitious applications: Scratched finish.
 5. Surfaces intended to receive roofing, except future floors, waterproofing membranes, and roof surfaces which are future floors or sand bed terrazzo: Floated finish.
 6. Floors and roof surfaces which are floors intended as walking surfaces or to receive floor coverings: Troweled finish.
 7. Unpainted concrete surfaces not exposed to public view: Smooth as-cast form finish.
 8. Unpainted concrete surfaces exposed to public view: Rubbed finish.
 9. Concrete surfaces to receive paint or plaster: Grout cleaned finish.
- D. Chemical Hardener: After completion of curing, apply chemical hardener in accordance with manufacturer's instructions to all interior floor slabs which are exposed in finished work and elsewhere as indicated. After final coat of chemical hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water. Do not place liquid floor hardener on floor areas scheduled to receive synthetic matrice terrazzo, or setting beds for tile, terrazzo, vinyl flooring, or like items.

3.05 CURING

- A. General: Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete. Cure concrete by applying curing compound, by moisture curing, by moisture-retaining cover curing, or by combinations thereof.
- B. Curing Compounds:
1. Apply curing compound to concrete slabs within 2 hours of completing final finishing operations. Apply uniformly in continuous operation. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period. Should side forms be removed before expiration of 7 days from start of curing, coat exposed surfaces with curing compound.
 2. Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, damproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials, unless otherwise acceptable to Engineer.

- C. Moisture Curing: Provide either of the following methods.
 - 1. Keep concrete surface continuously wet by covering with water or continuous water-fog spray.
 - 2. Cover concrete surface with absorptive cover, thoroughly saturated with water and kept continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.

3.06 SEALING

- A. Seal concrete by applying a sealing compound as required by Engineer.
- B. Surface Preparation: If necessary to remove curing compound, sandblast concrete surface. Clean surface free of dirt, oil, grease and other contaminants. If necessary use proprietary cleaning compounds (not raw acids) followed by thorough water rinsing. Use high pressure water equipment providing 1,200-2,000 psi to remove detergent residues. Do not attempt application when condensation is present.
- C. Application: Spray with low pressure (20 psi) airless spray equipment. Saturate the surface to the point of rejection. On vertical surfaces apply 2 coats.
- D. Coverage Rates: In accordance with manufacturer's recommendation.
- E. Paint Adhesion: Always test to verify compatibility between sealant and other proposed surface treatments.
- F. Warning: Remove inadvertent splashes before the solution has dried on the surface. If sealant is a hazardous material, allow use only by professional applicator. Three (3)- 4-inch cylinders shall be taken and a slump and air test shall be done at the beginning of concrete placement and every 50 cubic yards thereafter.

3.07 TESTS

- A. Arrange for and perform all testing required for qualification of proposed materials and the establishment of mix designs, in determining strengths for early form removal, for cylinder tests after the addition of water, and other needs of Contractor.
- B. Two slump tests, one before and one after the addition of super-plasticizer.
- C. Three (3) standard 4-inch cylinder samples of concrete from trucks receiving water after addition of water.

3.08 DEFECTIVE CONCRETE

- A. Modify or replace concrete not conforming to required levels, lines, details, and elevations.
- B. Structural analysis and additional testing may be required at no additional cost to Owner when the strength of a structure is considered potentially deficient.
- C. Where allowed, patch imperfections. Refer to Section 03345 for finish requirements.

3.09 PROTECTION AND REPAIRS

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. All concrete curbs, gutter, sidewalks, and driveways requiring removal and replacement, shall be removed and replaced to the next joint or scoring lining beyond the actually damaged or broken sections.
- D. In the event that joints or scoring lines do not exist or are five or more feet from the removed or damaged section, the damaged portions shall be saw cut, removed, and reconstructed to neat, plane faces.
- E. When saw cut sections are allowed for removal and replacement, use epoxied dowels in all cut planes.
- F. All new concrete shall match, as nearly as possible, the appearance of adjacent concrete improvements.
- G. Where necessary, lampblack or other pigments shall be added to the new concrete to obtain the desired results.
- H. The concrete surface must not be damaged or pitted by rain.
- I. The Contractor shall provide and use, when necessary, sufficient tarpaulins to completely cover all sections that have been placed within the preceding twelve (12) hours.
- J. The Contractor shall erect and maintain suitable barriers to protect the finished surface.
- K. Any section damaged from traffic or other causes occurring prior to its official final acceptance shall be repaired or replaced by the Contractor at his own expense in a manner satisfactory to the City Engineer.
- L. Spalling: Concrete shall not spall or show signs of spalling before the warranty expiration. All concrete with spalling shall be removed and replaced by the Contractor or Owner at his own expense. When approved by City Engineer, concrete with spalling may be repaired by an approved method. The approved method must be a five step process which includes a muriatic acid wash, pressure wash with orbital nozzle, application of approved grout & cement modifier, and application of an approved sealer. The following products are approved for use to repair spalling concrete:
 - 1. Planicrete AC Acrylic Latex Admixture for Mortar and Concrete mixed with Planitop X One-Component Fast Setting Vertical and Overhead Repair Mortar with Planiseal WR 40 Water Based 40%-Silane Penetrating Water Repellant.
 - 2. Duraset 1000 Modified Acrylic Resin mixed with G100 Pro-Series Grout Mix and Liquid Colorant.
 - 3. SuperSeal 2000 Solvent Based Acrylic Sealer.
- M. Damaged Sidewalk and/or Curb & Gutter shall be repaired or replaced according to the following criteria.
 - 1. Cracks in Concrete Infrastructure
 - a. Cracks in Concrete Sidewalk

- i. Single “hairline” cracks running perpendicular to the length of the sidewalk, and which do not show evidence of vertical offset or movement, do not require repair or replacement.
 - ii. All other cracks in sidewalk require removal and replacement of the entire concrete section*.
 - b. Cracks in Concrete Curb & Gutter
 - i. Single “hairline” cracks running perpendicular to the length of the curb & gutter, and which do not show evidence of vertical offset or movement, do not require repair or replacement.
 - ii. Single cracks running perpendicular to the length of the curb & gutter which are greater in width than a “hairline” crack, but which are less than 1/8 inch in width, shall be repaired by sealing the crack with an approved sealant following preparation including routing and cleaning.
 - iii. All other cracks in curb & gutter require removal and replacement of the entire concrete section*.
- 2. Gouges in Concrete Infrastructure (Damage to Planar Surfaces, excludes Edges/Corners)
 - a. Gouges in Concrete Sidewalk or Concrete Curb & Gutter
 - i. Single (or minimal) gouges up to 3 inches in length and less than ½ inch in depth, and which do not represent a safety hazard in the opinion of the inspector, do not require repair or replacement.
 - ii. Single (or minimal) gouges up to 3 inches in length and less than 3 inches in depth, shall be repaired using an approved two-part epoxy patching compound.
 - iii. All other gouges in sidewalk require removal and replacement of the entire concrete section*.
- 3. Chips to Concrete Infrastructure (Damage to Edges & Corners)
 - a. Chips in Concrete Sidewalk
 - i. Single (or minimal) chips up to 3 inches in length and less than 1 ½ inches in width, and which do not represent a safety hazard in the opinion of the inspector, do not require repair or replacement.
 - ii. All other chips in sidewalk require removal and replacement of the entire concrete section*.
 - b. Chips in Concrete Curb & Gutter
 - i. Single (or minimal) chips up to 3 inches in length and less than 1 ½ inches in width, shall be repaired using an approved two-part epoxy patching compound.
 - ii. All other chips in curb & gutter require removal and replacement of the entire concrete section*.
- 4. In addition to the information provided above, removal and replacement of the entire concrete section* is required for the following types of damage:
 - a. Multiple cracks, where the cracks are less than a sidewalk width apart.
 - b. Cracks that converge creating small isolated pieces of concrete.
 - c. Cracks that generally run parallel to the length of the infrastructure.
 - d. Cracks that circle back to the original side creating “half moon” pieces of concrete.
 - e. Cracks that allow the concrete to move vertically from the adjoining piece.
 - f. Excessive scaring, spalling, or scraping of the finished concrete surface.
 - g. Cracks with chipping along the edge at the surface indicating settlement or movement along the crack.
 - h. Any damage, which in the inspectors’ opinion, was clearly the result of negligence on the part of the builder, or damage which appears will result in failure of the sidewalk or gutter and its intended function.

*Sections may be cut and the damaged portions removed, provided no remaining or new section(s) are less than 5 feet in length. (Cut lines are considered as section lines.)

N. Approved Products for Concrete Damage Repair:

1. Concrete Sealant: Sikaflex® 1a or 1cSL (or approved equal)

Note: As an alternate to the two-part epoxy patching compound, and when approved by the City Engineer, the 5 step process and products listed for spalling repair may be used for chip and gouge repair.

O. Concrete sidewalk and curb & gutter which is defective due to settlement, uneven joints, or tripping hazards may be corrected by “Concrete Lifting” as approved by City Engineer. Concrete lifting shall conform to the following:

1. Concrete repair by lifting shall only be performed by a licensed contractor specializing in concrete lifting.
2. Concrete lifting shall be completed by drilling strategically placed holes in concrete. A grout, sand, Portland cement, and water mixture shall be used proportioned to harden without settlement and to sufficiently fill voids beneath the concrete. Foam products may also be used when approved by City Engineer. Holes shall be placed to allow for pumping the mixture under the concrete to lift the settled areas. Additional holes shall also be drilled to allow for filling voids created by the lifting procedure.
3. The proportion of Portland cement shall be a minimum of 5 percent by weight of dry mixture.
4. The use of the concrete lifting technique may be attempted to correct uneven adjoining sections of concrete or correct areas of defective drainage. If concrete lifting does not correct the defective concrete to the Engineers satisfaction, the concrete shall be removed and replaced.

3.10 PLACING CONCRETE IN COLD WEATHER

- A. No concrete shall be placed where the air temperature is lower than 40 degrees Fahrenheit, at a location where the concrete cannot be covered or protected from the surrounding air.
- B. When concrete is placed below a temperature of 35 degrees Fahrenheit the ingredients of the concrete shall be heated so that the temperature of the mixture shall not be less than 50 degrees or more than 100 degrees Fahrenheit.
- C. Before mixing, the heated aggregates shall not exceed 175 degrees Fahrenheit.
- D. Cement shall not be added while the temperature of the mixed aggregates and water is greater than 100 degrees Fahrenheit.
- E. When there is likelihood of freezing during the curing period, the concrete shall be protected by means of an insulated covering to prevent freezing of the concrete for a period of not less than 7 days after placing.
- F. Equipment for protecting concrete from freezing shall be available at the job site prior to placing concrete. Particular care shall be exercised to protect edges and exposed corners from freezing.

- G. In the event heating is employed, care shall be taken to insure that no part of the concrete becomes dried out or is heated to temperatures above 100 degrees Fahrenheit.
- H. The housing, covering, or other protection used shall remain in place and intact at least 24 hours after the artificial heating is discontinued.
- I. For a period of five days the concrete shall be kept above 40 degrees F and below 100 degrees F.

END OF SECTION