SECTION 03 35 00

CONCRETE FINISHING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Repair of surface defects.

B. Finishing of formed surfaces.

C. Slabs and flatwork.

D. Curing.

1.02 RELATED SECTIONS

A. Concrete formwork is specified in Section 03 11 00, Concrete Forming.

B. Cast-in-place concrete is specified in Section 03 30 00, Cast-In-Place Concrete.

C. Concrete topping slabs for station concourse and platforms are specified in Section 03 53 00, Concrete Topping.

1.03 MEASUREMENT AND PAYMENT

A. Measurement: Repair of surface defects, finishing, and curing of concrete will not be measured separately for payment.

B. Payment: Repair of surface defects, finishing, and curing of concrete will be paid for as part of the indicated Contract unit prices or lump-sum prices for the associated concrete work as indicated in the Bid Schedule of the Bid Form.

1.04 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO M182 Burlap Cloth Made from Jute or Kenaf

B. American Concrete Institute (ACI):

1. ACI 117 Standard Specification for Tolerances for Concrete Construction and Materials
2. ACI 301 Standard Specifications for Structural Concrete
3. ACI 308 Standard Practice for Curing Concrete
4. ACI 503.4 Standard Specification for Repairing Concrete with Epoxy Mortars

C. American Society for Testing and Materials (ASTM):

1. ASTM C33 Specification for Concrete Aggregates

2. ASTM C150 Specification for Portland Cement

3. ASTM C171 Specifications for Sheet Materials for Curing Concrete

4. ASTM C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete

5. ASTM C881 Specification for Epoxy-Resin-Base Bonding Systems for Concrete

6. ASTM E1155 Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers

D. State of California, Department of Transportation (CalTrans), Standard Specifications:

1. Section 51 Concrete Structures

1.05 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures. Submittals involving exposed concrete finishes require approval of the Engineer before they may be incorporated in the Work.

B. Shop Drawings: Submit drawings, or diagrams to scale, that indicate the location in plan and elevation of all concrete finishes.

C. Product Data: Submit manufacturers' product data for manufactured products.

D. Samples:

1. Submit 1/2-pint sample container of aluminum oxide and silicon carbide abrasive grit for review and acceptance where "non-slip finish" is indicated.

2. Submit samples not less than 12 inches by 12 inches in size of each type of sand blast finish, indicating materials and methods used to produce the sand blast finishes. Review by the Engineer will be for color and texture only. Approved samples will become the Engineer's control samples.

1.06 QUALITY ASSURANCE

A. Finishes:

1. Finishing of formed concrete surfaces shall conform to applicable requirements of ACI 301.

2. Finishes for slabs and flatwork shall conform to applicable requirements of ACI 301.

3. Special architectural finishes for formed concrete surfaces shall conform with applicable requirements of ACI 301.

4. Bridge deck finishes shall conform to applicable requirements of Caltrans Standard Specifications Section 51.

B. Curing: Conform to requirements of ACI 301 and ACI 308, as applicable, and requirements specified herein.

C. Site Mock-Ups: Provide site mock-ups, at least 3 feet by 4 feet in size, of finishes of formed surfaces in exposed locations and of exposed slab finishes for the Engineer's review and approval. Refer to Section 01 43 38, Field Samples and Mock-ups, for requirements and procedures.

D. Site Mock-ups of Architectural Concrete: Provide site mock-ups of architectural concrete showing finish texture and pattern of exposed formed concrete surfaces.

1. Size of mock-up shall be a minimum of 8 feet by 10 feet, unless otherwise approved by the Engineer to be smaller.

2. The number of mock-up panels required shall be the number necessary to obtain the Engineer's approval of pattern and texture of panel.

3. Approved mock-up shall be used as the standard for the aesthetic quality of the surface finish of architectural concrete.

E. Requirements of Regulatory Agencies: Comply with air pollution regulations of governing authorities for sand-blasting activities and operations.

PART 2 – PRODUCTS

2.01 TOOLS AND EQUIPMENT:

A. The Contractor shall furnish all materials, tools, equipment, facilities, and services as required for performing the required concrete-finishing work.

2.02 REPAIR AND FINISHING MATERIALS

A. Portland Cement: ASTM C150, Type II, of same brand as used in the work. Furnish white portland cement where required to produce color matching color of surrounding concrete.

B. Aggregate:

1. For Bonding Grout: ASTM C33, washed clean sand passing a No. 30 sieve.

2. For Patching Mortar: ASTM C33, washed clean, graded fine aggregate of suitable size for areas to be repaired. Clean coarse aggregate up to Size No. 8 may be added for repair of larger pockets and voids.

C. Commercial Patching Mortar: A structural repair mortar may be furnished if appropriate for the use and approved by the Engineer.

D. Epoxy Patching Mortar: As specified in ACI 503.4 for Epoxy Mortar.

E. Epoxy Adhesive: ASTM C881, Type II or Type V, epoxy-based bonding agent.

F. Anti-Slip Abrasive Grit: Virgin grain Aluminum Oxide or Silicon Carbide particles, or a mixture of the two.

2.03 CURING MATERIALS

A. Damp Curing Materials:

1. Waterproof Sheet Materials: ASTM C171, waterproof paper with white paper face, polyethylene film pigmented white, or white burlap-polyethylene sheeting.

2. Burlap: AASHTO M182, of class or weight suitable for the use and location. Do not use burlap where concrete is exposed to direct sunlight.

B. Curing Compound: ASTM C309, liquid membrane-forming curing compound, Type 1, Class A or B as appropriate for the use or location.

1. Where concrete surfaces will receive architectural finishes, such as resilient floor coverings or paint, or membrane waterproofing, membrane-forming curing compound shall not leave a coating or residue that will impair bond of adhesives, paints, and coatings with concrete.

PART 3 – EXECUTION

3.01 REPAIR OF SURFACE DEFECTS

A. Repair Standards: Repair of surface defects shall conform with applicable requirements of ACI 301. When using epoxy mortar, conform with applicable requirements of ACI 503.4.

B. Surface Defects:

1. Repair of surface defects shall begin immediately after form removal. For repair with epoxy mortar, concrete shall be dry.

2. Surface defects are defined to include: form-tie holes, air voids or pockets, bug holes with a nominal diameter or depth greater than 1/4-inch, honeycombed areas, rock pockets, visible construction joints, fins and burrs.

3. Repair of surface defects shall be tightly bonded and shall result in concrete surfaces of uniform color and texture, matching adjacent surfaces, and free of shrinkage cracks.

C. Repair Work:

1. Remove honeycombed and other defective concrete down to sound concrete. Saw-cut the edges perpendicular to the surface or slightly undercut. Feather-edges will not be permitted. Dampen the area to be patched and an area at least 6 inches wide surrounding it to prevent absorption of water from the patching mortar.

2. Where rock pockets or similar defects or voids expose steel reinforcement, cutout to solid surface behind the reinforcing steel to provide suitable key-lock for patching mortar. Patching mortar shall envelope the exposed reinforcing bar.

3. Bond patching mortar to concrete with bonding grout or epoxy adhesive. Bonding grout shall consist of 1 part portland cement to 1 part No. 30 mesh sand, mixed to the consistency of a thick cream, and then well brushed onto the concrete. Bond commercial patching mortar to concrete in accordance with the manufacturer's instructions.

4. Make the patching mortar of the same materials and of approximately the same proportions as used for the concrete, except omit the coarse aggregate. Use not more than 1 part portland cement to 2-1/2 parts sand by damp loose volume, and substitute white portland cement for a portion of the regular gray portland cement to produce patching mix matching the surrounding concrete in color when dry. Determine the proportion of white portland cement by trial mixes and test areas, prior to repair of actual defective areas.

5. After surface water has evaporated from the area to be patched, brush the bond coat well into the surface. When the bond coat begins to lose the water sheen, apply the patching mortar. Compact the mortar into place and strike off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, leave the patch undisturbed for at least one hour before being finally finished. Keep the patched area damp for 7 Days.

6. Neatly finish patched surfaces to match adjacent surrounding surface texture of concrete. Grind or fill surfaces to produce level and plumb, true planes.

7. For walls exposed in the finish work, form tie holes shall be patched and finished flush with adjacent surface. For holes passing entirely through walls, a plunger type injection gun or other suitable device shall be used to completely fill the holes.

8. Patching of honeycombed areas or rock pockets that are too large and unsatisfactory for mortar patching shall be cut out to solid surface, keyed, and packed solid with matching concrete to produce firm bond and flush surface. Patching shall match texture of adjacent surfaces where exposed in the finished work.

9. Repair work in exposed locations that does not match the texture and color of surrounding adjacent surfaces or that was not well performed shall be removed and performed again until the repair work conforms with Specification requirements.

10. Surfaces to receive membrane waterproofing shall have fins and loose material removed, and voids and cracks patched flush with adjacent surfaces.

11. Completed repairs shall be cured as herein specified under Article 3.04, Curing.

3.02 FINISHING OF FORMED SURFACES

A. Unexposed Surfaces:

1. Concrete that will not be exposed in the completed structure shall be any form finish as specified in Section 03 11 00, Concrete Forming, and ACI 301 for "rough form finish."

2. Concrete to receive membrane waterproofing shall receive a "smooth form finish" in accordance with ACI 301.

B. Exposed Surfaces: Unless indicated otherwise, concrete that will be exposed in the completed structure shall receive the following finishes as indicated:

1. Smooth Form Finish: Conform to ACI 301.

2. Smooth Rubbed Finish: Conform to ACI 301.

3. Grout Cleaned Finish: Conform to ACI 301.

4. Unspecified Finish: When finish is not indicated, provide "smooth form finish" as specified above.

C. Sand Blast Finish:

1. Blasting Operations and Requirements:

a. Apply sandblasted finish to exposed concrete surfaces where indicated.

b. Perform sand blasting at least 72 hours after placement of concrete. Coordinate with formwork construction, concrete placement schedule, and formwork removal to ensure that surfaces to be blast finished are blasted at the same age for uniform results.

c. Determine type of nozzle, nozzle pressure, and blasting techniques required to match the Engineer's control samples.

d. Abrasive blast corners and edge of patterns carefully, using back-up boards, to maintain uniform corner or edge line.

2. Depths of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surface to match the Engineer's control samples as follows:

    a. Brush Sand Blast Finish: Remove cement matrix to expose face of fine aggregate; no reveal.

    b. Light Sand Blast Finish: Expose fine aggregate with occasional exposure of coarse aggregate; maximum 1/16-inch reveal.

    c. Medium Sand Blast Finish: Generally expose coarse aggregate; 3/16-inch to 1/4-inch reveal.

3. Surface Continuity: Perform sand blast finishing in as continuous an operation as possible, utilizing the same work crew to maintain continuity of finish on each surface or area of work. Maintain patterns of variances in depths of cuts as indicated.

4. Construction Joints: Use technique acceptable to the Engineer to achieve uniform treatment of construction joints.

5. Protection and Repair:

    a. Protect adjacent materials and finishes from dust, dirt, and other surface or physical damage during abrasive blast finishing operations. Provide protection as required and remove from site at completion of the work.

    b. Repair or replace other work damaged by finishing operations.

6. Clean-up: Maintain control of concrete chips, dust, and debris in each area of the work. Clean up and remove such material at the completion of each day of operation. Prevent migration of airborne materials by use of tarpaulins, wind breaks, and similar containing devices.

3.03 SLABS AND FLATWORK

A. Placement and Finishing Standards: Slabs and flatwork shall be placed, consolidated, and finished in accordance with applicable requirements of ACI 301. Coordinate with Section 03 30 00, Cast-In-Place Concrete, as applicable.

1. High volume fly ash concrete (HVFAC) exhibits little or no bleed water. Commence finishing as soon as power screeding is complete, and commence initial curing as soon as finishing has been completed.

B. Placement:

1. Slabs and flatwork shall be placed and finished monolithically. Strike off and screed slabs to true, plane surfaces at required elevations, and thoroughly compact concrete with vibrators, floats, and tampers to force coarse aggregate below the surface. Finish slab within four hours of concrete placement.

2. Whether indicated or not, in areas where drains occur, slope finished slab to drains. Slope shall be a minimum of 1/8-inch per foot unless otherwise indicated.

C. Slab Finishes: Unless indicated otherwise, slabs and flatwork shall receive the following finishes as indicated:

1. Scratched Finish: Conform to ACI 301. Provide "scratched finish" for slab substrates to receive cementitious toppings or finishes, such as terrazzo or mortar setting bed for ceramic tile.

2. Floated Finish: Conform to ACI 301. Provide "floated finish" for track slabs and mud slabs and for slabs and flatwork to receive roofing and membrane waterproofing.

3. Troweled Finish: Conform to ACI 301. Provide "troweled finish" for interior slabs and flatwork to be exposed in the completed structure, for slabs to receive resilient floor coverings, and for flatwork to receive elastomeric bearing pads.

4. Broom Finish: Conform to ACI 301. Exact texture and coarseness of the broom finish shall match the approved site mock-up. Provide fine or medium-coarse "broom finish" as indicated for exterior sidewalks and paving, exterior ramps, equipment and transformer pads, and subway invert slab.

5. Nonslip Finish: Conform to ACI 301. Nonslip materials shall be aluminum oxide and silicone carbide grit particles. Provide "nonslip finish" for interior pedestrian ramps, walkways, subway cross-passage floors, and other floor areas where indicated.

6. Swirl Pattern Finish: Provide for garage floors. After basic floating operations have been completed, hand float slabs using wood float to produce a continuous swirl patterned surface, free from porous spots, irregularities, depressions, and small pockets or rough spots such as may be caused by accidentally disturbing particles of coarse aggregate embedded near surface. Use natural arm circular motion to produce rows of approximately one-foot radius swirl pattern covering approximately half of the preceding row with each successive row.

7. Unspecified Finish: When finish is not indicated or specified, provide finishes as specified in ACI 301.

D. Surface Tolerances: As specified herein:

1. Flat Tolerance: Slabs and flatwork with "troweled finish" and with "nonslip finish."

2. Straightedge Tolerance: Slabs and flatwork with fine "broom finish" or medium-coarse "broom finish."

3. Bullfloated Tolerance: Slabs and flatwork with "scratched finish," with "floated finish," and with coarse "broom finish."

E. Joints:

1. Construction, expansion, isolation, and contraction joints shall be located as indicated. Construction joints shall act as contraction joints. Where additional contraction joints are required to prevent shrinkage cracks, saw-cut such joints.

All joints shall be straight and true to line. Saw-cut joints not less than twelve hours nor more than twenty-four hours after placing concrete, unless otherwise approved by the Engineer.

2. Mark-off lines or edges at formed construction and expansion joints shall be finished with 1/4-inch radius curved edging tool, neat and true to line, uniform throughout.

3.04 CURING

A. Curing Standards: Curing of concrete shall conform with applicable requirements of ACI 301 and ACI 308, except that the duration of the curing period shall be 10 Days. Curing with earth, sand, sawdust, straw, and hay will not be permitted.

B. Curing Requirements:

1. Concrete shall be cured with waterproof sheet materials, damp burlap, or curing compounds.

2. Curing compounds shall not be used on top of ballasted aerial structures and on surfaces when their use may be detrimental to bonding of concrete, mortar, membrane waterproofing, calking and sealants, adhesives, plaster, paint, or the specified surface finish or coating.

C. Damp Curing:

1. Vertical surfaces shall be cured by keeping the forms wet at all times and by leaving the forms in place as long as possible as specified in Section 03 11 00, Concrete Forming. After removal of forms, concrete shall be kept continuously damp by fog spraying or otherwise washing down the concrete in an accepted manner until 10 Days after placing. Protect exposed surfaces by covering with sheet materials or burlap kept continuously moist.

2. Horizontal surfaces shall be cured and protected by covering the finished surfaces with waterproof sheet materials or damp burlap, left in place for a minimum of 10 Days and kept continuously moist.

3. Fog spray freshly placed slabs until finishing operations commence. Allow no slabs to become dry until finishing operations are complete.

D. Curing HVFAC: Initiate damp curing as soon as finishing has been completed. Damp cure for a minimum of 10 Days. Continue curing for a total of 28 Days. Curing after initial 10 Days may be by damp curing or using membrane-forming curing compound. Use evaporation reducer between finish operations, as necessary, to protect concrete from rapid drying

E. Curing Compound: Application of curing compound shall conform to applicable requirements of ACI 308.

3.05 PROTECTION

A. Protect exposed concrete surfaces, including flatwork, as required to prevent damage from impact or strains.

B. Protect fresh concrete from drying winds, rain, damage, or soiling.

C. Refer to Section 03 30 00, Cast-In-Place Concrete, Article 3.09, for additional requirements.

3.06 TOLERANCES

A. Formed Surfaces: Conform with applicable requirements of ACI 117.

1. Where elastomeric bearing pads are indicated, the level plane upon which bearing pads are placed shall not vary more than 1/16-inch from a 10-foot straightedge placed in any direction across the area and the area shall extend a minimum of 1 inch beyond the limits of the pads.

2. Bearing surfaces of girders on a slope or girders with a camber shall be finished on a horizontal/level plane so that loads are uniformly distributed over the entire surface of the elastomeric bearing pads.

3. The finished plane shall not vary more than 1/8-inch from the elevation indicated.

B. Slabs and Flatwork: Conform to applicable classification requirements of ASTM E1155, as follows:

1. Very Flat Tolerance: F_F 50, F_L30. 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: F_F 30, F_L20. 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: F_F 20, F_L 15. 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: F_F 15, F_L 13. 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.

END OF SECTION 03 35 00