SECTION 03 01 30

CAST-IN-PLACE CONCRETE MAINTENANCE

PART 1 - GENERAL

1.1 SCOPE

A. This specification section governs the maintenance of cast-in-place concrete including the following:

1. Removal of deteriorated concrete and subsequent replacement and patching
2. Epoxy crack injection.

1.2 RELATED SECTIONS

A. Section 03 20 00 – Concrete Reinforcement

B. Section 03 30 00 – Cast-in-Place Concrete

1.3 REFERENCED CODES AND STANDARDS

A. American Society for Testing and Materials (ASTM) International Standards, Latest Edition

1. C33 – Standard Specification for Concrete Aggregates
2. C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
3. C144 – Standard Specification for Aggregate for Masonry Mortar
4. C150 – Standard Specification for Portland Cement
5. C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
6. C881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
7. C928 – Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs

1.4 SUBMITTALS

The Contractor shall submit the following to the City Representative for review prior to concrete placement in accordance with Division 1:

A. Product Data: For each type of product.

1. Include construction details, material descriptions, chemical compositions, physical properties, test data, and mixing, preparation, and application instructions.

B. Material Certificates: For each type of Portland cement and aggregate supplied for mixing or adding to products at the Project site.

C. Product Test Reports: For each manufactured bonding agent, cementitious patching

mortar and crack injection adhesive, tests performed by manufacturer and witnessed by a qualified testing agency.

D. Field quality-control reports.

E. Quality Control Plan: Submit before work begins.

1.5 QUALITY ASSURANCE

A. Quality Control Plan: Prepare a written plan for concrete maintenance to systematically demonstrate the ability of personnel to properly perform maintenance work, including each phase or process, protection of surrounding materials during operations, and control of debris and runoff during the Work. Describe in detail materials, methods, equipment, and sequence of operations to be used for each phase of the Work.

1.6 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.

B. Store cementitious materials off the ground, under cover, and in a dry location.

C. Store aggregates covered and in a dry location; maintain grading and other required characteristics and prevent contamination.

1.7 FIELD CONDITIONS

A. Environmental Limitations for Epoxies: Do not apply when air and substrate temperatures are outside limits permitted by manufacturer.

B. Cold-Weather Requirements for Cementitious Materials: Do not apply unless concrete-surface and air temperatures are above 40 deg F and will remain so for at least 48 hours after completion of Work.

C. Hot-Weather Requirements for Cementitious Materials: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from patching materials. Do not apply to substrates with temperatures of 90 deg F and above.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: For repair products, obtain each type of product from single source and single manufacturer with resources to provide products of consistent quality in appearance and physical properties.

2.2 BONDING AGENT

A. Epoxy Bonding Agent: ASTM C881, Type II or Type V bonding system, and free of VOC's.

B. Mortar Scrub Coat: Mix consisting of 1-part Portland cement and 1-part fine aggregate complying with ASTM C144 except 100 percent passing a No. 16 sieve.

2.3 PATCHING MORTAR

A. Patching Mortar Requirements:

1. Only use patching mortars that are recommended by manufacturer for each applicable horizontal, vertical, or overhead use orientation.

2. Coarse Aggregate for Patching Mortar: ASTM C33, washed aggregate, size No. 8, Class 5S. Add to patching-mortar mix only as permitted by patching-mortar manufacturer.

B. Cementitious Patching Mortar: Packaged, dry mix for repair of concrete.

1. Compressive Strength: Not less than 6000 psi at 28 days when tested according to ASTM C109.

C. Polymer-Modified, Cementitious Patching Mortar: Packaged, dry mix for repair of concrete and that contains a latex additive as either a dry powder or a separate liquid that is added during mixing.

1. Compressive Strength: Not less than 6000 psi at 28 days when tested according to ASTM C109.

D. Magnesium Phosphate Patching Mortar: Packaged, dry mix for repair of concrete.

1. Compressive Strength: Not less than 6000 psi at 28 days when tested according to ASTM C109.

2.4 EPOXY CRACK-INJECTION MATERIALS

A. Epoxy Crack-Injection Adhesive: ASTM C881, Type IV, free of VOC's.

1. Capping Adhesive: Product manufactured for use with crack-injection adhesive by same manufacturer.

2. Color: Provide epoxy crack-injection adhesive and capping adhesive that blend with existing, adjacent concrete and do not stain concrete surface.

2.5 MISCELLANEOUS MATERIALS

A. Portland Cement: ASTM C150, Type II.

B. Water: Potable.

2.6 MIXES

A. General: Mix products, in clean containers, according to manufacturer's written instructions.

1. Do not add water, thinners, or additives unless recommended by manufacturer.

2. When practical, use manufacturer's premeasured packages to ensure that materials are mixed in proper proportions. When premeasured packages are not used, measure ingredients using graduated measuring containers; do not estimate quantities or use shovel or trowel as unit of measure.

3. Do not mix more materials than can be used within the time limits recommended by manufacturer. Discard materials that have begun to set.

B. Mortar Scrub Coat: Mix dry ingredients with enough water to provide consistency of thick cream.

C. Concrete: Comply with Section 03 30 00 “Cast-in-Place Concrete.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Notify City Representative seven days in advance of dates when areas of deteriorated or delaminated concrete and deteriorated reinforcing bars will be located.

B. Locate areas of deteriorated or delaminated concrete using hammer or chain-drag sounding and mark boundaries. Mark areas for removal by simplifying and squaring off boundaries.

C. Perform surveys as the work progresses to detect hazards resulting from concrete-maintenance work.

3.2 PREPARATION

A. Comply with manufacturer’s written instructions for surface preparation and product application.

B. Protect persons, motor vehicles, surrounding surfaces of bridge being repaired, bridge site, and surrounding facilities from harm resulting from concrete maintenance work.

1. Comply with each product manufacturer’s written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and property.

2. Use only proven protection methods appropriate to each area and surface being protected.

3. Provide temporary barricades, barriers, and directional signage to exclude public from areas where concrete maintenance work is being performed.

4. Contain dust and debris generated by concrete maintenance work and prevent it from reaching the public or adjacent surfaces.

5. Dispose of debris from operations by legal means.

C. Preparation for Concrete Removal: Examine construction to be repaired to determine best methods for safely and effectively performing concrete maintenance work. Examine adjacent work to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed during repair.

D. Reinforcing Bar Preparation: Remove loose and flaking rust from exposed reinforcing bars by needle scaling or wire brushing until only tightly adhered light rust remains.

1. Where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars, cut bars and remove and replace as indicated on Drawings.

2. Remove additional concrete as necessary to provide at least ¾ inch clearance at existing and replacement bars.

3. Splice replacement bars to existing bars according to ACI 318 by lapping or using mechanical couplings.

3.3 CONCRETE REMOVAL

A. Saw-cut perimeter of areas indicated for removal to a depth of at least ½ inch. Make cuts perpendicular to concrete surfaces and no deeper than cover on reinforcement.

B. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.

C. Remove additional concrete as necessary to provide a depth of removal of at least ½ inch over entire removal area.

D. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken, or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least ¾ inch clearance around bar.

E. Test areas where concrete has been removed by tapping with hammer. Remove additional concrete until unsound and disbanded concrete is completely removed.

F. Provide surfaces with a fractured profile of at least 1/8 inch that are approximately perpendicular or parallel to original concrete surfaces.

G. Thoroughly clean removal areas of loose concrete, dust, and debris.

3.4 PATCHING MORTAR APPLICATION

A. Place patching mortar as specified in this article unless otherwise recommended in writing by manufacturer.

1. Provide forms where necessary to confine patch to required shape.

2. Wet substrate and forms thoroughly and then remove standing water.

B. Pretreatment: Apply any manufacturer specified bonding agent, mortar scrub coat, or slurry coat according to manufacturer’s written instructions.

C. General Placement: Place patching mortar by troweling toward edges of patch to force intimate contact with edge surfaces. For large patches, fill edges first and then work toward center, always troweling toward edge of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.

D. Consolidation: After each lift is placed, consolidate material and screed surface.

E. Multiple Lifts: Where multiple lifts are used, score surface of lifts to provide a rough surface for placing subsequent lifts. Allow each lift to reach initial set before placing subsequent lifts.

F. Finishing: Allow surfaces of lifts that are to remain exposed to become firm and then finish to a smooth surface with a wood or sponge float.

G. Curing: Moist-cure cementitious patching materials, including polymer-modified cementitious patching materials, with wet burlap and polyethylene, a fine mist of water, or a water based compatible curing compound in accordance with ASTM C309.

3.5 EPOXY CRACK INJECTION

A. Clean cracks with oil-free compressed air or low-pressure water to remove loose particles.

B. Clean areas to receive capping adhesive of oil, dirt, paint and other substances that would interfere with bond.

C. Place injection ports as recommended by epoxy manufacturer, spacing no further apart than thickness of member being injected. Seal injection ports in place with capping adhesive.

D. Seal cracks at exposed surfaces with a ribbon of capping adhesive at least ¼ inch thick by 1 inch wider than crack.

E. Inject epoxy adhesive, beginning at widest part of crack and working toward narrower parts. Inject adhesive into ports to refusal, capping adjacent ports when they extrude epoxy. Cap injected ports and inject through adjacent ports until crack is filled.

F. After epoxy adhesive has set, remove injection ports and grind surfaces smooth.

3.6 FIELD QUALITY CONTROL

A. Contractor shall provide quality control of concrete maintenance work to ensure conformance with construction documents.

3.7 QUALITY ASSURANCE

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Packaged, Cementitious Patching Mortar: Three randomly selected sets of samples for each type of mortar required, tested according to ASTM C928.

2. Concrete as specified in Section 03 30 00 “Cast-in-Place Concrete.”

3. Epoxy Crack Injection: Core-drilled samples to verify proper installation. Test one sample for each 100 feet of crack injected. Where samples are taken, refill holes with epoxy mortar.

C. Product will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports and submit to City Representative.

3.8 CLEAN-UP

A. Remove from site all debris resulting from the work of this section.

B. Where cleaning is required, take care not to damage surrounding surfaces or leave residue from cleaning agents.

END OF SECTION