

SECTION 030130 - MAINTENANCE OF CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. This specification describes vertical or diagonal crack or joint chemical grout injection at foundation wall using the following systems:
 - 1. Non-structural cracks: Hydrophilic Polyurethane Chemical Grout (HPCG).
 - 2. Structural cracks: Liquid Epoxy Adhesive
- B. Industry Standards:
 - ASTM (American Society for Testing and Materials)

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Environmental Product Declaration for each type of product.
- B. Samples: Cured Samples for each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Product test reports.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Concrete-Maintenance Specialist Qualifications: Engage an experienced concrete-maintenance firm that employs installers and supervisors who are trained and approved by manufacturer to apply [**packaged patching-mortar**] [**crack-injection adhesive**] [**corrosion-inhibiting treatments**] [**and**] [**polymer sealers**] <Insert product> to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing or patching new concrete is insufficient experience for concrete-maintenance work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 BONDING AGENTS

- A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Manufactured product that consists of water-insensitive epoxy adhesive, Portland cement, and water-based solution of corrosion-inhibiting chemicals that forms a protective film on steel reinforcement.
- B. Epoxy Bonding Agent: ASTM C881, bonding system [**Type II**] [**Type V**] and free of VOCs.
- C. Latex Bonding Agent, Re-dispersible: ASTM C1059, Type I [**for use at nonstructural and interior locations unless otherwise indicated**].
- D. Latex Bonding Agent, Non-Re-dispersible: ASTM C1059 Type II for use at structural and exterior locations [**and where indicated on Drawings**] [**and where indicated by Design-Professional-of-Record**] [**and where directed by HPD**].

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. Color and Aggregate Texture: Provide patching mortar and aggregates of colors and sizes necessary to produce patching mortar [**where indicated**] that matches existing, adjacent, exposed concrete. Blend several aggregates, if necessary, to achieve suitable matches.
 - 3. 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 [**4000 psi**] [**5000 psi**] [**6000 psi**] <Insert value> at [**28 days**] <Insert time> when tested according to ASTM C109.
- C. Rapid-Strengthening, Cementitious Patching Mortar: Packaged, dry mix [, **ASTM C928**] for repair of concrete.
 - 1. Compressive Strength: Not less than [**1000 psi**] [**2000 psi**] [**3000 psi**] [**4000 psi**] <Insert value> within [**three**] <Insert number> hours when tested according to ASTM C109.
- D. Polymer-Modified, Cementitious Patching Mortar: Packaged, dry mix for repair of concrete and that contains a [**non-re-dispersible**] latex additive as either a dry powder or a separate liquid that is added during mixing.

1. Compressive Strength: Not less than [4000 psi] [5000 psi] [6000 psi] <Insert value> at [28 days] <Insert time> when tested according to ASTM C109.

- E. Polymer-Modified, Silica-Fume-Enhanced, Cementitious Patching Mortar: Packaged, dry mix for repair of concrete and that contains silica fume complying with ASTM C1240 and a [non-re-dispersible] latex additive as either a dry powder or a separate liquid that is added during mixing.

1. Compressive Strength: Not less than [4000 psi] [5000 psi] [6000 psi] <Insert value> at [28 days] <Insert time> when tested according to ASTM C109.

2.4 JOINT FILLER

- A. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A Shore durometer hardness of at least 80 according to ASTM D2240.
- B. Polyurea Joint Filler: Two-component, semirigid, 100 percent solids, polyurea resin with a Type A Shore durometer hardness of at least 80 according to ASTM D2240.
- C. Color: [Match existing joint filler] As selected by [Design-Professional-of-Record] [Owner] [HPD] from full range of industry colors.

2.5 EPOXY CRACK-INJECTION MATERIALS

- A. Epoxy Crack-Injection Adhesive: ASTM C881, bonding system [Type I,] [Type IV,] [Type IV at structural locations and where indicated, Type I at other locations;] free of VOCs.
 1. Capping Adhesive: Product manufactured for use with crack-injection adhesive by same manufacturer.

2.6 CORROSION-INHIBITING MATERIALS

- A. Corrosion-Inhibiting Treatment: Waterborne solution of alkaline corrosion-inhibiting chemicals for concrete-surface application that penetrates concrete by diffusion and forms a protective film on steel reinforcement.

2.7 POLYMER-SEALER MATERIALS

- A. Epoxy Polymer Sealer: Low-viscosity epoxy, penetrating sealer and crack filler recommended by manufacturer for penetrating and sealing cracks in exterior concrete traffic surfaces; [free of VOCs] [VOC content 100 g/L or less] [VOC content 400 g/L or less].
 1. Color: As selected by [Design-Professional-of-Record] [Owner] [HPD] from full range of industry colors.
- B. Methacrylate Polymer Sealer: Low-viscosity, high-molecular-weight methacrylate, penetrating sealer and crack filler recommended by manufacturer for penetrating and sealing cracks in exterior concrete traffic surfaces; [free of VOCs] [VOC content 100 g/L or less] [VOC content 400 g/L or less].
 1. Color: As selected by [Design-Professional-of-Record] [Owner] [HPD] from full range of industry colors.

2.8 MISCELLANEOUS MATERIALS

- A. Portland Cement: ASTM C150, Type I, II, or III unless otherwise indicated.
- B. Water: Potable.

2.9 MIXES

- A. General: Mix products, in clean containers, according to manufacturer's written instructions.
- B. Dry-Pack Mortar: Mix required type(s) of patching-mortar dry ingredients with just enough liquid to form damp cohesive mixture that can be squeezed by hand into a ball but is not plastic.

PART 3 - EXECUTION

3.1 CONCRETE MAINTENANCE

- A. Have concrete-maintenance work performed only by qualified concrete-maintenance specialist.
- B. Comply with manufacturers' written instructions for surface preparation and product application.

3.2 EXAMINATION

- A. Notify [**Design-Professional-of-Record**] [**HPD**] 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. At columns and walls make boundaries level and plumb unless otherwise indicated.
- C. Pachometer Testing: Locate at least three reinforcing bars using a pachometer, and drill test holes to determine depth of cover. Calibrate pachometer using depth of cover measurements, and verify depth of cover in removal areas using pachometer.
- D. Perform surveys as the Work progresses to detect hazards resulting from concrete-maintenance work.

3.3 PREPARATION

- A. Ensure that supervisory personnel are on-site and on duty when concrete maintenance work begins and during its progress.
- B. Protect persons, motor vehicles, surrounding surfaces of building being repaired, building site, plants, and surrounding buildings from harm resulting from concrete maintenance work.
 - 1. Comply with each product manufacturer's written instructions for protections and precautions.
 - 2. Contain dust and debris generated by concrete maintenance work and prevent it from reaching the public or adjacent surfaces.

3. Protect floors and other surfaces along haul routes from damage, wear, and staining.
 4. Provide supplemental sound-control treatment to isolate removal and dismantling work from other areas of the building.
 5. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.
- C. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is in working order.
1. Prevent solids such as aggregate or mortar residue from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from concrete maintenance work.
 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- D. Preparation for Concrete Removal: Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed in the course of repair.
1. Verify that affected utilities have been disconnected and capped.
 2. Provide and maintain shoring, bracing, and temporary structural supports as required to preserve stability and prevent unexpected or uncontrolled movement, settlement, or collapse of construction being demolished and construction and finishes to remain. Strengthen or add new supports when required during progress of removal work.
- E. Reinforcing-Bar Preparation: Remove loose and flaking rust from exposed reinforcing bars by **[high-pressure water cleaning]** **[abrasive blast cleaning]** **[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]** as directed by **[Design-Professional-of-Record]** **[HPD]**.
 2. Remove additional concrete as necessary to provide at least 3/4-inch clearance at existing and replacement bars.
 3. Splice replacement bars to existing bars according to ACI 318 by lapping, welding, or using mechanical couplings.
- F. Preparation of Floor Joints for Repair: Saw-cut joints full width to edges and depth of spalls, but not less than **[3/4 inch]** **[1 inch]** **[2 inches]** **<Insert dimension>** deep. Clean out debris and loose concrete; vacuum or blow clear with compressed air.
- 3.4 REMOVAL OF CONCRETE
- A. Do not overload structural elements with debris.
 - B. Saw-cut perimeter of areas indicated for removal to a depth of at least **[1/2 inch]** **<Insert dimension>**. Make cuts perpendicular to concrete surfaces and no deeper than cover on reinforcement.

- C. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.
- D. Remove additional concrete, if necessary, to provide a depth of removal of at least **[1/2 inch]** <Insert dimension> over entire removal area.
- E. 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 3/4-inch clearance around bar.
- F. Test areas where concrete has been removed by tapping with hammer, and remove additional concrete until unsound and disbonded concrete is completely removed.
- G. Provide surfaces with a fractured profile of at least 1/8 inch that are approximately perpendicular or parallel to original concrete surfaces. At columns and walls, make top and bottom surfaces level unless otherwise directed.
- H. Thoroughly clean removal areas of loose concrete, dust, and debris.

3.5 APPLICATION OF BONDING AGENT

- A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Apply to reinforcing bars **[and concrete]** . Apply to reinforcing bars in two coats, allowing first coat to dry two to three hours before applying second coat. Allow to dry before placing patching mortar.
- B. Epoxy Bonding Agent: Apply to reinforcing bars **[and concrete]**, leaving no pinholes or other uncoated areas. **[Apply to reinforcing bars in at least two coats, allowing first coat to dry before applying second coat.]** Place patching mortar while epoxy is still tacky. If epoxy dries, recoat before placing patching mortar.
- C. Latex Bonding Agent, Type I: Apply to concrete by brush roller or spray. Allow to dry before placing patching mortar.
- D. Latex Bonding Agent, Type II: Mix with Portland cement and scrub into concrete surface. Place patching mortar while bonding agent is still wet. If bonding agent dries, recoat before placing patching mortar.
- E. Slurry Coat for Cementitious Patching Mortar: Wet substrate thoroughly and then remove standing water. Scrub a slurry of neat patching mortar **[mixed with latex bonding agent]** into substrate, filling pores and voids.

3.6 INSTALLATION OF PATCHING MORTAR

- A. Place patching mortar as specified in this article unless otherwise recommended in writing by manufacturer **[or where dry-pack mortar is indicated]**.
 - 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 specified **[bonding agent]** **[slurry coat]** **[bonding agent and slurry coat]** <Insert requirement>.

- 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 edges of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.
- D. Vertical Patching: Place material in lifts of not more than thickness recommended by manufacturer. Do not feather edge.
- E. Overhead Patching: Place material in lifts of not more than thickness recommended by manufacturer. Do not feather edge.
- F. Consolidation: After each lift is placed, consolidate material and screed surface.
- G. 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 final set before placing subsequent lifts.
- H. 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] [rough surface with a broom or burlap drag] [surface matching adjacent concrete]** <Insert requirement>.
- I. Curing: Wet-cure cementitious patching materials, including polymer-modified cementitious patching materials, for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.7 INSTALLATION OF DRY-PACK-MORTAR

- A. Use dry-pack mortar for deep cavities **[and where indicated]**. Place 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 specified **[bonding agent] [mortar scrub coat] [slurry coat] [bonding agent and slurry coat]** <Insert requirement>.
- C. Place dry-pack mortar into cavity by hand, and compact tightly into place. Do not place more material at a time than can be properly compacted. Continue placing and compacting until patch is approximately level with surrounding surface.
- D. After cavity is filled and patch is compacted, trowel surface to match profile and finish of surrounding concrete.
- E. Wet-cure patch for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.8 FLOOR-JOINT REPAIR

- A. Cut out deteriorated concrete **[and reconstruct sides of joint with patching mortar]** **[as indicated on Drawings]** as directed by **[Design-Professional-of-Record] [HPD]**. Install joint filler in nonmoving floor joints where indicated and as specified in this article.

- B. Depth: Install joint filler to a depth of at least [**3/4 inch**] [**1 inch**] [**2 inches**] <Insert dimension>. Use fine silica sand no more than 1/4 inch deep to close base of joint. Do not use sealant backer rods or compressible fillers below joint filler.
- C. Top Surface: Install joint filler so that when cured, it is flush at top surface of adjacent concrete. If necessary, overfill joint and remove excess when filler has cured.

3.9 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, and other substances that would interfere with bond.
- C. Place injection ports as recommended by epoxy manufacturer, spacing no farther 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 1/4 inch thick by 1 inch wider than crack.
- E. Inject cracks wider than 0.003 inch to a depth of 8 inches.
- F. 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.
- G. After epoxy adhesive has set, remove injection ports and grind surfaces smooth.

3.10 APPLICATION OF CORROSION-INHIBITING-TREATMENT

- A. Apply corrosion-inhibiting treatment to [**surfaces indicated on Drawings, from wall-to-wall or curb-to-curb and from joint-to-joint in the perpendicular direction**] <Insert locations and extent where treatment shall be applied>.
- B. Apply by brush, roller, or airless spray in two coats at manufacturer's recommended application rate. Remove film of excess treatment before patching treated concrete [**or applying a sealer**].

3.11 APPLICATION OF POLYMER SEALER

- A. Apply polymer sealer by brush, roller, or airless spray at manufacturer's recommended application rate.
- B. Apply to traffic-bearing surfaces, including parking areas and walks.

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

- B. Perform the following tests and inspections:
1. Packaged, Cementitious Patching Mortar: **<Insert number>** randomly selected sets of samples for each type of mortar required, tested according to ASTM C928.
 2. Joint Filler: Core-drilled samples to verify proper installation.
 - a. Testing Frequency: One sample for each 100 feet of joint filled.
 - b. Where samples are taken, refill holes with joint filler.
 3. Epoxy Crack Injection: Core-drilled samples to verify proper installation.
 - a. Testing Frequency: [**Three samples from mockup and**]one sample for each 100 feet of crack injected.
 - b. 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.

END OF SECTION 030130