

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of existing concrete surfaces.
- B. Repair of exposed structural, shrinkage, and settlement cracks.
- C. Resurfacing of concrete surfaces having spalled areas and other damage.
- D. Repair of deteriorated concrete.
- E. Repair of internal concrete reinforcement.
- F. Scope of Work: As indicated on the Drawings.

1.02 REFERENCE STANDARDS

- A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2013.
- B. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2013.
- C. ASTM C928/C928M - Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Material for Concrete Repairs; 2009.
- D. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; American Welding Society; 2011.

1.03 SUBMITTALS

- A. Product Data: Indicate product standards, physical and chemical characteristics, Technical Specifications, limitations, maintenance instructions, installation guidelines, testing reports, and general recommendations regarding each material.
- B. Qualification Statements.
- C. Project Record Documents: Accurately record actual locations of structural reinforcement repairs and type of repair.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section, with not less than ten (10) years of documented experience.
- B. Installer Qualifications: Company specializing in performing Work of the type specified and with minimum of five (5) years of experience.
- C. Use adequate numbers of skilled workmen thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the Work of this Section.
- D. All Work shall be subject to acceptance by the Owner's Representative. All Work that does not comply with the intent of the Specifications shall be corrected by the Contractor.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Manufacturers' instructions for storage, shelf life limitations, and handling of products.

1.06 REGULATORY REQUIREMENTS (maybe add this language?)

- A. Conform to applicable Federal, State, and local regulatory requirements including flame and smoke rating requirements for finishes.
- B. Flammable Liquids serve all current regulation regarding flammable liquids such as posting "No Smoking" signs. Allow no open flames, welding, or other ignition sources in the Work.
- C. Conform to all applicable laws, codes, and regulations for disposal of all materials, debris, and containers.
- D. Materials shall be VOC Compliant.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply when air and substrate temperatures and weather conditions are outside limits permitted by Manufacturer.
- B. Cold-Weather Requirements for Cementitious Materials: Do not apply unless air temperature is between 40 and 90 deg F and will remain so for at least forty-eight (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. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply to substrates with temperatures of 90 deg F and above.

1.09 WARRANTY

- A. General: The warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Installer's Warranty: Installer's standard written form in which Installer agrees to repair or replace Work that does not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Provide written warranty from the Manufacturer against defects of materials for a period of three (3) year.
- C. Manufacturer's Warranty: Written warranty, signed by Manufacturer agreeing to repair or replace products that do not comply with requirements within specified warranty period.
  - 1. Provide written warranty from Manufacturer against defects of materials for a period of five (5) years.

PART 2 - PRODUCTS

2.01 CLEANING MATERIALS

- A. Detergent: Non-ionic detergent.
- B. Blasting Medium: Water.

2.02 CEMENTITIOUS PATCHING AND REPAIR MATERIALS

- A. Cementitious Repair Mortar, Trowel Grade: One- or two-component, factory-mixed, polymer-modified cementitious mortar.

Products:

- 1. SikaTop 123 PLUS by Sika Corporation.
- 2. Master Emaco S 488 CI (patching material), Masterkure 200W (curing compound) by Master Builder Solutions.

- B. Cementitious Repair Mortar, Form and Pour/Pump Grade: Flowable, one- or two-component, factory-mixed, polymer-modified cementitious mortar; in-place material resistant to freeze/thaw conditions.

Products:

- 1. SikaTop 111 PLUS by Sika Corporation, with aggregate as required per the Manufacturer's recommendations.
- 2. MasterEmaco S 466 CI (patching material), Masterkure 200W (curing compound), and MasterEmaco P 124 (rebar coating) by Master Builder Solutions.

- C. Bonding Agent/Anti-Corrosion Protective Coating for all exposed steel and surfaces to receive repair mortar:

Products:

- 1. Sika Armatec 110 EpoCem by Sika Corporation.
- 2. Master Emaco P 124 by Master Builder Solutions.

- D. Reinforcing Dowels/Bolts Injection:

Products:

- 1. Sikadur Anchor Fix 1 or Sikadur Anchor Fix 2 by Sika Corporation.
- 2. MasterEmaco ADH1420 by Master Builder Technologies.

2.03 EPOXY INJECTION AND REPAIR MATERIALS

- A. Epoxy Bonding Adhesive: Non-sag, two-part, one hundred percent (100%) solids; recommended by Manufacturer for purpose and conditions under which used.

- 1. Non-Load-Bearing Applications: ASTM C881/C881M Type I, II, IV, or V; whichever is appropriate to application.

- B. Epoxy Resin for Crack Injection: Two-part epoxy adhesive conforming to ASTM C-881 and AASHTO M-235, suitable for low pressure (below 20 psi) injection, extended pot life, meeting the following minimum characteristics:

1. Characteristic	Test Method	Results
Bond Strength	ANSI/ASTM C882	2,400 psi @ 2 days
Tensile Strength	ASTM D638	6,700 psi @ 14 days
Elongation (at 7 days at 70 deg.F)	ASTM D638	Three percent (3%)
Compressive Strength	ASTM D695	7,500 psi @ 1 day

2. Products:

- Sika Corporation: Injection material for medium cracks: Sikadur 35, and Injection material for fine cracks: Sikadur 52. Cap seal to set prior to injecting material: Sikadur 31.
- Simpson Strong Tie Corporation; Crack-Pac: [www.simpsonstrongtie.com](http://www.simpsonstrongtie.com).
- Or approved equal.

- C. Surface/Crack Filler: Factory-formulated surface/crack fillers compatible with substrate and finish-coat materials indicated.

1. Products:

- Sikadur Crack Fix; Low-viscosity, high strength epoxy sealing system.
- Simpson Strong Tie Corporation; ETI-LV: [www.simpsonstrongtie.com](http://www.simpsonstrongtie.com).
- Or approved equal.

- D. Surface/Crack Filler With Polyurethane Vehicular Traffic Coating: Factory-formulated surface/crack fillers compatible with substrate and finish-coat materials indicated.

1. Products:

- LymTal; Iso – Flex 888 QC: [www.lymtal.com](http://www.lymtal.com).
- Neogard Division of Jones-Blair Company; 70995: [www.neogard.com](http://www.neogard.com)
- Sika; Sikaflex-2c NS: [www.usa.sika.com](http://www.usa.sika.com)
- or approved equal.

## 2.04 ANCILLARY MATERIALS

- A. Reinforcing Steel: ASTM A615/A615M Grade 60 (60,000 psi) (420 MPa) billet-steel deformed bars, unfinished.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify that surfaces are ready to receive Work.
- B. Beginning of installation means acceptance of substrate by Contractor.

### 3.02 CLEANING EXISTING CONCRETE

- A. Clean concrete surfaces of dirt or other contamination using the gentlest method that is effective.
  - 1. Try the gentlest method first, then, if not clean enough, use a less gentle method, taking care to watch for impending damage.
  - 2. Clean out cracks and voids using same methods.
- B. The following are acceptable cleaning methods, in order from gentlest to less gentle:
  - 1. Water washing using low-pressure, maximum of 100 psi, and, if necessary, use brushes with natural or synthetic bristles.
  - 2. Increasing the water washing pressure to maximum of 400 psi.
  - 3. Adding detergent to washing water; with final water rinse to remove residual detergent.
  - 4. Steam-generated low-pressure hot-water washing.
  - 5. Abrasive blasting: Use only abrasive media that have been proven not to damage concrete by testing on mock-up.

### 3.03 CONCRETE RESTORATION: SPALLS REPAIR

- A. Concrete Spalls Without Exposed Rebar:
  - 1. Mechanically prepare spalled area to remove loose and deteriorated concrete and chip a new fractured aggregate surface. Saw cut perimeter to 1/4-inch minimum depth.
  - 2. If the reinforcing bar is corroded, and/or concrete is deteriorated, and/or oxidation residue is found on the concrete, perform concrete spall repair as stated in Article 3.03 Subparagraph B and Architectural Drawings for repair instructions.
  - 3. Install dowels if the patch is deeper than 2 inches for vertical surface and horizontal surface. See Article 3.03 Subparagraph D and Architectural Drawings for repair instructions.
  - 4. Use clean water to saturate the concrete surface and flush away dust and loose material. Apply concrete bonding agent. Mix and place the patching material in strict accordance with the Manufacturer's directions. The concrete substrate must be surface saturated with no standing water and the patching mix scrubbed into the substrate, filling pores and voids. Fill the entire area, force material against the saw cut perimeter edge, consolidate, and screed flush with perimeter surfaces.
  - 5. Install the repair material in multiple lifts not less than 1/8-inch thick or more than 1-1/2 inches thick.

6. Before material sets completely, provide new concrete patch to match original profiles, adjacent surface texture and free of irregularities or changes in plane.

B. Concrete Spalls with Exposed Rebar:

1. Mechanically prepare spalled area to remove loose and deteriorated concrete and chip a new fractured aggregate surface. Saw cut perimeter to 1/4-inch minimum depth.
2. If the reinforcing bar is corroded, and/or half the diameter of a reinforcing bar in the spalled area is exposed, and/or concrete is deteriorated, and/or oxidation residue is found on the concrete, chip concrete away from exposed bar to provide 1/2-inch clearance behind the bar or until sound concrete is found. Perform the following:
  - a. Clean the exposed reinforcement bar with a wire brush to provide a surface free of corrosion. Verify the remaining reinforcing bar diameter.
  - b. If the reinforcing bar has lost less than or equal to ten percent (10%) original bar diameter due to corrosion:
    - i. Clean bar, and immediately apply a coat of anti-corrosion protective coating with 40 mils dry film thickness (DFT) that fully covers the bar surface and allow to dry before applying patch.
  - c. If the exposed reinforcement bar has corroded to the extent that it is no longer a contiguous bar through the spall area or the section is reduced by more than ten percent (10%) of the original bar diameter due to corrosion:
    - i. Chip away concrete for required splice length. Remove corroded reinforcing bar and replace with new steel threaded rod. Refer to Architectural Drawings for the bar size and splice length requirements.
    - ii. Weld new reinforcing bar to bottom/behind the existing sound reinforcing bar.
    - iii. Clean bar, and immediately apply a coat of anti-corrosion protective coating with 40 mils dry film thickness (DFT) that fully covers the bar surface and allow to dry before applying patch.
3. Install dowels if the patch is deeper than 2 inches for vertical surface and horizontal surface. See Article 3.03 Subparagraph D and Architectural Drawings for repair instructions.
4. Use clean water to saturate the concrete surface and flush away dust and loose material. Apply concrete bonding agent. Mix and place the patching material in strict accordance with the Manufacturer's directions. The concrete substrate must be surface saturated with no standing water and the patching mix scrubbed into the substrate, filling pores and voids. Fill the entire area, force material against the saw cut perimeter edge, consolidate, and screed flush with perimeter surfaces.
5. Install the repair material in multiple lifts not less than 1/8 inch thick or more than 1-1/2 inches thick.
6. Before material sets completely, provide new concrete patch to match original profiles, adjacent surface texture and free of irregularities or changes in plane.

C. Concrete Patching by Form and Pump Method:

1. Design and construct forms to resist pumping pressure in addition to weight of wet concrete. Seal joints and seams in forms and junctions of forms with existing concrete.
2. Mechanically prepare spalled area to remove loose and deteriorated concrete and chip a new fractured aggregate surface. Saw cut perimeter to 1/4-inch minimum depth.
3. If the reinforcing bar is corroded, and/or concrete is deteriorated, and/or oxidation residue is found on the concrete, see Article 3.03 Subparagraph B.2 and Architectural Drawings for repair instructions.
4. Install dowels if the patch is deeper than 2 inches for vertical surface and horizontal surface. See Article 3.03 Subparagraph D and Architectural Drawings for repair instructions.
5. Use clean water to saturate the concrete surface and flush away dust and loose material. Mix and place the patching material in strict accordance with the Manufacturer's directions. The concrete substrate must be surface saturated with no standing water and the patching mix scrubbed into the substrate, filling pores and voids. Fill the entire area, force material against the saw cut perimeter edge, consolidate, and screed flush with perimeter surfaces.
6. Pump concrete into place, releasing air from forms as concrete is introduced. When formed space is full, close air vents and pressurize to 14 psi.
7. Wet-cure concrete for not less than seven (7) days by leaving forms in place or keeping surfaces continuously wet by water-fog spray or water-saturated absorptive cover.
8. Fill placement cavities and repair voids with patching mortar.
9. Before material sets completely, provide new concrete patch to match original profiles, adjacent surface texture and free of irregularities or changes in plane.

D. Epoxy Grouting of Dowels:

1. Epoxy grouting will be used in locations where either all-thread rod or rebar (dowel) is embedded into existing concrete.
2. In concrete, holes shall be drilled with rotary hammer. Size shall be 1/8 inch in diameter larger than rod or bar size. Immediately before applying epoxy grout, holes shall be reamed with a circular wire brush attached to a drill motor and then blown out with oil-free compressed air.
3. Epoxy grout for downward holes may either be non-sag or liquid type, normal set. Horizontal or overhead holes shall be non-sag type, normal set. Liquid epoxy shall be poured or injected slowly as per Manufacturer's inspection into the hole to avoid trapped air. Non-sag to reach the bottom of the hole. In both types the hole should be filled approximately half (1/2) full.
4. Rod or bar shall be slowly inserted and turned a minimum of one rotation. Do not pull up and down or dowel when installing, remove any epoxy grout around hole before it has set.
5. Install one dowel for every square foot. For linear spalls less than 12-inches in length, install dowel in the center of the spall. For linear spalls more than 12-inches in length, install dowels 12-inches O.C. Place bolts at least 3 inches from spall perimeter.

### 3.04 CONCRETE RESTORATION: CRACK REPAIR

#### A. Deck Surfaces:

##### 1. Surface Cracks

##### a. For Dynamic Cracks – Shall be identified by the Architect

- i. Rout out cracks to 1/4-inch wide and 1/4-inch deep groove in concrete substrate. Clean routed cracks and surrounding area removing dust, dirt, loose materials, foreign matter, and other impurities that might impair adhesion of sealant.
- ii. Install bond breaker tape at the base of the routed groove.
- iii. Fill routed joint with polyurethane sealant to be approved by Architect. Tool and allow sealant to cure. Provide sealant free of air pockets, foreign embedded matter, ridges, and sags within recommended application temperature ranges. Forced well into cracks using a brush, putty knife, or trowel. Allow for sealant shrinkage when applying. Smooth sealant surface flat and flushed with adjacent surfaces. Ensure no concave or convex surface of sealant after sealant is cured.
- iv. If surface of sealant appears concave, apply more sealant at the depression and tool surface to flush with adjacent surfaces.
- v. After sealant is cured, retexture surface to match texture of adjacent surfaces and free of irregularities or changes in plane and apply elastomeric coating.
- vi. Perform adhesion pull test.

##### b. Static Cracks:

- i. With Polyurethane Vehicular Traffic Coating: Repair hairline cracks up to less than 1/16 inch wide as follows:
  - a) Remove dust, dirt, loose materials, foreign matter, and other impurities that might impair adhesion of coating. Remove mildew by sterilizing before filling. Clean surface around cracks.
  - b) Apply polyurethane vehicular traffic coating of minimum 30 mils thickness, 4-inches wide centered over crack. If shrinkage occurs after initial application, apply additional polyurethane vehicular traffic coating to cracks.
- ii. With Polyurethane Vehicular Traffic Coating and Polyurethane Sealant: Repair cracks equal to or greater than 1/16-inch wide up to less than 1-inch wide as follows:
  - a) Remove dust, dirt, loose materials, foreign matter, and other impurities that might impair adhesion of coating. Remove mildew by sterilizing before filling. Clean surface around cracks.
  - b) Rout crack with polyurethane sealant to be approved by Architect and allow to cure. Apply polyurethane vehicular traffic coating of minimum 30 mils thickness, 4-inches wide centered over crack. If shrinkage occurs after initial application, apply additional polyurethane vehicular traffic coating to cracks.



iii. With Polyurethane Vehicular Traffic Coating and Polyurethane Sealant: Repair cracks equal to or greater than 1-inch wide as follows:

- a) Crack should be treated as an expansion joint. Remove dust, dirt, loose materials, foreign matter, and other impurities that might impair adhesion of coating. Remove mildew by sterilizing before filling. Clean surface around cracks.
- b) Seal crack with polyurethane sealant to be approved by Architect and allow to cure.

2. Through Cracks:

- a. Remove dust, dirt, loose materials, foreign matter, and other impurities from and around cracks.
- b. Mix epoxy resin adhesive to be approved by Architect and set porting devices as specified by the epoxy material manufacturer. Spacing of the porting should not exceed the thickness of the substrate.
- c. Seal cracks with the mixed epoxy resin adhesive, either manually or using injection equipment over the cracks and around each porting device to provide adequate seal (minimum of 1-inch wide and 1/4-inch thick) to prevent the escape of the epoxy resin adhesive for the injection grouting.
- d. Allow the epoxy resin adhesive cap seal to set before injection. Minimize defacing or discoloration of the concrete substrate.
- e. Inject epoxy resin using the manual method or automated injection equipment as specified by the Manufacturer.
- f. After the epoxy resin has cured, remove the ports and seal to produce a finish appearance to match adjacent surfaces. Ensure no concave or convex surface after curing.

B. Concrete Walls Through and Surface Cracks:

1. Remove dust, dirt, loose materials, foreign matter, and other impurities from and around cracks.
2. Mix epoxy resin adhesive to be approved by Architect and set porting devices as specified by the epoxy material manufacturer. Spacing of the porting should not exceed the thickness of the substrate.
3. Seal cracks with the mixed epoxy resin adhesive, either manually or using injection equipment over the cracks and around each porting device to provide adequate seal (minimum of 1-inch wide and 1/4 inch thick) to prevent the escape of the epoxy resin adhesive for the injection grouting.
4. Allow the epoxy resin adhesive cap seal to set before injection. Minimize defacing or discoloration of the concrete substrate.
5. Inject epoxy resin using the manual method or automated injection equipment as specified by the Manufacturer.

6. After the epoxy resin has cured, remove the ports and seal to produce a finish appearance to match adjacent surfaces. Ensure no concave or convex surface after curing.

3.05 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field inspection and testing.

END OF SECTION 030100