DIVISION 3

SECTION 03 01 00

CONCRETE RESTORATION

PART 1 -GENERAL

1.01 SUMMARY

A. This Section includes restoration of concrete spalls and cracks, and other aesthetic and structural restorative treatments to concrete. This work includes the repair of concrete members at the locations shown on the contract drawings and as directed by the Authorities Representative.

1.02 SUBMITTALS

A. Product Data: For each product specified in Part 2 - Products.

B. Manufacturer Approved Installer Credentials: Prior to pre-installation conference, submit installer credentials issued by manufacturer of concrete restoration products.

C. Pre-construction Test Reports:

1. Concrete Spall Restoration Bond Strength Test Reports.

D. Field Quality Control Test Reports:

1. Concrete Spall Restoration Sounding Test Reports.

E. Warranty Prerequisites:

1. Sample Warranty: Prior to pre-installation conference, submit sample warranty and warranted application procedures from manufacturer.
2. Manufacturer Inspection Reports/Certifications (On-demand).

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer Qualifications: Company with minimum ten (10) years of experience in manufacturing of specified products and systems.
2. Applicator Qualifications: Company with minimum of five (5) years of experience in application of specified products and systems on projects of similar size and scope and is acceptable to product manufacturer.

B. Comply with the following, except where exceeded by the requirements in this Section:

1. ACI 224 "Cracking."
2. ACI 503 "Adhesives for Concrete."
3. **ACI 546 "Repair of Concrete."**

C. Pre-installation Conference: Prior to starting concrete restoration Work, conduct an on-site conference to review the detailed requirements of the Work.

1. Attendees shall include Contractor’s Project manager and superintendent, Engineer’s Project representative, Owner’s Project representative, manufacturer's authorized representative, manufacturer approved installer. Provide seven (7) business days advance notice to attendees.
2. Agenda shall include:
    a. Manufacturer approved installer credentials.
    b. Sample warranties and warranted application procedures.
    c. Project construction schedule.
    d. Weather conditions.
    e. Condition of substrate and preparation.
    f. Proposed equipment.
    g. Mixing procedures.
    h. Installation sequence.
    i. Quantification procedures.
    j. Curing procedures.
    k. Mockups.
    l. Tests and inspections.

1.04 TESTS AND INSPECTIONS

A. Pre-construction Testing:
    1. Concrete Spall Restoration Bond Strength Testing:
        a. Performance Models: Engineer will determine three (3) locations for each spall restoration detail, where spall restoration has occurred, to be used as performance models for field testing.
        b. Testing: Immediately following manufacturer's recommended time period for development of bond, conduct pull tests in accordance with ASTM C 1583 / ASTM C 1583M on each performance model to measure tensile and bond strength of each concrete spall restoration performance model. Arrange for Engineer and manufacturer's authorized representative to be present at testing, provide five (5) business days’ notice.
        c. Test Reports: Reports shall include date of test, location, date concrete spall restoration was installed, test method, and test results.
        d. Acceptance: Obtain Engineer's written acceptance of test reports before proceeding with the Work.
B. Field Quality Control Testing:
    1. Concrete Spall Restoration Sounding Test:
        a. Testing: Test quality of concrete spall restoration installations by sounding at locations selected in writing by Engineer.

b. Test Reports: Reports shall include date of test, locations, test method, and detailed test results and recommendations.

1.05 PROJECT CONDITIONS

A. Weather Condition Limitation: Proceed with concrete restoration Work only when existing and forecasted weather conditions will permit Work to be performed in accordance with manufacturers' recommendations and warranty requirements.

1.06 WARRANTY

A. Product Manufacturer's Warranty:
   1. Prior to starting concrete restoration work, Contractor shall submit a "letter of intent" to warranty the work, in accordance with this Warranty article, to the manufacturer, and obtain manufacturer's approval of same.
   2. Written form in which manufacturer agrees to furnish concrete restoration products and labor to repair or replace those areas of concrete restoration that do not comply with performance and other requirements specified in the Contract Documents during the warranty period.
   3. Warranty Period: Five (5) Years.

B. Manufacturer's Inspection and Certification:
   1. Coordinate inspections required by manufacturer. Provide three (3) business days' notice to manufacturer's authorized representative to inspect Work at the required milestones or intervals. No Work is to proceed until after each inspection is completed with written acceptance by manufacturer's authorized representative.
   2. Upon acceptance of completed Work by manufacturer, obtain manufacturer's certification stating that the Work complies with the requirements for Warranty.

PART 2 - PRODUCTS

2.01 COMPOSITE PATCHING COMPOUNDS

Corrosion Resistant Rebar Coating	
MasterEmaco P124	BASF
Sika Armatec 110 EpoCem	Sika
Or Approved Equal	

Bonding Agent	
MasterEmaco P124	BASF
Sikadur 32 HI-Mod	Sika
Or Approved Equal	

Note: Apply bond coat as per manufacturer's recommendations.

Concrete Repair Mortar- Crack Resistant	
MasterEmaco T 1060	BASF
[MasterEmaco T 1061-for rapid setting]	
SikaTOP 123	Sika
Or Approved Equal	

Note: Prime concrete with scrub coat, per Manufacturer's Recommendations.

Structural Concrete Repair Mortar (Troweled)	
MasterEmaco N 400 [MasterEmaco N 400 RS]	BASF
SikaTOP 123Plus (overhead and vertical repair)	Sika
SIkaTop 122Plus (horizontal repair)	
Or Approved Equal	

2.02 CONCRETE SLAB PATCHING MATERIAL

Rapid Hardening Patching Mortar	
10-60 Rapid Mortar	BASF
SikaQuick 2500	Sika Corp.
Or Approved Equal	

Protective Cementitious Coating	
SikaTop Seal 107 (polymer modified cementitious mortar)	Sika Corp.
Or Approved Equal	

2.03 CRACK INJECTION EPOXY AND PORTS

Injection Epoxy Adhesive for Hairline Cracks up to ¼"	
Master Inject 1500	BASF
Or Approved Equal	

Injection Port	
1. For Drilled Socket:	Lily Corporation
Injecti-Port I	
2. For Surface Mount:	Lily Corporation
Injecti-Port II	
3. For Surface Mount at Interior Corners:	Lily Corporation
Nestler P-380	
Or Approved Equal	

2.04 REINFORCING MATERIALS

A. Deformed Reinforcing Bar

1. Epoxy Coated , **ASTM A 775**, Grade 60, unless otherwise indicated

B. Threaded Rod

1. Stainless Steel **Type 304**, diameter as shown on details

C. Pins

1. Stainless Steel or zinc coated, ¼" dia x 2" long, Rawl Drive Pins as manufactured by Rawlplug Co. or approved equal.

2.05 ACCESSORIES

Duct Tape (3" Wide)

Duct Tape 6969 3M

Silver, 72mm Wide

Or Approved Equal

Curing Agent

MaterEmaco A400 BASF

Or Approved Equal

As recommended by the manufacturer of concrete repair material

PART 3 - EXECUTION

3.01 GENERAL

A. Comply with Section 017300 (Execution).

B. All concrete restoration work shall be sealed and coated as indicated on drawings, or as otherwise directed by Engineer.

3.02 MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS

A. Comply with manufacturer's written installation instructions and recommendations for applications indicated.

B. If written instructions are not available or do not apply to Project conditions, consult manufacturer's authorized representative for specific recommendations before proceeding with Work. Document such recommendations in detail and submit to Engineer along with Product Data.

3.03 PREPARATION

A. Comply with ICRI 310.1R-2008 "Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion"

B. Final concrete surface preparation for Concrete Repairs (before application of bonding agent):

1. After marking out the repair perimeter and removing the concrete to the extent indicated on drawings, and before applying any bonding agent, prepare the concrete substrate surfaces as follows:
   a. Follow ICRI Technical Guidelines, in compliance manufacturer's instructions for particular substrate conditions.
   b. Mechanically remove an additional 1/8" -3/8" from all concrete substrate surfaces, up to the bottom of the sawcut.
   c. Roughen sawcut surfaces to remove smooth finish.
   d. Achieve a concrete surface profile (CSP) in the range from ICRI-CSP 5 to ICRI-CSP 10, on all substrate surfaces, unless otherwise specifically indicated by manufacturer.

C. Concrete Coating Preparation: Perform surface preparation and cleaning, following ICRI Technical Guidelines, in compliance with manufacturer's instructions for particular substrate conditions.
   1. For traffic coating (e.g. balcony floors, parking decks): ICRI-CSP 6

3.03 VERTICAL AND OVERHEAD CONCRETE SURFACES RESTORATION

A. Preparation for Concrete Surface Restoration:
   1. Sound all concrete slab edges, vertical concrete surfaces, overheads and exposed spandrels with a 3 lb. dead blow hammer at approximately 2”-3” O.C.. Remove all loose material and mark areas of delamination.
   2. Saw-cut (minimum ½” deep) existing concrete, minimum 1-1/2” away from the marked perimeter of the resulting spall/delamination into sound concrete and in a configuration indicated on Drawings.
   3. Remove decayed concrete using methods least likely to damage elements to be retained or adjoining sound construction. Removal methods must not create micro-cracking in the base concrete. Temporarily cover openings when not in use.
   4. Expose embedded reinforcing steel by removing surrounding concrete with hand tools. Expose all steel reinforcing bars within 2" of the surfaces by chipping away concrete to minimum 3/4" beyond the steel reinforcing steel and into sound concrete.
   5. Clean reinforcing steel using a motor driven wire brush to remove all rust and scale.
   6. Wash the cavity with potable water
   7. Saturate the cavity with water using brush or spray bottles to prevent suction of water from the repair mortar.

      At 50° F, cavity to be saturated but surface dry (SSD) 1.5 hour prior to repair.
      At 70° F, cavity to be saturated but surface dry (SSD) 1.0 hour prior to repair.
      At 90° F, cavity to be saturated but surface dry (SSD) 0.5 hour prior to repair.
   8. Whenever the depth of spall is 2” or more, provide ¼” dia., 2” long pins in base concrete @ 6” O.C. with 1” embedment.

9. All reinforcing steel that supplements effective or damaged reinforcing steel shall be installed with a minimum clear cover of ¾" to repaired concrete surfaces and shall be prepared as required to meet the min. clearance requirement and to match adjacent concrete surfaces.

B. Installation of Modified Composite Patching Mortar (Cavity Less Than 3" Deep):
   1. Follow manufacturer's written instructions regarding storage conditions, surface preparation and protection, mixing ratio, application procedure, application time, and finishing time.
   2. Complete and finish surface of patch to match existing surface texture and profile.
   3. Avoid feathering.

C. Installation of Modified Composite Patching (Deeper Repair cavity between 3" – 4" deep)
   1. Cavity having closed spaced steel reinforcing bars greater than # 6.
      a. Use formwork and pump technique for concrete repair. Avoid trapping air during the pumping process by providing venting tubes. Provide injection ports at approximately 3' – 0" apart.
      b. Prepare pre-mixed modified cement aggregate pumping concrete and apply with pressure into the cavity as per manufacturer's instructions.
      c. On vertical surfaces start at the lowest point in the cavity filling in a manner that prevents air entrapment. Continue until the cavity is filled.
      d. At all times monitor the pressure in order to prevent displacement of the formwork.

3.04 HORIZONTAL REINFORCED CONCRETE SURFACES AND DEEP RESTORATION

A. Preparation:
   1. Sound all horizontal concrete surfaces with 3 lb. dead blow hammer at approximately 2"-3" O.C and mark areas of damaged and delaminated concrete.
   2. If the marked areas of damage at a given reinforced concrete deck were found to be substantial, plan and schedule your preparation and removal without diminishing the structural integrity of the surface.
   3. Saw cut minimum ½" deep existing concrete at distance minimum 1-1/2" away from the perimeter of the marked area of delamination into adjacent sound concrete and in a configuration shown on the Drawings.
   4. Remove all decaying and delaminated concrete using methods least likely to damage sound adjacent element to be retained. Removal methods must not create microcracking in the base concrete. Prepare surface of cavity and boundaries to prevent feathered edge conditions.
   5. Expose embedded steel reinforcing bars by removing surrounding concrete with hand tools. Expose all top steel reinforcing bars within 2" of the surfaces by chipping away concrete to minimum 3/4" beyond the steel reinforcing steel and into sound concrete.
   6. Whenever the depth of spall is 2" or more, provide ¼" dia., 2" long pins in base concrete @ 6" O.C. with 1" embedment.

7. Clean uncovered steel reinforcing bars using motor-driven wire brush to remove all rust, scaling and adhered concrete. If cross section area of any steel reinforcing bars has been reduced by minimum 20%, notify the Engineer for further examination and any instructions for rebar splicing.
   a. Any of the steel reinforcement restoration shall be used:
      - Complete steel reinforcement
      - Additional or supplemental rebars over or adjacent to affected section.
   b. Place new rebars in the following manner:
      - Mechanical spliced to existing rebars in accordance with ACI 318 recommendations
      - Placed parallel to and at a distance approximately ¾" away from existing bars in accordance with ACI 318 Recommendations.
8. Roughen surface of cavity to a profile necessary to achieve bonding. Perform abrasive and pressurized air cleaning to remove all loose particles and clean cavity with potable water to remove any bond inhibitive material. Surface of existing concrete cavity expected to receive the mortar patch shall be sound, clean, and free from any defects with existing aggregate bonded to the cement metrics.
9. For Joist Restoration provide adequate formwork.
10. Coat cleaned steel reinforcing bars in accordance with manufacturers written instructions.

B. <u>Installation of Modified Composite Patching Mortar (Cavity Less Than 3" Deep):</u>
   1. Follow manufacturer's written instructions regarding storage conditions, surface preparation and protection, mixing ratio, bonding, patching mortar to existing surface, application procedure, application time, and finishing time.
   2. Complete and finish surface of patch to match existing surface texture and profile and make surface ready for coating application.
   3. Avoid feathering.
   4. Apply bonding agent if recommended by the manufacturer of modified repair concrete.
   5. Prepare repair concrete mix as per Engineer's and manufacturer's instructions. Pour to the level of adjacent concrete surface. Finish the top surface smooth.
   6. Avoid feathering.

C. <u>Installation of Modified Composite Cement for deep cavity repair (cavity between 3" – 4")</u>
   1. Follow manufacturer's written instructions for:
      a. Mix Proportion of concrete mix using modified cement and aggregate.
      b. Cavity Preparation includes application of bonding agent approved by the modified cement manufacturer.
      c. Application Procedure
      d. Application Time
      e. Finishing Time

2. Complete and finish surface of patch to match existing surface and make surface ready for coating application.
3. Avoid feathering.

3.05 CLEAN UP

A. Restore site to pre-construction condition including both interior and exterior areas.

3.06 INSPECTIONS

A. Test quality of spall repair installations by sounding at locations selected in writing by Engineer.
B. Defective restoration work or work that does not fulfill warranty requirements shall be fixed at no cost to Owner.
C. Final inspection and acceptance in writing of concrete restoration work shall be made by the Engineer and manufacturer to verify conformance with drawings and specifications.

3.07 COMPLETION

A. Submit all warranties required by these specifications for approval prior to final payment.

END OF SECTION 03 01 00