

## SECTION 03730 – CONCRETE REPAIRS

### PART 1 – GENERAL

#### 1.01 RELATED DOCUMENTS

- A. The General Provisions of the contract, including the General Provision for Construction Projects (2016), Special Provisions, and General Requirements of the Specifications, apply to the work specified in this Section.

#### 1.02 DESCRIPTION OF WORK

- A. This section is for locating and confirming the size of defective areas in the concrete structure and repairing of all concrete spalls, delaminations, honeycombing, and other defective concrete within the existing concrete structure. This section applies to locations as designated on the plans as well as all other locations encountered by the Contractor and DOT-A.

#### 1.03 DEFINITIONS

- A. Bracing: Temporary supplemental members used to avoid local or global instability during construction, evaluation, or repair that are intended to be removed after completion.
- B. Delamination: A planar separation in a material that is roughly parallel to the surface of material.
- C. Rehabilitation: Repairing or modifying an existing structure to a desired useful condition
- D. Repair: The reconstruction or renewal of concrete parts of an existing structure for its maintenance or to correct deterioration, damage, or faulty construction of members or systems of a structure.
- E. Shoring: Props or posts of timber or other material in compression used for the temporary support of excavations, formwork, or unsafe structures; the process of erecting shores
- F. Termination Joint: The interface where a placement of repair material meets existing concrete, the edge of an expansion joint, or other existing surfaces.
- G. Unsound Concrete: Concrete that is fractured, delaminated, spalled, deteriorated, defective, contaminated or otherwise damaged.

#### 1.04 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic design designation only.
- B. American Concrete Institute (ACI)
  - 1. ACI 117: (2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
  - 2. ACI 503.7: (2007) Specification for Crack Repair by Epoxy Injection
- C. ASTM International (ASTM)
  - 1. ASTM C928: (2020a) Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
  - 2. ASTM D4580: (2012) Standard Practice for Measuring Delaminations in Concrete Bridge Decks by Sounding
- D. International Concrete Repair Institute (ICRI)
  - 1. ICRI 310.2R: (2013) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair

#### 1.05 SUBMITTALS

- A. Submit in accordance with Section 01300 –SUBMITTALS
- B. Preconstruction Submittal
  - 1. Submit for record, a qualification statement by the Contractor listing their completed concrete repair projects, including size, location, owner, engineer/architect and contact numbers. Contractor Qualifications shall comply with Section 1.06.B
  - 2. Schedule indicating proposed methods and sequence of operations for the concrete repair work.
- C. Product Data
  - 1. Product data of all materials used for concrete repaired under this section. Product data shall also include test data, certificates, and manufacturer's instructions for the following items:

- a. Concrete patching materials
  - b. Crack repair materials
- D. Material Safety Data Sheets: Furnish the manufacturer's Material Safety Data Sheets for each of the materials present at any time on the job site.
- E. Documentation of Repairs: Include records of each repaired concrete area including spalls and cracks. Documentation shall include the following:
- 1. The date of concrete repair mortar placement or date of epoxy gravity feeding or injection.
  - 2. The location of the center of each repair rectangle, or crack location as indicated by distance from two nearest column lines.
  - 3. Dimension of the spall repair rectangle or length of crack repair.

#### 1.06 QUALITY CONTROL

##### A. General Requirements

- 1. To protect personnel from overexposure to toxic materials, conform to the applicable manufacturer's Safety Data sheets or local regulations.
- 2. Inspection and testing of work, must be in accordance with established procedures, manufacturer's instructions, specific instructions from DOT-A if given, or recommended practices as referenced herein and the Contract Documents.

B. Contractor Qualifications: An experienced installer who has completed at least five (5) years experience in concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Tolerances: Construction tolerances for repairs must conform to ACI 117. Where existing condition do not allow tolerances to conform to ACI 117, use the details and materials for such conditions as indicated in the Contract Documents. For conditions not shown or that are different than indicated in the Contract Documents, notify DOT-A before proceeding with the work at those locations.

D. Observation of Work: DOT-A will observe the Work of the Contractor at various phases during the repair process. The observations will include a visual observation of the repair patches, and sounding the patched areas with a hammer

to check for soundness. The Contractor shall provide access for DOT-A for their observations. The access will include the work platform used by the Contractor to perform the work. The platform shall be operated by the Contractor's personnel, if applicable, and shall be in accordance with OSHA safety requirements. The Contractor shall provide access to DOT-A on five (5) days during the construction process for random observations. The five days will not be sequential and will be scheduled according to the Contractor's production schedule. DOT-A will schedule with the Contractor in advance to arrange for the observations. A punch list will be compiled as a result of the observation. Upon receipt of the punch list, the Contractor shall make the necessary repairs, and provide one (1) additional day of access for DOT-A for final observation.

- E. Rejection of Installed Work: DOT-A shall have the right to reject all work which is not in compliance with the requirements of the drawings and specifications.
1. Replacement of rejected work may require that the materials in place in the rejected areas be entirely removed to the solid concrete deck. Use methods that shall produce acceptable work. Additional surface preparation may be required. The Contractor shall research and define these procedures and complete the additional surface preparation and reapplication of the repair material at no extra cost to the State.
  2. See Section 01433 – MOCK-UPS to perform mock up repair. Other repairs shall not be performed until Mock-Up has been inspected and approved by DOT-A.

#### 1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in original tightly sealed containers or unopened packages, clearly labeled and containing manufacturer's name, labels, date of manufacture, product identification, manufacturer's instructions for mixing, and warning for handling and toxicity.
- B. All repair materials shall be stored in a manner to prevent deterioration for the intrusion of foreign matter. Any material which has deteriorated or that has been damaged shall not be used for concrete repair and shall be promptly removed from the site. The storage of materials and equipment shall not be limited to areas designated by the DOT-A, and shall be secured under lock and key at all times.

## PART 2 – PRODUCTS

### 2.01 MATERIALS

- A. Epoxy Bonding Adhesive: Provide epoxy bonding adhesive if recommended by the manufacturer. Bonding adhesive must be provided by the same manufacture as patching material.
- B. Patching Material: ASTM C 881 two component, polymer modified, Portland cement, trowel grade mortar, have high abrasion resistance, suitable for vertical and overhead surfaces, of a class and grade to suit requirements. Refer to manufacturer's specifications for preparation and application guidance. Patching material and bonding adhesive shall be supplied by the same manufacturer and shall be fully compatible with each other.
- C. Water: ASTM C 94 and potable
- D. Curing Compound: For curing of Patching Material, cover with wet burlap or approved equal. Leave wet burlap on until opening to traffic.
- E. Crack Repair Epoxy: Low viscosity, high strength, resin adhesive that conforms to ASTM C-881 specifications. Resin must be applicable for gravity feed installation method for horizontal cracks and pressure injection installation method for vertical and overhead cracks.
- F. Other Materials: All other materials, not specifically described but required for the successful completion and installation of the work shall be as selected by DOT-A.

## PART 3 – EXECUTION

### 3.01 JOB CONDITIONS

- A. Adhere to the manufacturer's printed instructions regarding weather and climate condition restrictions on the use of all materials supplied in this section.
- B. Do not apply the materials if it is raining or if rain is imminent. Take proper precautions to protect newly placed and completed repairs from weather conditions such as strong wind or rain.
- C. Do not man scaffolds or lift equipment in wind or rain conditions that makes working dangerous.

- D. Protection: Precautions shall be taken to avoid damage to any surface near the work area due to slippage.
- E. Barricades: Erect temporary barricades and railings, to prevent people from entering the project area. Coordinate with DOT-A on final location and placement.

### 3.02 PROTECTION OF WORK

- A. Do not allow construction loads to exceed the loads that a structural member or structure is safely capable of supporting without damage. Provide supplemental support if construction loads are expected to exceed safe load capacity.
- B. Use all means necessary to protect the materials of this section before and during installation and to protect this work and the work of all other trades. In the event of damage during installation, immediately make repairs and replacements necessary to the approval of the DOT-A at no additional cost to the State.
- C. Protect repair materials from environmental damage by weather events during the length of the curing period.

### 3.03 EQUIPMENT FOR CONCRETE PREPARATION

- A. Means and methods used for concrete removal and surface preparation must be selected and used such as to minimize damage to the structure and to the concrete substrate that remains.
- B. Equipment for Concrete Removal: Removal equipment and techniques must be suitable to produce concrete surface profiles and level of cleanliness in designated areas as required by this specification and the contract Documents.
  - 1. Cutting Equipment: Cutting, lifting, and transporting equipment must be adequate to cut, support, and transport concrete sections without incurring any damage to the existing structure.
  - 2. Concrete Breakers: Provide sharp tips on breaker equipment to minimize microcracking damage in partial depth removal.
- C. Materials for Formwork and Embedded Items
  - 1. Install and remove formwork without damaging or staining the existing structure or repair material.

2. Forms used for polymer concrete/mortars must be tight enough to hold the material that is used without leaking. All surfaces where bond is not desired, but which are exposed to the monomer or resin, must be treated with a form release agent.

### 3.04 CONCRETE REPAIR SURFACE PREPARATION

- A. Cleaning shall precede application of the patching material by not more than 24 hours. The surface to be patched shall be cleaned according to the manufacture's specifications.
- B. Exposed reinforcing and structural steel shall be cleaned to remove all loose and built-up rust, asphalt residue, and all other contaminants detrimental to achieving an adequate bond. It may be necessary to use hand tools to remove scale from the reinforcing steel or anchor bolts.
- C. The surface shall be free of spalls, laitance and all traces of foreign material. If necessary, detergent cleaning shall precede blast cleaning to ensure the removal of contaminants that are detrimental to achieving an adequate bond. Ultra-high hydro-demolition of 10,000 psi or more is an acceptable method of total surface preparation.
- D. Any additional surface preparation shall be in accordance with the manufacturer's recommendations for the patching material which is used. All un-chipped surfaces that will receive new material shall be mechanically roughened to the greater of a 1/8 inch amplitude or manufacturer's recommendation.

### 3.05 CONCRETE REPAIR INSTALLATION

- A. All work shall be performed in such a way to eliminate any dust, vapors or odors from entering into the interior spaces. No dust or debris shall come in contact with vehicles parked nearby construction area. The contractor shall clean the vehicle of such dust and debris if it occurs. Every precaution necessary to achieve this shall be implemented.
- B. No "feathering" of patching material shall be allowed. All patching will include saw cutting around the entire perimeter of the repair.
- C. Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner. All patching material shall be sanded smooth after the repair is complete and material curing is complete. The finish surface shall be flush with the surrounding concrete surface, and shall not be visually evident after application of the coating. Failure to accomplish this shall

require the Contractor to remove the coating, further sand the surface until flush at no cost to the State.

- D. If required by manufacturer, the reinforcing steel shall receive two (2) coats of corrosion inhibiting bonding agent at 20 mils each, total of 40 mils DFT. The concrete surface shall receive one (1) coat at 20 mins DFT. Contractor shall follow manufacturer's specifications for recommended time between application of bonding agent and patching mortar.
- E. Where existing components are removed, the contractor shall repair, patch and finish all flooring, wall, and ceiling surfaces to match existing condition.
- F. Compatibility: Before patching, verify compatibility with and suitability of substances, including compatibility with in-place finishes or primers.
- G. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.
- H. At the Ewa Third Level Roadway the Contractor shall patch the spall and delamination area of the roadway deck after scarify existing concrete overlay where shown on the construction drawings. If size or location of the spalls differ from the construction drawings notify DOT-A prior to commencing concrete repair work.
- I. If spalls or delaminated concrete caused by moisture are found in the structural slab and was not caused by the contractor's pavement demolition, the contractor shall notify DOT-A in writing the location and size of the spall or delamination. The contractor shall not patch the spall or delaminated area until written approval is given by DOT-A.

### 3.06 IN-PLACE TEST OF REPAIRS

- A. Utilizing a 2-pound hammer, test all completed concrete spall repairs to locate hollow or ringing sounding areas. A hollow sound generally will indicate that either the repair material has not completely filled the space from which the damaged concrete was removed or that it has not adequately bonded to the concrete substrate. Submit revised method of installation to prevent the non-compliant work from happening again.
- B. The Contractor shall remove the repair mortar from hollow or ringing sounding areas, prepare the surfaces of the exposed reinforcing bars and the sound concrete substrate, if necessary, form and then place, cure and finish the new repair mortar at no additional cost to the State. Upon completion, the repairs will be retested by DOT-A.



### 3.07 CRACK REPAIR BY GRAVITY FLOW

- A. Locate and identify crack, sound surface and mark extent for approval if it is different from what is shown in the drawing.
- B. Remove dust, laitance, grease, curing compounds, waxes, impregnations, foreign particles, efflorescence and other bond inhibiting materials from the surface.
- C. If crack surface is packed solid with dirt/or debris, remove the debris by routing the crack surface with crack chaser or grinder, follow up with compressed air to remove fines. Prior to application blow crack out with oil-free compressed air.
- D. Allow the repair area to dry for at least 24 hours before applying the resin.
- E. Prepare surface per manufacturer's recommendations and repair cracks using gravity feed method.
- F. Resin for gravity feed shall be epoxy or high molecular weight methacrylates (HMWM) with maximum viscosities of 200 cps. Should moisture present within cracks epoxy should be used as the resin.
- G. Remove excessive resin and match texture and appearance of surrounding concrete.

### 3.08 CRACK REPAIR BY PRESSURE INJECTION

- A. Locate and identify crack, sound surface and mark extent for approval if it is different from what is shown in the drawing. Do not mark over crack.
- B. Remove dust, laitance, grease, curing compounds, waxes, impregnations, foreign particles, efflorescence and other bond inhibiting materials from the surface.
- C. If crack surface is packed solid with dirt/or debris, remove the debris by routing the crack surface with crack chaser or grinder, follow up with compressed air to remove fines. Prior to application blow crack out with oil-free compressed air.
- D. Allow the repair area to dry for at least 24 hours before applying epoxy.
- E. Where concrete surface adjacent to the crack are deteriorated, "v" groove the crack until sound concrete is reached.
- F. Prepare surface per manufacturer's recommendations and repair cracks using injection method.
- G. Epoxy shall conform to ASTM C-881 specifications.

- H. Remove excessive epoxy and match texture and appearance of surrounding concrete.

### 3.09 CLEANING

- A. Surfaces Not Involved in the Repairs: Adjacent surfaces damaged by staining left by concrete work, or other concrete materials shall be completely restored to the original new conditions with respect to color and texture to the acceptance by DOT-A.
- B. Remove debris and rubbish from the site daily. Prevent debris and rubbish from entering the waterway. Debris and rubbish shall not be allowed to accumulate on the site. Debris shall be removed and transported in a manner that will prevent spillage into the open channel, onto the adjacent ground and streets.
- C. Upon completion of the work, remove all materials, tools, forming materials, catchments, work platforms, refuse, and debris generated by the work specified in this section.
- D. Cracks Repaired by Gravity Flow
  - 1. The uncured epoxy resin adhesive can be cleaned from tools with an approved solvent. The cured epoxy resin adhesive can only be removed mechanically.
  - 2. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.
- E. Cracks Repaired by Pressure Injection
  - 1. After the epoxy resin adhesive for grouting has cured, the epoxy resin adhesive for sealing cracks and porting devices shall be removed as required by DOT-A. Clean the substrate in a manner to produce a finish appearance acceptable to DOT-A.
  - 2. The uncured epoxy resin adhesive can be cleaned from tools with approved solvent. The cured epoxy resin adhesive can only be removed mechanically.
  - 3. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

## PART 4 – MEASUREMENT AND PAYMENT

### 4.01 METHOD OF MEASUREMENT

Work under this Section shall be measured as indicated and will be paid for at the Contract basis indicated in the proposal schedule. The Contract Price paid shall be full compensation for all labor, tools, equipment, and all other incidentals necessary to complete the work.

### 4.02 BASIS OF PAYMENT

Concrete Repairs involving spall repairs shall be measured and paid for, at the contract unit price bid. The contract unit price paid shall be full compensation for all labor, tools, equipment, and all other incidentals necessary to complete the work.

For ALLOWANCE items in the Proposal Schedule, the allowance is an estimate and the amount shall not exceed the maximum amount shown in the Proposal Schedule. Payment shall be the actual cost as invoiced by the Contractor and approved by the DOTA Engineer. The Contractor shall be allowed to include overhead, profit, insurance and/or other mark-ups, as stipulated in Section 9.5 of the 2016 General Provisions for Construction Projects, Air and Water Transportation Facilities Divisions.

Structural Slab Repairs of moisture related spalls shall be covered by allowance funds. Areas of the structural concrete slab damaged by the contractor's demolition of the work shall be repaired at the contractor's expense and is not covered by allowance funds.

<u>Item No.</u>	<u>Description</u>	<u>Unit</u>
03730.1	Included Spall Repair for Third Level Roadway Deck	Square Feet
03730.2	Curb Spall Repair	Linear Feet
03730.3	Structural Slab Spall Repairs	Allowance.

All other concrete repairs specified in this section shall be considered incidental to and included in the bid prices for the various items of work in this project.

END OF SECTION