Revised for Accelerated Highway Safety Improvement Program:
April 19th, 2018

SPECIAL PROVISION

SPECIFICATION 815
SYSTEMATIC DECK PRESERVATION APPROACH USING THIN EPOXY OVERLAY WITH BROADCAST AGGREGATE SYSTEM

815-1 DESCRIPTION

815-1.01 Scope

a. This work shall consist of the preservation of new and existing bridge concrete decks with the application of a systematic deck preservation approach that includes: 1) surface preparation, 2) application of a corrosion inhibitor, 3) application of a gravity-fed low viscosity crack sealer/healer; and 4) application of a thin epoxy overlay with a broadcast aggregate wearing surface in conformity with the lines, dimensions, typical sections, design and construction criteria and other details shown on the plans, standard plans and in accordance to these specifications or as established by the Engineer.

b. This item shall also include any furnishing of materials, labor, equipment, and all incidentals required for the surface preparation, the application of a corrosion inhibitor, the proper application of the gravity-fed low viscosity crack sealer/healer and the thin epoxy overlay with broadcast aggregate. All these works prior to the installation of the overlay shall be considered a subsidiary obligation.

c. The term "surface preparation" refers to the procedure done prior to the beginning of the application of the gravity-fed low viscosity crack sealer/healer and the thin epoxy overlay with broadcast aggregate and all its components including, but not limited to grinding, repairs of spall areas, or any other defects on the concrete surface that can affect the performance of the overlay.

d. A technical representative from the manufacturer/supplier shall be on-site during all phases of the work. This shall include, but not be limited to surface preparation, deck surface repairs, overlay application, and overlay cure.

e. The contractor shall submit documentation with the complete surface preparation procedures, application and curing procedures, and technical information from the manufacturer/supplier, to the Engineer for evaluation and approval prior to the beginning of works. The application of the products shall be according to the manufacturer/supplier instructions and recommendations. The thin epoxy overlay with broadcast aggregate system shall be specifically for use over concrete bridge decks. The system shall have been used in other jurisdictions in the United States.

f. Each word, sentence, section or article of this document is independent. Not applying parts of it does not imply that it cannot be enforced afterwards nor invalidates the remaining provisions.

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815-1.02 Reference Documents to be used for the Construction of this item.

a. ASTM C 881: Epoxy-Resin-Base Bonding Systems for Concrete
b. ASTM C 579: Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
c. ASTM D 790: Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
d. ASTM D 5821: Determining the Percentage of Fractured Particles in Coarse Aggregate
e. ASTM D 638: Tensile Properties of Plastics
f. ASTM D 732: Standard Test Method for Shear Strength of Plastic by Punch Tool
g. ASTM C882: Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
h. ASTM D 695: Standard Test Method for Compressive Properties of Rigid Plastics
i. ASTM C 566: Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
j. ASTM D 570: Standard Test Method for Water Absorption of Plastics
k. ASTM D 2240: Standard Test Method for Rubber Property—Durometer Hardness
l. ASTM C 1583: Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
m. ASTM D 2393: Test Method for Viscosity of Epoxy Resins and Related Components
n. AASHTO M 235: Standard Specification for Epoxy Resin Adhesives.
o. ASTM E274/E274M – 11 Standard Test Method for Skid Resistance of Paved Surfaces using a Full-Scale Tire
p. ASTM G 109 - Standard Test Method for Determining Effects of Chemical Admixtures on Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments

815-2 MATERIALS

815-2.01 General - The Contractor shall follow the recommendations made by the manufacturer/supplier for the applications of the systematic bridge deck preservation approach using: corrosion inhibitors, a gravity-fed low viscosity crack sealer/healer; and a thin epoxy overlay with broadcast aggregate and the applicable requirements specified in

these specifications. Materials not conforming to this section of the specification shall not be used without written consent from the Engineer.

815-2.02 Corrosion Inhibitor – The Corrosion Inhibitor shall be a low-viscosity combination of amino alcohols, and inorganic inhibitors. It shall protect or reduce the corrosion in reinforced concrete structures exposed to pneumatic tire traffic, water, chlorides, and chemical attacks. The product shall meet the requirements specified in ASTM G 109 Specification with a viscosity less than 25 centipoise (CPS). The Corrosion Inhibitor shall not be slippery when the product dries. The Contractor shall submit the product technical data sheets and Manufacturer's certifications for review and approval by the Engineer. When required by the Engineer, the Contractor shall also submit certified test reports for approval. The Corrosion Inhibitor shall not be applied in the field or incorporated in to the work without prior approval by the Engineer.

815-2.03 Gravity-fed low viscosity Structural Crack Healer/Sealer - The gravity-fed low viscosity crack healer/sealer shall be a low-viscosity epoxy and high-strength adhesive for structures exposed to pneumatic tire traffic, water, chlorides, and chemical attacks. The crack healer/sealer shall meet the requirements specified in ASTM C 881 and AASHTO M-235 Specifications. The Contractor shall also submit to the Engineer the technical data sheets and certified test reports. The structural crack healer/sealer shall not be applied in the field or incorporated in to the work without prior approval of the Engineer. The material properties shall meet the requirements specified in the following parameters and specifications:

Table 815-1: Physical and Mechanical Properties of the Structural Crack Healer/Sealer

Property	Requirement	Test Method
Maximum Viscosity (low, Grade 1)	90 cps	ASTM D 2393
Minimum Pot Life	25 minutes	
Minimum Bond Strength at 2 days in 73°F	1,300 psi	ASTM C 882
Minimum Compressive Strength at 7 days in 73°F	10,000 psi	ASTM D 695
Minimum Flexural Strength at 7 days in 73°F	9,000 psi	ASTM D 790
Minimum Tensile Strength at 7 days in 73°F	7,000 psi	ASTM D 638

Material shall be factory packaged in strong moisture proof containers capable of withstanding shipping, handling and storage without breakage. Material shall have a

storage life of at least one year.

815-2.04 Thin Epoxy Overlay with Broadcast Aggregate System - The thin epoxy overlay system for a bridge concrete deck is made of two main components: the polymer resin and the aggregates. The polymer resin acts as a binder for the aggregates that provide the wearing surface for the roadway. The overlay system shall comply with the following properties:

Table 815-2: Physical and Mechanical Properties of the Epoxy Overlay System

Property	Requirement	Test Method
Minimum Compressive Strength @ 4hrs [1]	1,000 psi @ ≥75°F	ASTM C 579
Minimum Compressive Strength @ 24 hrs [1]	5,000 psi @ ≥75°F	ASTM C 579
Minimum Tensile Strength [1]	2,000 psi @ 7 days	ASTM D 638
Tensile Elongation Percent [1]	30% to 80% @ 7 days	ASTM D 638
Maximum Water Absorption [1]	1%	ASTM D 570
Minimum Shore D Hardness [1]	70±5	ASTM D 2240
Gel Time [2]	15 min. to 45 min. @ 75°F	ASTM C 881
Viscosity [2]	700 to 2,500 cps	ASTM D 2393
Minimum Adhesive Strength to Concrete [1]	250 psi @ 24 hrs	ASTM C 1583
Minimum Flexural Yield Strength [1]	3,000 psi @ 7 days	ASTM D 790

[1] Cured overlay system
[2] Uncured polymer resin

a. **Polymer resin** - The polymer resin is the binder of the epoxy overlay with broadcast aggregate system and shall be either of an epoxy-urethane co-polymer blend, or a modified epoxy polymer. The product used within these requirements shall have been used with success in any other United States jurisdiction.

b. **Aggregates -** The aggregate use for the thin epoxy overlay application shall be pre-packed quartzite granite or abrasive silica flint as indicated in construction plans, clean and free from dirt, clay, asphalt, and other foreign or organic material. It shall surface dry, non-polishing, fractured or angular in shape with a maximum moisture content of 0.2 percent by weight according to ASTM C 566, and a minimum Mohs hardness of at least 6.5. The aggregates shall be transported and stored in a way that limits the moisture intrusion. It shall have a proven record of

performance in applications of this type and shall follow the recommendations and requirements of the epoxy overlay system manufacturer and those specified in this specification. Any aggregate that fails the requirements of the manufacturer/supplier and this specification shall not be approved. The aggregate gradation shall meet the following requirements:

Table 815-3: Aggregate Gradation for Epoxy Overlay System

Sieve Size	Percent Passing
No. 4	100
No. 10	10-35
No. 20	0-10

815-2.05 Basis of Acceptance - The acceptance of the systematic deck preservation approach will be based on the criteria stated in this section. However, this does not relieve the responsibility of the Contractor for the proper application of the systematic deck preservation systems and all its components including, but not limited to surface preparation with all its incidentals, gravity-fed low viscosity crack healer/sealer, repairs of spall areas, or any other defects on the concrete surface that can affect the performance of the preservation method.

a. Corrosion Inhibitor - Acceptance of the material will be on the basis of Manufacturer's certification establishing the material meets the contract requirements. However, failure by the material to perform adequately in actual use shall be just cause for rejection regardless of certification.

b. Gravity-fed low viscosity crack healer/sealer - Acceptance of the material will be on the basis of Manufacturer's certification establishing the material meets the contract requirements. However, failure by the material to perform adequately in actual use shall be just cause for rejection regardless of certification.

c. Thin epoxy overlay with broadcast aggregate system - will be based on a manufacturer/supplier certification establishing that the material meets the contract requirements. Failure of the material to provide intended bonding performance due to improper installation or placement shall be cause for rejection and removal of the overlay.

i. The minimum adhesive strength to concrete shall be 250 psi at 24 hours with 100 percent of failures occurring in the concrete substrate after finishing the whole application process, according to ASTM C 1583. **If lower strength values or**

failures out from the concrete substrate occurred, the material shall be rejected. Failed test shall be reported immediately (within one hour) to the Engineer.

ii. The test samples shall be taken a minimum of every 35 square meters or fraction thereof. The test shall be performed with extremely care to minimize damage to any adjacent epoxy overlay or any structural and miscellaneous components. Any damage and all its associated costs shall be Contractor's expense.

iii. All samples shall be placed in labeled and sealed polyethylene bags prior to shipment to the testing facility. Core holes shall be repaired by the Certified Applicator. Any repair process shall be submitted to the Engineer for evaluation and approval prior to the beginning of the works. All test results shall be submitted to the PRHTA Material Testing Office for final acceptance.

iv. The certified Tensile Strength Test (Pull-off), the repairs of core holes, and all associated costs shall be a subsidiary obligation under the epoxy overlay with broadcast aggregate system pay item.

v. Within 60 days after the construction of the Thin Epoxy Overlay with Broadcast Aggregate System, the PRHTA will measure the skid resistance in accordance with *ASTM E274/E274M – 11 Standard Test Method for Skid Resistance of Paved Surfaces using a Full-Scale Tire.* A minimum friction number (FN40R- Corrected field FN by test speed as provided by the Pavement Management Office of PRHTA) of 55 shall be obtained. If the minimum FN is not obtained, the contractor must remove and replace all system at no additional cost for PRHTA. Locations for skid resistance test shall be selected randomly or as directed by the Pavement Management Office of PRHTA.

815-3 CONSTRUCTION REQUIREMENTS

815-3.01 General - The works for systematic deck preservation approach using: corrosion inhibitor, gravity-fed low viscosity crack sealer/healer and thin epoxy overlay with broadcast aggregate shall be accomplished as required in the contract documents and in coordination with other operations in progress within the area. The Contractor shall submit a construction plan that includes all work related to surface preparation, placement, and curing at least 15 working days prior to the beginning of works. The Contractor shall also include its quality control procedures as well as the contract quality assurance and acceptance requirements. **No construction activities shall start without the approval of the construction plan**. A meeting shall take place at the job site at least 3 days prior to the beginning of works. The presence of the contractor, its subcontractors, technical representatives from the manufacturer/supplier for the epoxy overlay system, aggregates,

structural crack healer/sealer is mandatory. Also, the Engineer and the inspectors will attend this meeting. The works for systematic deck preservation approach using: corrosion inhibitor, gravity-fed low viscosity crack sealer/healer and thin epoxy overlay with broadcast aggregate shall be conducted by closing the minimum required lanes for the execution of the construction activities. Working with a partially open bridge shall warrant a minimum inconvenience to public traffic, while assure an execution according to plans, contract documents and products manufacturer recommendations. The work shall be accomplished in coordination with other operations in progress within an area. Strict speed control measurements shall be in place when traffic is allowed through the bridge on adjacent lanes until final curing is completed. Speed control measurements are subsidiary items of the Thin Epoxy Overlay with Broadcast Aggregate System pay item. All works shall be accomplished as required in the contract documents and in coordination with other operations in progress within an area.

815-3.02 Storage and Handling

a. The polymer material shall be store on the job site in a dry, weather protected facility away from moisture and within the maintained temperature range of 60° F to 100°F, or according to the manufacturer's recommendations. The polymer shall be handled using protective gloves, clothing, boots, and safety goggles according to the manufacturer/supplier recommendations and following all OSHA regulations when directly exposed to the material.

b. The aggregates shall be store in a dry, free of moisture facility fully protecting the aggregates from any contaminants, including rain or any moisture source.

c. Corrosion Inhibitor Material shall be factory packaged in strong moisture proof bags or containers capable of withstanding shipping, handling and storage without breakage. Material shall have a storage life of at least one year.

815-3.03 Equipment for Surface Preparation

a. On site equipment used for the surface preparation shall be free of oil leaks.

b. The shot-blasting equipment shall be a self-contained cleaning system with dust collector. This equipment shall use steel shot or pellet. It must be able to discharge reused shots or pellets, and contaminants into a separator that automatically recycles the cleaned abrasive and discharges dust and surface contaminants into a dust

collector. The size and hardness of the shot, the flow of the shots or pellets, the forward speed, and the number of passes shall be as recommended by the Equipment Manufacturer and approved by the Engineer. The cleaning residue shall be contained and removed by the shot-blasting equipment. All operations using the shot-blasting equipment shall follow the environmental permits for the project avoiding any contamination to nearby water crossings.

815-3.04 Systematic Deck Preservation Approach: surface preparation for the application of the corrosion inhibitor and gravity-fed low viscosity crack sealer/healer

a. The contractor shall submit documentation with the complete surface preparation procedures, application and curing procedures, and technical information from the manufacturer/supplier, to the Engineer for evaluation and approval at least 15 working days prior to the beginning of works. All repair materials shall be compatible with the proposed deck preservation method used. The contractor shall contact the manufacturer/supplier to verify the drying/workable time for the corrosion inhibitor prior to apply the gravity-fed low viscosity crack sealer/healer and include all information in the surface preparation and application procedure plan.

b. The concrete deck area to be treated shall be cleaned using shot-blasting equipment describe in this specification to remove any oil, dirt, rubber, debris, or other material that may be detrimental to the applications on the corrosion inhibitor and the gravity-fed low viscosity crack sealer/healer and curing according to the manufacturer's recommendations.

c. Prior to apply the corrosion inhibitor and the gravity-fed low viscosity crack sealer/healer the Contractor shall clean all dust, debris, or concrete fines from the deck surface including vertical faces of curbs and barrier walls up to a high of 0.025 meters above surface with compressed air. The air stream shall be free of oil, debris, or other foreign particles.

d. Prevent the sealer from leaking through cracks onto persons, traffic, and property. If deck preparation procedures or the sealer deface the appearance of bridge components other than the crack sealed areas, repair those components at no additional cost to the PRHTA. Any patching material needed for spalling repairs at bridge deck surface or soffit shall be install or furbish, including all its incidentals under Spalling Repair pay item.

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815-3.05 Systematic Deck Preservation Approach: surface preparation for the application of the thin epoxy overlay with broadcast aggregate system

a. The contractor shall submit documentation with the complete surface preparation procedures, application and curing procedures, and technical information from the manufacturer/supplier, to the Engineer for evaluation and approval at least 15 working days prior to the beginning of works. All repair materials shall be compatible with the thin epoxy overlay with broadcast aggregate system used. Some epoxy overlay systems require patching materials to be in place a minimum of 28 days before application. The contractor shall contact the manufacturer/supplier to verify this time if this type of repair is necessary, and include all information in the surface preparation and application procedure plan.

b. The concrete deck area to be treated shall be cleaned using shot-blasting equipment describe in this specification to remove any oil, dirt, rubber, debris, or other material that may be detrimental to the epoxy overlay bonding and curing according to the manufacturer's recommendations. Prior to the overlay placement the Contractor shall clean all dust, debris, or concrete fines from the deck surface including vertical faces of curbs and barrier walls up to a high of 0.025 meters above surface with compressed air. The air stream shall be free of oil, debris, or other foreign particles.

c. The Contractor shall cover the bridge deck drains and expansion joints, and any other element not intended to be cover by the epoxy overlay.

d. Traffic shall not be allowed on any portion of the deck being treated between surface preparation and the application of the thin epoxy overlay with broadcast aggregate.

e. The final surface shall comply with the International Concrete Repair Institute (ICRI) Surface Preparation Level 5-7 or ASTM E 965 with a pavement macro-texture of 0.00102 meters to 0.00204 meters.

f. The contractor shall perform the surface preparation within a time frame of 24 hours prior to the application of the thin epoxy overlay with broadcast aggregate. After the surface preparation, no traffic shall be allowed on any portion of the treated area until the application of the thin epoxy overlay with broadcast aggregate and curing time are finished.

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815-3.06 Application of the Corrosion Inhibitor

a. Handling of the corrosion inhibitor shall be performed according to the manufacturer/supplier instructions and recommendations. The corrosion inhibitor shall be compatible with the thin epoxy overlay with broadcast aggregate system. The presence of a technical representative from the manufacturer/supplier is mandatory for the application of the product.

815-3.07 Application of the Gravity-Fed Low Viscosity Crack Sealer/Healer

a. Handling and mixing of the polymer resin shall be performed according to the manufacturer/supplier instructions and recommendations. The presence of a technical representative from the manufacturer/supplier is mandatory for the application of the product.

815-3.08 Application of the Thin Epoxy Overlay with Broadcast Aggregate System

a. Handling and mixing of the polymer resin shall be performed according to the manufacturer/supplier instructions and recommendations. The presence of a technical representative from the manufacturer/supplier is mandatory for the application of the product.

b. The thin epoxy overlay with broadcast aggregate shall not be applied in the following weather conditions:

1. If the ambient air temperature is below 60°F.
2. If the deck temperature is below 60°F.
3. If moisture content in the deck exceeds 4.5 percent measured in accordance with ASTM D 4263.
4. Rain is forecasted within 8 hours after the estimated completion time.

d. The use of special machinery capable of metering, mixing, and distributing the polymer resin may be use according to the manufacturer/supplier's recommendations. Polymer components shall be mixed immediately before dispensing to maximize material working time.

e. The mixed polymer components shall be applied in two courses using a V-notched squeegee. Each course shall consist of a layer of epoxy covered with a layer of aggregate. The minimum overall thickness of the overlay system shall be 0.0095 meters.

f. In the first course, the aggregates shall be broadcasted using a truck mounted spreader capable of dispensing them onto the deck uniformly. If the first course application does not receive enough aggregate before the polymer resin gels, it shall be removed and replaced. The aggregate shall cover the whole surface in such a manner that no wet spots appear before the polymer begins to gel. Use the following table to determine the maximum time after applications of the polymer resin and before broadcasting the aggregate unless directed otherwise by the manufacturer.

Table 815-4: Time Limits for Broadcasting the Aggregate (All Courses)

Temperature	Maximum Time
Above 90°F	10 minutes
80°F @ 90°F	15 minutes
70°F @ 80°F	20 minutes
60°F @ 70°F	25 minutes
50°F @ 60°F	35 minutes

g. After the first course of epoxy overlay has cured to the point where the aggregate cannot be pulled out, all excess and loose aggregate shall be remove using oil-and moisture free compressed air or vacuum equipment before the second course is applied.

h. In the second course, the aggregate shall be broadcasted using a truck mounted spreader capable of dispensing the aggregate onto the deck uniformly. The aggregate shall cover the whole surface in such a manner that no wet spots appear before the polymer begins to gel.

i. Longitudinal joints between successive courses shall be stagger and overlap so that no ridges appear between two adjacent lanes.

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815-3.09 Curing

a. Curing of the Corrosion inhibitor

1. Curing of the corrosion inhibitor shall be done according to manufacturer/supplier instructions and recommendations. The presence of a technical representative from the manufacturer/supplier is mandatory for the application of the product.

b. Curing of the Gravity-Fed Low Viscosity Crack Sealer/Healer

1. Curing of the gravity-fed low viscosity crack sealer/healer shall be done according to the manufacturer/supplier instructions and recommendations. The presence of a technical representative from the manufacturer/supplier is mandatory for the application of the product.

c. Curing of the Thin Epoxy Overlay with Broadcast Aggregate System

1. The minimum curing time limits shall follow the table below, or unless otherwise indicated by the manufacturer/supplier representative.

Table 815-5: Minimum Curing Time for Epoxy Overlay with Broadcast Aggregate

Course	60°F @ 75°F	76° @ 90°+
1	4 hours	2 hours
2	6.5 hours	3 hours

2. If the average temperature drops below 60° F the minimum curing time for the second course shall be 8 hours.

3. No traffic of any vehicle or construction equipment shall be allowed during the curing time on the treated area.

4. After the second course of epoxy overlay has cured, all excess and loose aggregate shall be remove using oil-and moisture free compressed air or vacuum equipment before open the bridge section to traffic.

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815-3.10 Qualifications of Manufacturer/Supplier and Applicator

a. **Manufacturer/Supplier Qualifications –** For the corrosion inhibitor, gravity-fed low viscosity crack sealer/healer; and thin epoxy overlay with broadcast aggregate systems specified in this specification, the Manufacturer/supplier shall be specialized in the manufacturing of the products with a minimum of 4 years of experience, and shall have supplied them in a minimum of 15 projects in the United States. It shall support and instruct applicators in surface preparation and application of the system, and shall have a representative on-site during the whole process as specified in this article.

b. **Certified Applicator Qualifications –** A Certified Applicator shall be approved by the Manufacturer/Supplier and have completed a course of instructions (given by the Manufacturer/Supplier) in the installation of products specified in this specification. The Certified Applicator shall have documented experience in at least 5 projects within the past 2 years. The Manufacturer/Supplier shall submit documentation proving the qualifications of the Certified Applicator.

815-4 METHOD OF MEASUREMENT

815-4.01 The corrosion inhibitor shall me measured by square meter of bridge placed, completed and accepted.

815-4.02 The gravity-fed low viscosity crack sealer/healer shall be measured by square meter of bridge surface placed, completed and accepted.

815-4.03 The spalling repairs shall be measured by square meter, completed and accepted.

815-4.04 The thin epoxy overlay with broadcast aggregate system shall be measured by square meter of bridge surface placed, completed and accepted.

815-4.05 The method of measurement for items on articles 4.01, 4.02, 4.03 and 4.04 include the following: surface preparation, furnishing and placing concrete patching materials, epoxies and admixtures, gravity-fed low viscosity crack sealer/healer, primers, putties, resin systems, top coat protection, paints, and composite repairs, cleaning corroded reinforcement, grinding, steel shot-blasting, water pressure cleaning, compressed air cleaning, vacuum cleaning, proper storage facilities for materials, disposal of materials and any other

requirements according to plans, specifications or directed by the Engineer. Tests required in article 2.04, and the qualifications compliances required by article 3.07 shall be included in the method of measurement.

815-5 BASIS OF PAYMENT

815-5.01 The completed and accepted quantities of the systematic deck preservation approach using: corrosion inhibitor, gravity-fed low viscosity crack sealer/healer and thin epoxy overlay with broadcast aggregate system which are included in the contract, measured as provided above, will be paid for at the contract unit price per unit of measurement as provided below. Such price and payment shall constitute full compensation for all labor, supervision, transportation, materials, equipment, and all incidentals required for the construction and erection of the system, to the lines and grades shown on the plans and approved by the Engineer.

815-5.02 Payment will be made under:

Pay Item	**Pay Unit**
Corrosion Inhibitor	Square Meter
Gravity-fed low viscosity crack sealer/healer	Square Meter
Thin Epoxy Overlay with Broadcast Aggregate System	Square Meter
Spalling Repair	Square Meter