

BRIDGE DECK THIN POLYMER OVERLAY

Effective: May 7, 1997

Revised: June 28, 2024

Description. This work shall consist of furnishing and installing a bridge deck thin polymer overlay (TPO). TPO is a concrete deck overlay consisting of a concrete deck treatment followed by two layers of hybrid polymer epoxy-urethane each containing a blend of hard aggregate, resulting in an overlay thickness of 3/8 inch as defined herein. The overlay is intended to fill and repair cracks, seal the deck concrete, provide the specified friction, resist wearing, and withstand traffic loads, extreme changes in weather conditions, and deformations due to structure loading and temperature changes.

This work shall also include the final surface preparation of the existing concrete deck by shot blasting after all repairs have been completed and cured as specified.

The Department maintains a Qualified Product List for thin polymer overlays. This list can be found on the Department's web site under Bridge Deck Thin Polymer Overlay Systems. The supplier of the material shall be selected from this list and shall furnish a technical representative at the job site during overlay placement to provide recommendations on technical aspects of the installation of the bridge deck thin polymer overlay.

Materials. The manufacturer of the materials shall supply a Safety Data Sheet (SDS) detailing the appropriate safety and handling considerations. These SDS shall be prominently displayed at the storage site and all workers shall be thoroughly familiar with safety precautions before handling the material.

The concrete deck treatment consists of a two-part polymer (components A + B), free of any fillers or volatile solvents, and formulated to be mixed at a ratio specified by the overlay team personnel. Provide material having viscosity conforming to AASHTO M235, Grade 1 and surface tension that will effectively fill and repair cracks, seal the deck concrete, and serve as a primer that enhances the bonding of the epoxy-urethane and aggregate to the concrete deck. Use concrete deck treatment material that is compatible with the epoxy-urethane and aggregate and approved by the overlay installer.

(a) Concrete Deck Treatment. The concrete deck treatment consists of a two-part polymer (components A + B), free of any fillers or volatile solvents, and formulated to be mixed at a ratio specified by the overlay team personnel. Provide material having viscosity conforming to AASHTO M235, Grade 1, and the AASHTO MP35, Table 1 properties of compressive strength (24 hrs.), tensile strength (7 days), tensile elongation (7 days), water absorption, Shore D hardness, and be 100% solids and have a surface tension that will effectively fill and repair cracks, seal the deck concrete, and serve as a primer that enhances the bonding of the epoxy-urethane and aggregate to the concrete deck. Use concrete deck treatment material that is compatible with the epoxy-urethane and aggregate and approved by the overlay installer.

- (b) Epoxy Resin Binder. The binder shall consist of a two-part exothermic epoxy resin which holds the aggregate firmly in position and conforms to the requirements of AASHTO MP35, Table 1. The epoxy resin shall be packaged in suitable, well-sealed containers, clearly labeled as to the type of material and the ratio of components to be mixed by volume. Each packaged component shall display the type (resin or hardener), brand name, name of the manufacturer, lot number, temperature range for storage, expiration date, and quantity. Each container shall be labeled with the appropriate caution warnings regarding contact with the component. The epoxy resin binder manufacturer shall ensure that the material is suitable for temperatures that will be experienced at the time of placement. The epoxy resin binder shall be on the Department's current "Qualified Product List for Bridge Deck Thin Polymer Overlay Systems".
- (c) Aggregate. The aggregate shall contain less than 0.2 percent moisture and be clean and free of dust. The aggregate shall have a Mohs scale hardness greater than 6 and shall consist of bauxite, crushed porphyry, aluminum oxide, or other similarly hard, durable, angular-shaped aggregate, as recommended by the manufacturer and approved by the Engineer. Wet bottom boiler coal slag shall not be used.

The aggregate shall conform to AASHTO MP35, Section 6.2.

At the pre-construction conference, the Contractor shall provide the Engineer with the source of the material that will be used. The manufacturer shall furnish samples of resin material and aggregate as required by the Engineer.

Equipment. The equipment used shall be subject to the approval of the Engineer and shall meet the following requirements:

- (a) Surface Preparation Equipment. Surface preparation equipment shall be according to the applicable portions of Section 1100 and the following:
 - (1) Mechanical Scarifying Equipment. Scarifying equipment shall be a power-operated, mechanical scarifier capable of uniformly scarifying or removing the existing concrete surface and new patches to the depths required satisfactorily. Other types of removal devices may be used if their operation is suitable, and they can be demonstrated to the satisfaction of the Engineer.
 - (2) Shotblasting Equipment. The blasting medium shall be steel shot. The size and hardness of the shot, the flow of the shot, the forward speed, and the number of passes shall be as recommended by the manufacturer. The shot-blasting equipment shall be capable of removing weak concrete at the surface, including the microfractured concrete surface layer remaining because of mechanical scarification, and shall have oil traps. The cleaning residue shall be contained and removed by the shot-blasting equipment.
 - (3) Hand-Held Blast Cleaning Equipment. Blast cleaning using hand-held equipment shall be performed by abrasive blasting. Hand-held blast cleaning equipment shall have oil traps.

(4) Power-Driven Hand Tools. Power-driven hand tools will be permitted. Jackhammers shall be lighter than the nominal 45-pound (20 kg) class. Jackhammers or chipping hammers shall not be operated at angles over 45 degrees, measured from the surface of the slab.

(b) Pull-off Test Equipment. Equipment used to perform pull-off testing shall be either approved by the Engineer or obtained from one of the following approved sources:

James Equipment
007 Bond Tester
800-426-6500

Germann Instruments, Inc.
BOND-TEST Pull-off System
847-329-9999

SDS Company
DYNA Pull-off Tester
805-238-3229

Pull-off test equipment shall include all miscellaneous equipment and materials to perform the test and clean the equipment, as indicated in the Illinois Pull-off Test (Surface or Overlay Method). Before the start of testing, the Contractor shall submit to the Engineer a technical data sheet and material safety data sheet for the epoxy used to perform the testing. For solvents used to clean the equipment, a material safety data sheet shall be submitted.

(c) Overlay Application Equipment. For mechanical applications, the equipment shall consist of an epoxy distribution system, aggregate dispersing equipment, sweeper broom or vacuum truck, and a source of lighting if work is to be performed at night. The epoxy distribution system shall thoroughly blend the epoxy components so that the resulting product has the same material properties as certified in the Materials section. The Engineer reserves the right to sample from the epoxy distribution system at any time during placement operations. The aggregate spreader shall be propelled in such a manner as to uniformly apply the aggregate so that 100 percent of the epoxy material is covered to excess. The sweeper broom or vacuum truck shall be self-propelled. Equipment shall provide compressed air that is free from oil and water.

For hand applications, the equipment shall consist of calibrated containers, a paddle-type mixer, squeegees or rollers, and a broom. All equipment shall be suitable for mixing and placement according to the epoxy manufacturer's recommendations.

Construction. All hot-mix asphalt removal and deck repairs shall be performed and cured according to the Special Provision for "Deck Slab Repair" before any surface preparation operations. The thin polymer overlay shall not be placed on any concrete surface that is less than 28 days old.

(a) Surface Preparation.

- (1) Bridge Deck Scarification. When specified, concrete bridge deck scarification shall be performed to the depth noted on the plans. Sidewalks, curbs, drains, reinforcement, and/or existing transverse and longitudinal joints that are to remain in place shall be protected from damage during scarification and cleaning operations. All damage caused by the Contractor shall be corrected at the Contractor's expense, to the satisfaction of the Engineer.

The scarification work shall consist of removing the designated concrete deck surface using mechanical scarifying equipment. In areas of the deck that are not accessible to the scarifying equipment, power-driven hand tools will be permitted.

A trial section located on the existing deck surface will be designated by the Engineer. The Contractor shall demonstrate that the equipment, personnel, and methods of operation are capable of producing results that are satisfactory to the Engineer. The trial section will consist of an area of approximately 30 sq. ft. (3 sq m).

Once the settings are established, they shall not be changed without the permission of the Engineer. The removal shall be verified, as necessary, at least every 16 ft. (5 m) along the cutting path. If concrete is being removed below the desired depth, the equipment shall be reset or recalibrated.

All areas designated to be scarified shall be scarified uniformly to the depth as specified on the plans but shall not exceed 1 in. (25 mm). Concrete removal below the specified depth shall be replaced at the Contractor's expense, to the satisfaction of the Engineer.

- (2) Deck Patching. After bridge deck scarification, the deck shall be thoroughly cleaned of broken concrete and other debris. The Engineer will sound the scarified deck and all unsound areas will be marked for removal and repairs. All designated patching shall be completed according to the Special Provision for "Deck Slab Repair."

Patching shall be completed before final surface preparation. Patches shall be struck off and then roughened with a suitable stiff bristled broom or wire brush to provide a rough texture design to promote bonding to the overlay. Hand finishing of the patch surface shall be kept to a minimum to prevent overworking of the surface.

- (3) Final Surface Preparation. Final surface preparation shall consist of the operation of shot-blasting equipment to remove any weak concrete at the surface, including the microfractured concrete surface layer remaining because of mechanical scarification. Any areas determined by the Engineer to be inaccessible to the shot blasting equipment shall be thoroughly blast-cleaned with hand-held equipment.

Final surface preparation shall also include the cleaning of all dust, debris, and concrete fines from the deck surface including vertical faces of curbs and barrier walls up to a height of 1 in. (25 mm) above the overlay. Compressed air shall be used for this operation. When using compressed air, the air stream must be free of oil. Any grease,

oil, or other foreign matter that rests on or has absorbed into the concrete shall be removed completely.

After the final surface preparation has been completed and before placement of the overlay, the prepared deck surface will be tested by the Engineer according to the Illinois Pull-off Test (Surface Method). The Contractor shall provide the test equipment.

- a. Start-up Testing. Before the first overlay placement, the Engineer will evaluate the shot-blasting method. The start-up area shall be a minimum of 600 sq. ft. (56 sq. m). After the area has been prepared, six random test locations will be determined by the Engineer, and tested according to the Illinois Pull-off Test (Surface Method).

The average of the six tests shall be a minimum of 175 psi (1,200 kPa) and each test shall have a minimum strength of 160 psi (1,100 kPa). If the criteria are not met, the Contractor shall adjust the shotblasting method. Start-up testing will be repeated until satisfactory results are attained.

Once an acceptable shot-blasting procedure (speed, size of shot, etc.) is established, it shall be continued for the balance of the work. The Contractor may, with permission of the Engineer, change the shotblasting procedure or equipment, in which case additional start-up testing will be required.

- b. Lot Testing. After start-up testing has been completed, the following testing frequency will be used. For each structure, each stage will be divided into lots of not more than 4500 sq. ft. (420 sq m). Three random test locations will be determined by the Engineer, and tested according to the Illinois Pull-off Test (Surface Method).

The average of the three tests shall be a minimum of 175 psi (1,200 kPa) and each test shall have a minimum strength of 160 psi (1,100 kPa). In the case of a failing individual test or a failing average of three tests, the Engineer will determine the area that requires additional surface preparation by the Contractor. Additional test locations will be determined by the Engineer.

In addition to start-up and lot testing, the Department may require surface pull-off testing of areas inaccessible to shot-blasting equipment and blast cleaning with hand-held equipment. The Engineer will determine each test location, and each test shall have a minimum strength of 175 psi (1,200 kPa).

(b) Application of Overlay

- (1) Overlay Placement. The handling and mixing of the epoxy resin and hardening agent shall be performed safely to achieve the desired results according to the manufacturer's written recommendations. Overlay materials shall not be placed when ambient air temperatures are below 55°F (13°C) or above 90°F (32°C), or when deck temperature is below 60°F (16°C). All components shall have a temperature no less than 60°F (16°C)

immediately before mixing and placement. Overlay materials shall not be placed when rain is forecast within 24 hours of application.

There shall be no visible moisture present on the surface of the concrete at the time of application of the thin polymer overlay. A plastic sheet left taped in place for a minimum of two hours, according to ASTM D 4263, shall be used to identify moisture in the deck.

Construction traffic shall not be allowed on any portion of the deck that has been shotblasted or on the overlay without approval from the Engineer. Overlay placement shall begin as soon as possible after the surface preparation operation. In no case shall the time between surface preparation and application of the first lift exceed 24 hours.

The polymer overlay shall consist of a two-course application of epoxy and aggregate. Each of the two courses shall consist of a layer of epoxy covered with a layer of aggregate in sufficient quantity to completely cover the epoxy. The total thickness of the overlay shall not be less than 1/4 inch (6 mm). The dry aggregate shall be applied in such a manner as to cover the epoxy mixture completely within five minutes of application. The dry aggregate shall be sprinkled or dropped vertically in a manner such that the level of the epoxy mixture is not disturbed. First course applications that do not receive enough aggregate before the gel time shall be removed and replaced. A second course applied with insufficient aggregate may be left in place but will require additional applications before opening to traffic.

The preceding course of thin polymer overlay shall be cured until brooming or vacuuming can be performed without tearing or otherwise damaging the surface before the application of succeeding courses. No traffic or equipment shall be permitted on the overlay surface during the curing period.

After the curing period, all loose aggregate shall be removed by brooming or vacuuming before the next overlay course is applied. This procedure is repeated until the minimum overlay thickness is achieved.

Unless otherwise specified, the thin polymer overlay courses may be applied over the expansion joints and joint seals of the bridge deck. The expansion joints and joint seals shall be protected by a bond breaker. Before opening any application to traffic, the overlay over each joint shall be removed.

Before opening to traffic, at least one pull-off test location per lane, per 100 feet (30 m) of bridge length will be designated by the Engineer. Pull-off testing shall be performed according to the Illinois Pull-off Test (Overlay Method). The Contractor shall provide the test equipment. Each test shall have a minimum strength of 150 psi (1,000 kPa). Unacceptable test results will require removal and replacement of the overlay at the Contractor's expense, and the locations will be determined by the Engineer.

The thickness of the overlay shall be verified to be at least 1/4 inch (6 mm) thick, as measured from the deck surface to the top of the resin. Cores from pull-off tests shall be

used to determine overlay thickness. Thin areas shall be re-coated and re-tested at no additional cost to the Department.

If additional applications are required due to deficient thickness or insufficient aggregate, the Engineer may require additional pull-off strength tests to verify the Contractor's procedures.

Pull-off test locations, thickness test locations, and any de-bonded areas shall be repaired before final acceptance.

- (2) Curing. The Contractor shall plan and prosecute the work to provide at least eight hours of curing or the minimum cure as prescribed by the manufacturer before opening that section to public or construction traffic.
- (3) Storage and Handling. Resin materials shall be stored in their original containers inside a heated warehouse in a dry area. Storage temperatures shall be maintained between 60 – 90°F (16 – 32°C)

The resin material shall be stored on the job site in a trailer, protected from moisture, and maintained within a temperature range of 60 – 90°F (16 – 32°C).

Protective gloves and goggles shall be provided by the Contractor to workers who are directly exposed to the resin material. Product Safety Data Sheets from the manufacturer shall be provided for all workers by the Contractor.

All aggregates shall be stored in a dry environment and shall be protected from contaminants on the job site. Aggregate that is exposed to rain or other moisture shall be rejected.

Method of Measurement. The area of scarification on the bridge deck will be measured for payment in square yards (square meters).

The area of thin polymer overlay will be measured in square yards (square meters) of horizontal deck area, completed and accepted.

Basis of Payment. This work shall be paid for at the contract unit price per square yard (square meter) for BRIDGE DECK THIN POLYMER OVERLAY of the thickness specified.

The concrete bridge deck scarification will be paid for at the contract unit price per square yard (square meter) for CONCRETE BRIDGE DECK SCARIFICATION of the thickness specified.