BUILDING STRENGTH™

PRO-POXY™ TYPE III DOT CONCRETE CONSTRUCTION SOLUTIONS

APPLICATION GUIDE

DAYTON® SUPERIOR®

A bridge deck overlay application consists of two coats of an advanced polymer epoxy that quickly develops a high tensile strength to seal, protect and extend the life of bridge decks in both new and restoration construction. This economical and highly effective method blends an epoxy binder that is applied evenly to the bridge deck surface. Aggregate is immediately applied over the binder epoxy, to increase the texture depth of the pavement and provides a long-lasting seal to protect the bridge deck from the effects of traffic, freeze thaw, deicing products and harsh weather conditions. In addition to the protective seal, the bridge deck overlay provides increased pavement grip in wet or dry conditions resulting in fewer accidents, less fatalities and saves more lives.

Pro-Poxy™ Type III D.O.T. is a 100% solids, low modulus, moisture tolerant, low viscosity epoxy urethane binder meeting the requirements of ASTM C-881, Type III, Grade I, Classes B & C.

Steward, AK - Exit Glacier Road Bridge Rehabilitation

RECOMMENDED MATERIALS:

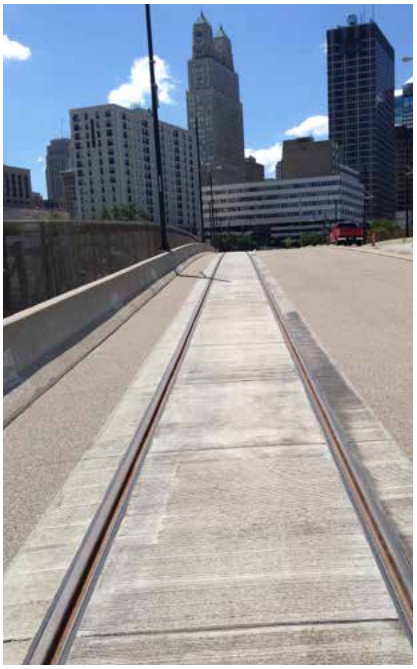
Pro-Poxy™ Type III D.O.T.	Epoxy/urethane binder and adhesive
Pro-Poxy™ Type III DOT LT	Low temperature epoxy/urethane binder and adhesive
Dry aggregate	As specified
Pro-Poxy™ 2500	Epoxy repair mortar (As required)
HD50	Rapid set, cement-based repair mortar (As required)
Bridge Seal 75%	Penetrating Epoxy Healer/Sealer (as specified)
Pro-Poxy™ 45	Penetrating Epoxy Healer/ Sealer and/or Primer (as specified)
Pro-Poxy™ 45 LT	Penetrating Epoxy Healer/ Sealer and/or Primer (as specified)

High friction resurfacing

Lake Barkley, Kentucky

SAFETY CONSIDERATIONS:

- Maintain current SDS's onsite and adhere to all requirements
- Adequate traffic control and/or lane protections
- Wear protective clothing; steel toe boots, safety glasses and gloves
- Site appropriate PPE; hard hats, reflective vests, reflective pants
- Organic solvent respirators if working in enclosed, poorly ventilated areas
- Dust masks when necessary for aggregate broadcasting



Kansas City - Light Rail Bridge

AGGREGATE SELECTION:

The broadcast aggregate for this system is typically selected by the project specifier, with the aggregate imparting several important characteristics to the epoxy overlay system including; durability, traction/ slip resistance, & aesthetics. The aggregate gives the overlay system its ability to withstand repeated abuse from vehicle tires, and in vehicular areas shall be angular and have a Mohs hardness of 6.0 or higher.

Although numerous aggregates are available for use with epoxy polymer overlays, their selection depends on several factors including type and amount of traffic as well as aesthetic and safety considerations.

For high volume and heavy weight traffic applications, larger sized, more angular aggregates with a higher mohs hardness are used. Examples include: flint, calcined bauxite and certain granites. These types of aggregates are also typically used where vehicular safety and surface friction are of higher concern.

For lower volume/lower speed, lighter weight traffic (e.g. parking structures, pedestrian traffic) installations, smaller sized, less angular aggregates are generally used. Aggregate selection in these applications varies much more than those for high speed, high traffic situations and the aggregates are selected for size, color, safety and durability. Examples range from crushed colored glass, which is colorfast, excellent for delineation/safety and relatively hard to flint and coal slag which are slightly more durable and a more suitable, less expensive option for driving surfaces.

Aggregate shall be free of dirt, clay and all impurities and consist of natural silica sand, basalt, or other non-friable aggregate. Aggregate shall contain less than 0.2% moisture when tested in accordance with ASTM C566.

Specialty aggregates and top coatings can be used to produce a variety of visual effects to differentiate areas such as; bike lanes, identify handicap parking, create pedestrian paths, etc. There are many choices of specialty aggregates available to achieve a desired visual effect including; colored quartz, ground recycled glass, and naturally dark, light, or colored stone.

Typical aggregates used in bridge deck overlays include:

- Flint Rock
- Bauxite
- Washington Stone

ESTIMATING GUIDE

Broadcast Overlays:

Course #1: Epoxy rate: 40 ft²/gal. (1 L/m²)

Aggregate rate: 1-1.5 lb/ft², (4.88-7.32 kg/m²).

Course #2: Epoxy rate: 20 ft²/gal. (2 L/m²)

Aggregate rate: 1-1.5 lb/ft², (4.88-7.32 kg/m²).

Epoxy Mortar: 2 gal/ (7.6 L) epoxy mixed with 10 gal (37.8 L) of dry sand yields approximately 0.94ft³

Road repair with HD 50 by Dayton Superior

PRECONSTRUCTION MEETING:

Before starting the epoxy overlay, a preconstruction meeting is recommended. The meeting should include representatives from all participating parties such as; the owner, engineer, contractor, and materials manufacturer. This meeting should address the, parameters, means, methods, materials, traffic control and safety precautions necessary to achieve the overlay objectives.

DECK REPAIRS:

The Pro-Poxy Type III DOT is compatible with all cementitious patch and repair materials with the exception of materials that contain magnesium phosphate. Any recently patched cementitious material to receive an overlay should cure for 28 days, or have a moisture content of less than 5%. Deck evaluations should be performed per the recommendations in ACI 562 and horizontal repairs performed per the recommendations in ACI Bulletin 7, found in the ACI/ ICRI Concrete Repair Manual.

- The Dayton Superior HD50 can be used for deck repairs.
    - Can be coated with epoxy in as little as 4 hours
- The Unitex Pro-Poxy™ 2500 can be used for deck repairs
    - Can receive a wet on wet application of the Pro-Poxy Type III DOT overlay
- For small, or shallow repairs, the Pro-Poxy Type III DOT can be mixed with the overlay aggregate to create an epoxy mortar. Measure equal parts of the Pro-Poxy Type III DOT, parts A & B. Mix the epoxy for 3 minutes. Once the epoxy has been mixed, slowly add the aggregate and blend until the aggregate is wetted out with epoxy. Typical mortar ratios are between 1-part mixed epoxy to 2.5 – 4 parts aggregate.
    - Can receive a wet on wet application of the Pro-Poxy Type III DOT overlay

Twin Falls, ID

RECOMMENDED EQUIPMENT:

- Shot blasting equipment
- Walk behind scarifier or miller
- Sandblasting equipment
- Sweeping equipment
- Angle grinders with concrete abrasives (diamond grinder)
- Oil free compressed air for blowing off deck and/or running pump
- Epoxy Pump capable of one-to-one ratio dispensing (Lily CD250 or equivalent) and/or cean mixing and measuring buckets (proper proportioning is critical)
- Low-speed, high toque drill and helical style mixing tip if using a pump mixer
- Generator or other access to power
- Notched squeegees (3/16" typical)
- Stiff bristle brooms
- Shovels
- Rollers for detailing
- Spiked Cleats suitable for wet surfaces
- Duct tape
- IR Thermometer
- Moisture Pin Meter
- Extra 5 gallon buckets (purging epoxy pump, waste collection, aggregate distribution)
- Disposable rags
- Solvent (Citrus Clean J48, Acetone, Xylene or Isopropyl alcohol)
- Protective gloves
- PPE as required

SURFACE PREPARATION:

- Minimum age of concrete must be 21-28 days or 80% of the design strength with less than 5% moisture from date of placement. Depending on the concrete mix design, curing and drying conditions.
- Surface and ambient temperature must be a minimum of 50˚F (10˚C) before applying
- Concrete surface must be less than 5% moisture content when tested with a moisture pin meter.
- Surface to be bonded must be clean and sound.
- Sounding the deck per ASTM C4580 is recommended. Procedure B outlines chain dragging for delaminations.
- Repair all delamination's, potholes and cracks
- Remove oil, dirt, grease, laitance, curing compounds and other foreign matter that may cause a problem with bond.
- Surface should be a concrete surface profile (CSP) of 5-9 according to ICRI 310.2
- Typically paint lines, skip marks need to be removed by scarification or milling.
- Asphalt typically requires milling applications. Due to its softer nature, asphalt has a tendency to capture steel shot from shotblasting procedures.
- Shotblast the concrete deck to remove the concrete surface, contaminates, and expose clean, textured concrete.
- Concrete edges adjacent to parapets and walls that are not reached by shotblasting will require grinding and/or sand blasting.
- Tape off and protect any drains or joints that are not to receive epoxy coatings
- Final removal of all debris, dust, steel shot, and laitance from the concrete deck with clean, oil-free, compressed air prior to epoxy installation

EPOXY PRIMERS:

The Pro-Poxy Type III DOT is a low viscosity epoxy that can seal interior and exterior above grade slabs and as low modulus crack filler. While not required, Dayton Superior/ Unitex epoxy primers can be used in conjunction with the Pro-Poxy Type III DOT. These primers are lower viscosity, highly penetrating healer/sealers that are applied to the concrete deck prior to the epoxy overlay.

The epoxy primers are applied by distributing the material evenly with a squeegee, broom or roller. All excess epoxy primer is then removed with a squeegee, or a broom. The overlay system is immediately applied while the epoxy primer is still wet.

MIXING:

Condition material to 65˚-85˚F (18˚-29˚C) for ease of mixing and optimum flow prior to using.
Mix only what can be used within the pot life

Hand Mixing

Premix each component then place 1 part by volume of Component A and 1 part by volume of component B into a clean pail and mix for three minutes with a low speed, high toque drill using a Jiffy mixer or paddle until uniformly blended.

Note:

- This method is typically used where truck mounted application machines are not applicable to the specified locations because of logistics and/or restrictions.
- When mixing in buckets, designate 1 color for each part (exp. Part A- White, Part B- Blue) and mark the buckets at a set volume for easy, consistent batching.
- Fully submerge the mixer and mix at a speed that does not entrap air into the epoxy
- Have multiple mixing buckets on hand, as mixed epoxy builds up on the lining
- DO NOT allow unmixed material to contaminate the deck
- DO NOT leave hand mixing containers turned over after the epoxy is poured out. turn mixing buckets upside down to drain on deck

Mechanical mixing and application

The Pro- Poxy™ Type III D.O.T. shall be applied by a truck or trailer mounted application machine onto the pavement section to be treated in varying widths at a uniform application thickness. The epoxy pump must be able to dispense and mix the epoxy at a one-to-one ratio.

Note:

- Lily CD250 and similar pumps have been used successfully with Pro-Poxy Type III DOT
- When using an epoxy pump, purge epoxy from the static mixing nozzle into a bucket before starting the first time, and between any pauses to ensure unmixed material is not dispensed onto the deck.
- Metering equipment is recommended to monitor dispensing and coverage rates.
- Check all connections to ensure epoxy is not being dripped onto the deck
- Ensure the pump is not pulling in air which results in popping, and foamy epoxy

INSTALLATION PROCEDURE:

Mix the epoxy as previously directed and apply

Course #1

- Spread the neat Pro-Poxy™ Type III D.O.T. at a coverage rate of 40 ft²/gal. (1 m²/L) using a 3/16 notched squeegee
- Immediately broadcast select aggregate to refusal (typically 1-1.5 lb/ft², 4.88-7.32 kg/m²).
- After the initial cure of the first course, remove all excess aggregate

Course #2

- Spread the neat Pro-Poxy™ Type III D.O.T. at a coverage rate of 20 ft²/gal. (0.5 m²/L), once again broadcasting the select aggregate to the point of rejection.
- After the initial cure of the second course, remove all excess aggregate
- Allow the system to cure.

After all the aggregate has been removed it can be opened up to traffic.

Colder temperatures will slow the setting time while warmer temperatures will accelerate the set time.

INSTALLATION NOTES, TIPS & TRICKS:

- Installation crew members who walk through the wet, neat epoxy should wear spikes shoes
  - Typically squeegee and rock applicators who traffic through the epoxy
- Use duct tape to protect joints, steel and create clean lines when starting or stopping.
  - Pull the tape after aggregate has been broadcast, before epoxy sets.
- Turn off AC units on install equipment to prevent water being dropped on the deck.
- Diaper trucks and equipment install rigs as necessary to prevent deck contamination.
- When working on single lane applications, on second lifts of the first epoxy overlay, create a tape line approximately 6" inset from the edge of the base application. This inset will allow the second lift of the adjacent installation to overlap, reducing overlapping seams.
- Slight imperfections in the first lift are typically leveled out in the second lift.
- In colder temperatures, use the Pro-Poxy type III DOT LT or Bridge Seal Accelerator in the regular Pro-Poxy type III DOT to reduce the cure times.

CURE TIMES:

Cure Time

Temperature	Set Time
50-55°F (10-12.7°C)	5-6 hours
60°-65°F (16-18°C)	3-4 hours
70 - 74°F (22-23°C)	2-2 1/2 hours
75 - 79°F (24-26°C)	1 1/2-2 hours
The data shown is typical for controlled laboratory conditions. Reasonable variation from these results can be expected due to Inter-laboratory precision and bias. Material, surface and ambient temperatures will affect set times.	

Note: When faster turnaround is required, the use of Bridge Seal Accelerator can reduce the set time of Pro-Poxy Type III DOT between 30-60% based on ambient conditions, material temperatures, and substrate conditions

OVERLAY QUALITY CONTROL MEASURES:

- Monitor and record the amount of product used compared to the installation area for each lift.
- When using a pump, ensure the epoxy part A and part B are being dispensed at the same rate
- Take small cup samples (1/2- 1/4 of cup) of the mixed epoxy when the installation begins to ensure setting
- Visually inspect the epoxy between each lift, looking for anomalies such as dark or soft spots
- Perform pull off bond testing per ASTM C1583 / ICRI 210.3

TROUBLE SHOOTING:

Epoxy not setting up, or extended set times

- Was the material mixed at a 1-to-1 ration
  - If not mixed at the correct ratio, the epoxy may not harden
- Did the deck and material temperatures stay at or above 40° F during the curing period?
  - Colder temperatures extend the curing time. As a general rule, the gel time of the epoxy will be double for each 10˚ to 15˚ decrease in temperature below 75˚F.
  - At or under 40° F, mixed material will cease reacting, and will not harden.

Epoxy setting too fast

- Was the Pro-Poxy Type III DOT preconditioned to 65˚-85˚F, or the concrete deck 90° +
  - As a general rule, the gel time of the epoxy will be cut in half for each 10˚ to 15˚ increase in temperature above 75˚F

Material thick, and difficult to pump or mix

- Was the Pro-Poxy Type III DOT preconditioned to 65˚-85˚F
  - The colder the epoxy, the higher the viscosity (thicker).

Dark and/or soft spots in the epoxy overlay

NOTE: This is indicative of unmixed material

- Did raw Part A or B drop on the deck from totes or containers
- Was the static mixing nozzle purged before each start and stop of epoxy pumping
- Where mixing buckets turned upside down on the deck and allowed to drain
  - Soft spots must be completely removed down to clean, bare concrete and solid surrounding epoxy before patching.

Delamination of the epoxy coating

~ Was the deck correctly prepared and contaminations removed prior to installation?

~ Is the delamination over an incompatible patch or repair such as magnesium phosphate repair mortars or rubberized concrete repair product?

~ Did the delamination occur over a steel joint, or deck?

~ Excessive moisture in the concrete or moisture drive?

INDUSTRY REFERENCES:

ACI 548.5R-16	Guide for Polymer Concrete Overlays
ASTM C881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ICRI 310.2R	Selecting and Specifying Concrete Surface Preparation
ACI 562	Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures and Commentary
ACI/ ICRI	Concrete Repair Manual
ACI Bulletin 7	Repair Application Guide: Spall Repair of Horizontal Concrete Surfaces
Standard Test Method for ASTM C C1583	Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
SIMILAR TO ICRI 210.3	
ICRI 210.3R	Guide for Using In-Situ Tensile Pull-off Tests to Evaluate Bond of Concrete Surface Materials
ASTM C4580	Standard Practice for Measuring Delaminations in Concrete Bridge Decks by Sounding
ACI 503R	Appendix A, of the ACI Manual of Concrete Practice- Pipe Cap Pull Off Test

**This is an older test method with limited current practice, superseded by ASTM C1583*

DISCLAIMERS:

This application guide does not claim to address all of the health and safety practices associated with the installation of epoxy overlays. It is the applicators' responsibility to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

It is the responsibility of the user of this document to establish health and safety practices appropriate to the specific circumstances involved with its use. ACI does not make any representations with regard to health and safety issues and the use of this document. The user must determine the applicability of all regulatory limitations before applying the document and must comply with all applicable laws and regulations, including but not limited to, United States Occupational Safety and Health Administration (OSHA) health and safety standards.

This document is intended as a voluntary field guide for the Owner, design professional, and concrete repair contractor. It is not intended to relieve the user of this guide of responsibility for a proper condition assessment and structural evaluation of existing conditions, and for the specification of concrete repair methods, materials, or practices by an experienced engineer/designer.

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