Region Bridge Support Unit
Bridge Field Services

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Thin Epoxy Overlay/Healer Sealer Treatments on Bridge Decks

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Introduction

Epoxy based sealers and overlays have been used as preventive maintenance treatments on bridge decks in Michigan since the early 1990's. The initial treatments were time consuming and their effectiveness and longevity were uncertain. Since then, improvements in material and application methods made through employee innovations and industrial advances have erased all uncertainty. By educating employees on identifying the proper candidates and proper installation methods, epoxy based sealers and overlays have become a fast, cost effective, and long lasting treatment that has extended the life of Michigan's structures.

Flood Coat

Flood coat is a term used to describe the flooding of an entire bridge deck with a material to seal or bridge cracks to prevent moisture intrusion. The flood coat method pours material on the deck and then squeegees or brooms the material over the entire surface, essentially flooding the deck. Flood coating is typically used with thin epoxy overlays and penetrating sealers such as healer sealers, however, the term may be applied to other materials similar in nature.

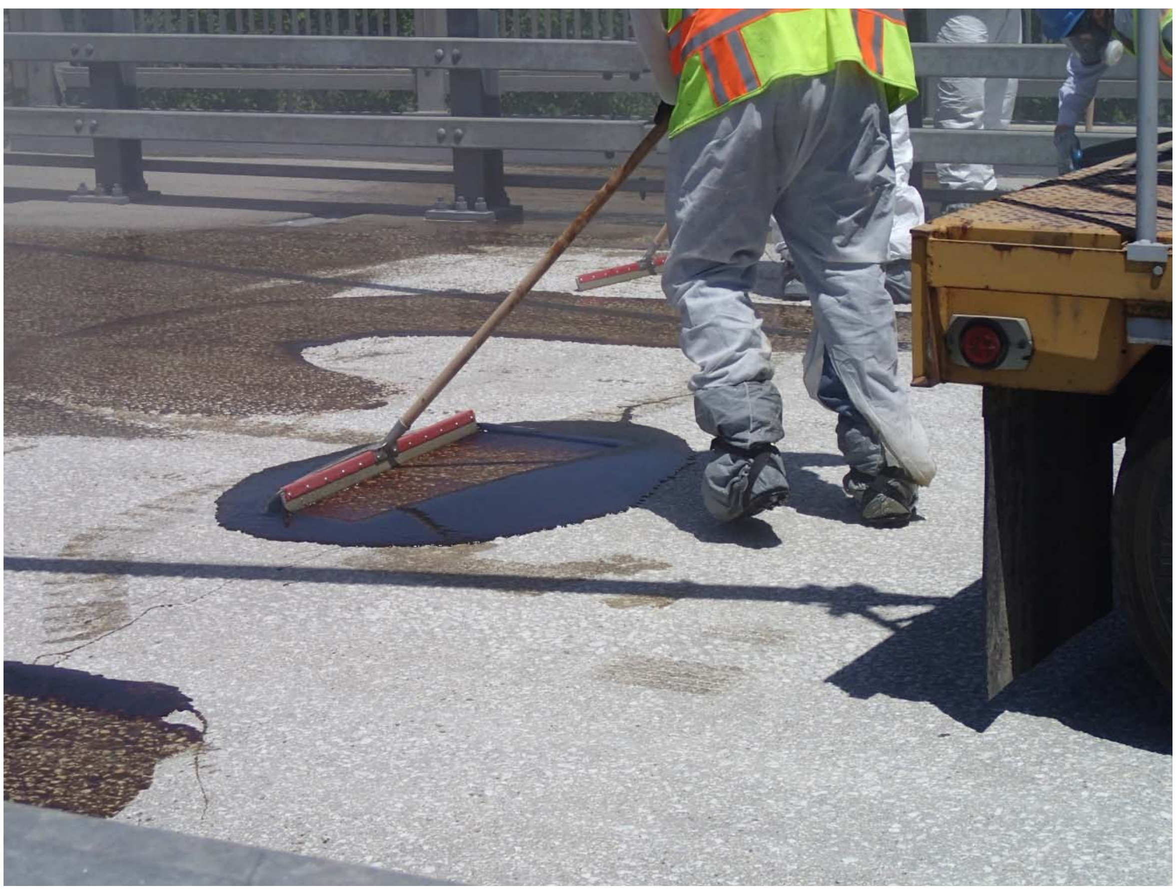

Figure 1 Flooding a bridge deck with a thin overlay epoxy

Identifying Candidates

There are several factors to consider when identifying a candidate and application method. Factors may include: cause of cracking, need for increased skid resistance, deck condition, traffic control and cost.

When investigating the causes of cracking one must interpret whether the cracks are caused by seasonal weather changes, concrete shrinkage or stresses in the deck. Micro cracks that are due to shrinkage or weather fluctuations that are not visible to the naked eye are more suitable for a flood coat rather than crack chasing. A crack chasing operation may be better suited for sealing cracks caused by local stresses in the deck to ensure significant penetration of the material and to allow for future monitoring of the cracks.

Concrete decks are also susceptible to traffic wear, polishing and loss of friction. Often a bridge deck requires a higher friction surface to increase skid resistance. In these cases an epoxy overlay will seal the cracks and restore the friction of the wearing surface.

Decks with an underside National Bridge Inventory (NBI) condition rating of 4 or less should not be crack chased or flood coated because it will not appreciably improve the life expectancy of a deck already exhibiting widespread, full depth distress. Also, sealing the cracks will not "glue" together a poor top surface. Deck patching must be performed prior to flood coating poor/fair deck surfaces.

Mobility also needs to be considered. Crack chasing operations are faster, but will only seal the visible cracks. A flood coat operation involves longer lane closures, but successfully seals every crack.

Crack Chasing Candidates

Crack chasing is the simplest method for sealing widely spaced and easily identifiable cracks on a bridge deck. This work should always be performed on a bridge deck in conjunction with other ongoing work. Visible cracks should be sealed every time a lane closure is set up on a bridge deck. All bridge decks that are being patched or having joints replaced should have the perimeter of the concrete work crack chased (unless a healer sealer or thin epoxy overlay is also scheduled). Bridge decks that are experiencing working stress cracks should not have a thin epoxy overlay applied. Crack chasing and healer sealers will allow the continued unimpeded monitoring of the cracks. Finally, crack chasing should be limited to the bridge decks outlined above because it is heavily reliant on the applicators ability to identify cracks in the field while healer sealers and thin epoxy overlays seal all of the cracks.

Figure 2 Crack chasing operation

Thin Overlay Candidates

Thin overlays and healer sealers, although both can be applied as a flood coat, are uniquely different. They both seal the cracks in bridge decks but do so in different ways. A thin overlay "bridges" the cracks in a deck. The thin overlay acts as an integrally bonded layer on the bridge that prevents moisture from entering the cracks. It is a two coat system, each coat consisting of a layer of epoxy and aggregate. The epoxy is applied approximately 3/16 inch thick and followed by a layer of aggregate. The aggregate typically used is trap rock, chipped flint or bauxite. It is imperative that the deck preparation prior to application be done properly because this type of system does not penetrate, and only bridges the cracks and bonds to the deck surface. The preparation involves removing the deck tining and paint lines by scarifying or heavy shotblast, followed by a heavy shotblast that profiles the deck surface to a concrete surface profile 7 (CSP 7), as determined by the International Concrete Repair Institute Guideline 310.2R. This ensures the exposure of sufficient large aggregate and the removal of any contamination that may interfere with the bonding of the thin overlay to the deck surface. Again, the overlay must bond to exposed large aggregate in the deck surface. The cement mortar is not strong enough to provide a proper bond and will result in debonding and failure of the thin overlay.

Thin overlays are the best option for bridge decks, and should be considered for every bridge deck greater than one year old, that is not showing abnormal signs of wear from contracting or design errors. Exceptions to this are when the deck condition is too low for a treatment to be worthwhile or as discussed below, within the section *Healer Sealer Candidates.*

Figure 3 Shotblasting in preparation of a thin epoxy overlay.

Healer Sealer Candidates

A healer sealer is a crack penetrating sealer with a much lower viscosity than thin overlay materials. The viscosity of epoxy based healer sealers is approximately 50-80 centipoises (cps), while thin overlay epoxies have a viscosity of approximately 2000 cps. For scale, water has a viscosity of approximately 1 cps and honey 2000-3000 cps. A healer sealer is a one coat system that involves flooding the deck with the penetrating crack sealer and broadcasting fine aggregate to maintain skid resistance. A light shotblast, equivalent to a CSP 3, as determined by the International Concrete Repair Institute Guideline 310.2R, is necessary to remove contaminates and "open up" the cracks in the deck. The cracks' edges are rounded off by shotblasting and any debris in the crack is removed. This allows the healer sealer to sufficiently penetrate the crack. Any healer sealer on the deck surface that does not penetrate will wear off over time, while the healer sealer that penetrated the cracks will remain and continue to prevent moisture intrusion.

Healer sealers should be considered on bridge decks with widespread cracking that are in mobility sensitive areas, or as deemed appropriate by the Region's asset management plan. While healer sealers are marginally quicker and less expensive than thin overlays, these savings quickly disappear considering they require reapplication every 8 to 10 years and should only be selected because of present day required budgetary savings or mobility restrictions.

Skid Resistance

Skid resistance is measured by determining the Skid Number (SN). The SN is a measure of the frictional resistance to motion (F) divided by the load perpendicular to the interface (L) multiplied by 100.

$$SN = \frac{F}{L \times 100}$$

A SN greater than 35 is acceptable for heavily traveled roads. Typical bridge decks throughout the state have a SN between 35 and 45.

A thin epoxy overlay will increase the SN of a bridge deck to approximately 65. This is a significant increase in skid resistance. A healer sealer will increase or maintain a SN of 45. It will temporarily increase the SN of a smooth deck and maintain the SN of other decks. After the healer sealer has worn off, the deck will return to the original SN.

Figure 4 Angular aggregate used for thin epoxy overlays to increase skid resistance.

Viscosity

Viscosity is a measure of a fluid's resistance to flow. Knowing the viscosity of a material is helpful in understanding its characteristics during application. A higher value will penetrate cracks more slowly and be less effective sealing smaller cracks than lower values.

Supplier	Product	Manufacturer's Application Rates	Mix Ratio	Shelf Life	Manufacturer's Aggregate Rates	Viscosity (centipoise)
BASF	MasterSeal 350	1st - 2.5 gallon / 100 sft	1.0A : 1.0B	2 years	1st - 10 pounds / syd	2000
		2nd - 5.0 gallon / 100 sft			2nd - 10 pounds / syd	
E-Bond	526 Lo-Mod	1st - 2.5 gallon / 100 sft	1.0A : 1.0B	1 year	1st - 10 pounds / syd	1500
		2nd - 5.0 gallon / 100 sft			2nd - 14 pounds / syd	
E-Chem	EP50	1st - 2.5 gallon / 100 sft	1.0A : 1.0B	Not Given	1st - 10 pounds / syd	Not Given
		2nd - 5.0 gallon / 100 sft			2nd - 14 pounds / syd	
Euclid Chemical	Flexolith	1st - 2.5 gallon / 100 sft	1.0A : 1.0B	2 years	1st - 13 pounds / syd	1700
		2nd - 5.0 gallon / 100 sft			2nd - 18 pounds / syd	
	Flexolith Summer Grade	1st - 2.5 gallon / 100 sft	1.0A : 1.0B	2 years	1st - 13 pounds / syd	1700
		2nd - 5.0 gallon / 100 sft			2nd - 18 pounds / syd	
	Flexolith HD	1st - 2.5 gallon / 100 sft	1.0A : 1.0B	2 years	1st - 13 pounds / syd	Not Given
		2nd - 5.0 gallon / 100 sft			2nd - 18 pounds / syd	
Poly-Carb	Flexogrid Mark – 163	1st - 2.9 gallon / 100 sft	2.0A : 1.0B	2 years	1st - 15 pounds / syd	Not Given
		2nd - 6.7 gallon / 100 sft			2nd - 15 pounds / syd	
	Flexogrid Mark - 154	1st - 2.9 gallon / 100 sft	1.0A : 1.0B	1 year	1st - 15 pounds / syd	750
		2nd - 6.7 gallon / 100 sft			2nd - 15 pounds / syd	
Sika	Sikadur 22-Lo Mod	No application rate given.	1.0A : 1.0B	2 years	1st - 18 pounds / syd	2000
					2nd - 18 pounds / syd	
Transpo	T-48 Chip Seal	1st - 2.5 gallon / 100 sft	2.0A : 1.0B	Not Given	1st - 13 pounds / syd	1200
		2nd - 2.5 gallon / 100 sft			2nd - 13 pounds / syd	
Unitex	Propoxy Type III DOT	1st - 2.5 gallon / 100 sft	1.0A : 1.0B	2 years	1st - 13 pounds / syd	1500
		2nd - 5.0 gallon / 100 sft			2nd - 13 pounds / syd	

Table 1 2016 Approved two component 100% solids thin epoxy overlay systems

Supplier	Product	Manufacturer's Application Rates	Mix Ratio	Shelf Life	Manufacturer's Aggregate Rates	Viscosity (centipoise)	Time to penetrate cracks
E-Chem	EP100	1 gallon / 100 sft	2.0A : 1.0B	2 years	Not Given	Not Given	Not Given
Euclid Chemical	Dural 335	1 gallon / 100 sft	4.0A : 1.0B	1 year	0.8 pounds / syd	80	20 minutes @ 75 degrees
	Dural 50 LM	1 gallon / 100 sft	2.0A : 1.0B	2 years	0.8 pounds / syd	80	20 minutes @ 75 degrees
Poly-Carb	Mark 127	1 gallon / 100 sft	2.0A : 1.0B	2 years	1.5 pounds / syd	100	30 to 60 minutes @ 75 degrees
Sika	Sikadur 55 SLV	1 gallon / 100 sft	2.5A : 1.0B	2 years	1.4 pounds / syd	95	20 minutes @ 75 degrees
Unitex	Pro-Poxy 40 LV LM	1 gallon / 100 sft	1.0A : 1.0B	1 year	Not Given	Not Given	Not Given

Table 2 2016 Approved two component 100% solids epoxy healer sealer systems

Comparing the viscosity values in Table 1 and Table 2 help display how one method "bridges" cracks and the other penetrates them. The smaller values for healer sealer indicate the mixed material can flow easily into tight cracks. The larger numbers for thin epoxy overlay indicate the material remains on the deck surface. Typical application rates for healer sealer are 100 square feet per gallon. However, variations in viscosity may increase/decrease rates by as much as 50 square feet per gallon.

Thin Overlay Surface Preparation

Surface preparation is the most important step to maximize the effectiveness of a thin epoxy overlay. In Michigan, the required method of deck preparation is shotblasting. Shotblasting is derived from the collision of small particles traveling at a high velocity against the deck surface to remove material and is not known to cause micro cracking. Other methods of removal such as milling rely on heavy mass and heavy impact into the deck surface and are known to cause micro cracking.

Performing a heavy shotblast to the deck surface will remove all paint lines, oils, dirt, curing compounds, weak surface mortar and other contaminants. The velocity of the shotblaster and the size of the steel shot determine the number of passes across a surface required to achieve specific Concrete Surface Profiles (CSP).

Type	Diameter	Profile[*]
S-170[†]	0.017 in. (0.43 mm)	CSP 3
S-230	0.023 in. (0.58 mm)	CSP 3
S-280	0.028 in. (0.71 mm)	CSP 3
S-330	0.033 in. (0.84 mm)	CSP 5
S-390	0.039 in. (1.0 mm)	CSP 5
S-460	0.046 in. (1.17 mm)	CSP 7
S-550[†]	0.055 in. (1.40 mm)	CSP 9

[*]Each type of shot will produce a CSP range. The profile obtained is also influenced by machine setup and rate of travel.
[†]Use of this size is not recommended bv some manufacturers.

Table 3 - Steel shot selection table. Image(s) courtesy of the International Concrete Repair Institute (ICRI) from Technical Guideline No. 310.2R-2013, "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

Multiple passes with a shotblaster is common to achieve a CSP 7. The number of passes is dependent on condition/tining of the deck, speed of shotblaster, type of equipment, etc. Michigan bridge decks are tined when the concrete is wet. This tining process pushes the large aggregate into the concrete deck below the surface. **Removal of the tining is required as a first step on bridge decks.** It is important to understand the surface roughness and aggregate exposure required for proper bonding of the epoxy because steel shotblasting may create surface profiles ranging from two to nine. The International Concrete Repair Institute Guideline 310.2R defines the surface profiles, classifies them on a scale of 1 to 10, and recommends steel shot sizes to achieve most CSP's (See Table 3).

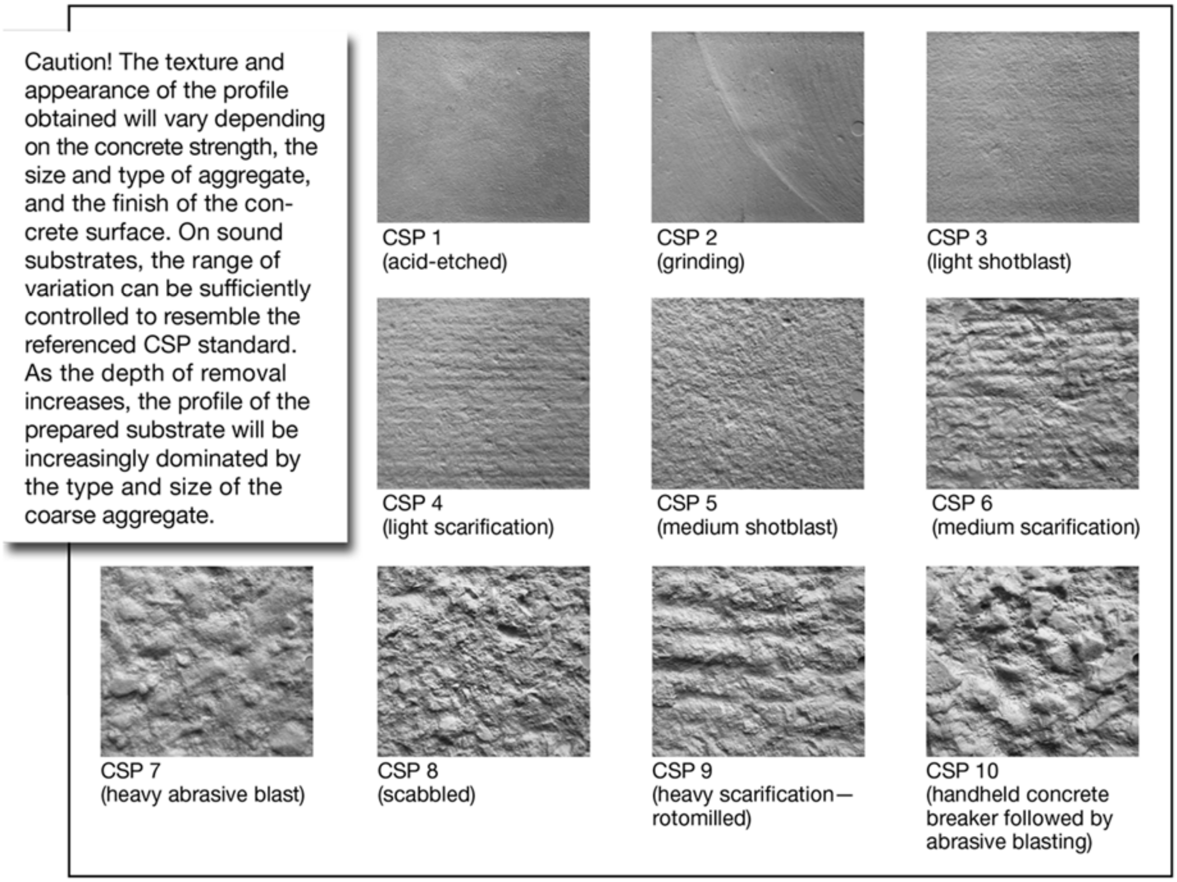

Figure 5 - Image(s) courtesy of the International Concrete Repair Institute (ICRI) from Technical Guideline No. 310.2R-2013, "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair

ICRI has developed surface profile chips to aid in this determination in the field. These surface profile chips should be placed on each bridge deck prior to placing the overlay to verify and document that the proper CSP has been achieved. Figure 6 shows a CSP 3 chip and figure 7 shows a CSP 7 chip. MDOT personnel may contact the Region Bridge Support Unit to obtain a set of CSP chips.

Figure 6 Light Shotblast – CSP 3 - Image(s) courtesy of the International Concrete Repair Institute (ICRI) from Technical Guideline No. 310.2R-2013, "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair

Figure 7 Heavy Shotblast – CSP 7 - Image(s) courtesy of the International Concrete Repair Institute (ICRI) from Technical Guideline No. 310.2R-2013, "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair

Figure 8 is an example of improper surface preparation. The tining and areas of weak mortar in the deck had not been removed resulting in a premature failure of the thin overlay.

Figure 8 Thin overlay failure due to improper surface preparation.

Paint striping acts as a bond breaker and must be removed. Scarifying is an effective method to remove paint striping. If any unsound areas are discovered during shotblasting they must be repaired and the overlay application delayed. All patches utilizing Portland cement must cure for a minimum of 28 days. There are many proprietary patching materials derived from polymers that may be overlaid earlier than 28 days. Great care must be taken when selecting a non-Portland Cement based patching material. Consult the manufacturer of both the thin overlay epoxy and patching material to address any compatibility concerns. Some polymer based patching materials, such as magnesium phosphates, are incompatible with epoxy based thin overlays.

Figure 9 Proper profile provided by shotblasting for a thin epoxy overlay
(Note the amount of exposed aggregate)

Vehicular traffic is not allowed on the prepared shotblast surface prior to completing both courses of the overlay. The surface must be reshotblast in the event the lane needs to be opened or it rains to remove all materials that may interfere with the bonding or curing of the epoxy. Proper planning will reduce the amount of repetitive shotblasting occurrences.

Healer Sealer Surface Preparation

Shotblasting must also be performed prior to applying healer sealer. The purpose of shotblasting for a healer sealer is to round crack edges and facilitate penetration of the epoxy. A concrete surface profile (CSP) 3 is easily achieved by shotblasting. Usually tining is not removed nor is aggregate exposed, but the surface should be noticeably lighter in color.

Figure 10 Noticeable Color change

Vehicular traffic is not allowed on the prepared shotblast surface prior to completing the healer sealer. Vehicular traffic would push dirt and other fine particles into the freshly opened cracks and deter the desired crack penetration. The surface must reshotblast in the event the lane needs to be opened or if it rains to remove all materials that may interfere with the bonding or curing of the epoxy. Proper planning will reduce the amount of repetitive shotblasting occurrences.

Final Cleaning

Expansion joints should be taped off prior to application. Removing cured epoxy from strip seal joints often damages the gland which will lead to deterioration of the beams, bearings, and the substructure. Deck drains should also be taped or covered to prevent the release of epoxy to a roadway or water below.

Figure 11 Dry compressed air is used to remove loose surface particles.

A rolling magnetic sweeper is helpful to retrieve steel shot for reuse and reduces the amount of particles on the deck. Clean the deck with oil-free moisture free compressed air after shotblasting to remove any dust or loose particles from the cleaning operation. A vacuum truck may be used prior to cleaning the deck with compressed air. Brooms and broom trucks are prohibited because they force dust particles into the freshly cleaned cracks.

Moisture Testing

No visible moisture shall be present on the surface of the concrete at the time of application. Additionally, moisture testing must be completed on all flood coats in accordance with ASTM D4263. Conduct the test by securely taping one 18 inch by 18 inch 4 mil transparent polyethylene sheet to the deck for every 500 square feet of bridge deck. Allow the plastic sheet to remain in place for a minimum of three hours or the manufacturer's recommended cure time for the weather conditions at the time of application, whichever is longer.

ASTM D4263 detects the capillary moisture that would form on or within the surface between the concrete deck and the epoxy. The presence of capillary moisture will create a bond breaker prior to the epoxy adhering to the deck surface or crack faces. **A flood coat type application must be delayed if moisture in the form of condensation forms on the polyethylene sheet during the test to allow capillary moisture to escape from the concrete.**

Application Temperature and Weather

The recommended air and surface temperature for proper curing of epoxy is a minimum 50°F and rising for both the daytime and nighttime temperatures. Do not place materials if weather or surface conditions are such that the material cannot be properly handled, placed, and cured within the manufacturer's requirements and specified requirements of traffic control. In the event of unexpected precipitation all uncured material must be immediately covered and protected with plastic sheeting. Areas exposed to precipitation or that have cured prior to receiving broadcast aggregate must be removed and replaced. Removing an improperly placed thin overlay is expensive and requires the use of a fine tooth mill.

Figure 12 - Removal of thin epoxy overlay by fine tooth mill.

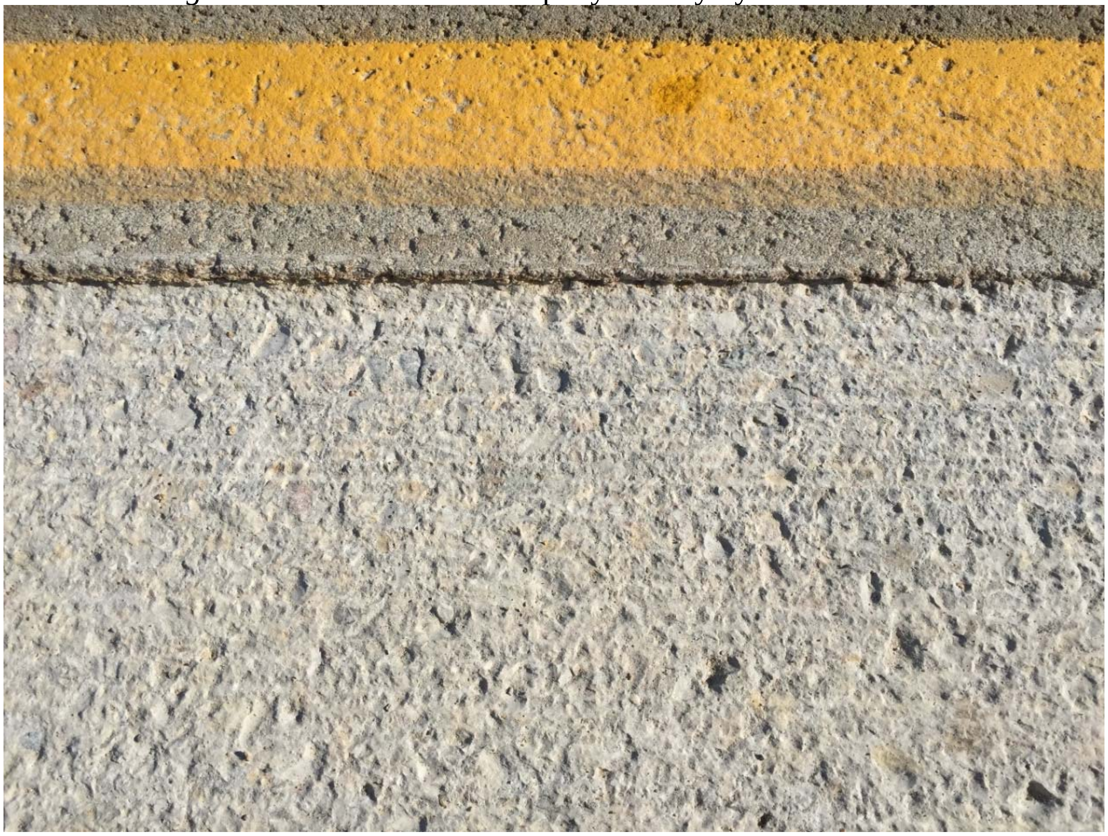

Figure 13 - Fine tooth mill profile.

Applying Epoxy

Epoxy and aggregate should be stored in a warm location for several hours when daytime temperatures will not reach 70°F. Epoxy may be conditioned to 100°F with the use of blanket heaters to ensure it is properly mixed and achieves a consistent cure time.

Figure 14 Contained mixing station with calibrated containers and a clock ensures the material is mixed accurately.

Mixing the epoxy must be done in a controlled fashion to eliminate any variances. Ratios range from 1:1 to 4:1 depending on the brand. Epoxy should be measured in containers that are clearly labeled “A” and “B” when hand mixing. Mix the measured epoxy in a mixing container of at least 150 percent larger volume to prevent spills. Placing a tarp underneath the mixing containers and having an absorption kit nearby is helpful to capture any spilled material. It is imperative to not allow any unmixed epoxy spill onto the deck. The unmixed Part A or Part B on the deck will absorb into the concrete and cause a bond breaker. Spills on additional layers will skew the component ratio leaving a “soft spot” of uncured overlay material on the deck.

Figure 15 An electric drill with Jiffy® type mixing paddle combines the resin and hardener.

Use a half inch electric or gas powered drill with an appropriately sized Jiffy® type mixing paddle. Keep the entire paddle beneath the surface of the epoxy to prevent entraining air. All brands need to be mixed for exactly three minutes. A watch or other timing device must be used for accuracy. Less mixing will lead to improper curing and jeopardize adhesion of the product. Over mixing may result in premature setting of epoxy.

For mechanical mixing applications, use automatic dispensers that are calibrated to the correct proportion of Part A and Part B, capable of mixing and dispensing the material for continuous placement. Do not turn off the pump or nozzle once the overlay begins unless the nozzle is placed in a drip pail. Part A and Part B have different viscosities and the epoxy will drip out of the mixing nozzle off-ratio and the drips will skew the component ratio leaving a "soft spot" of uncured epoxy material on the deck.

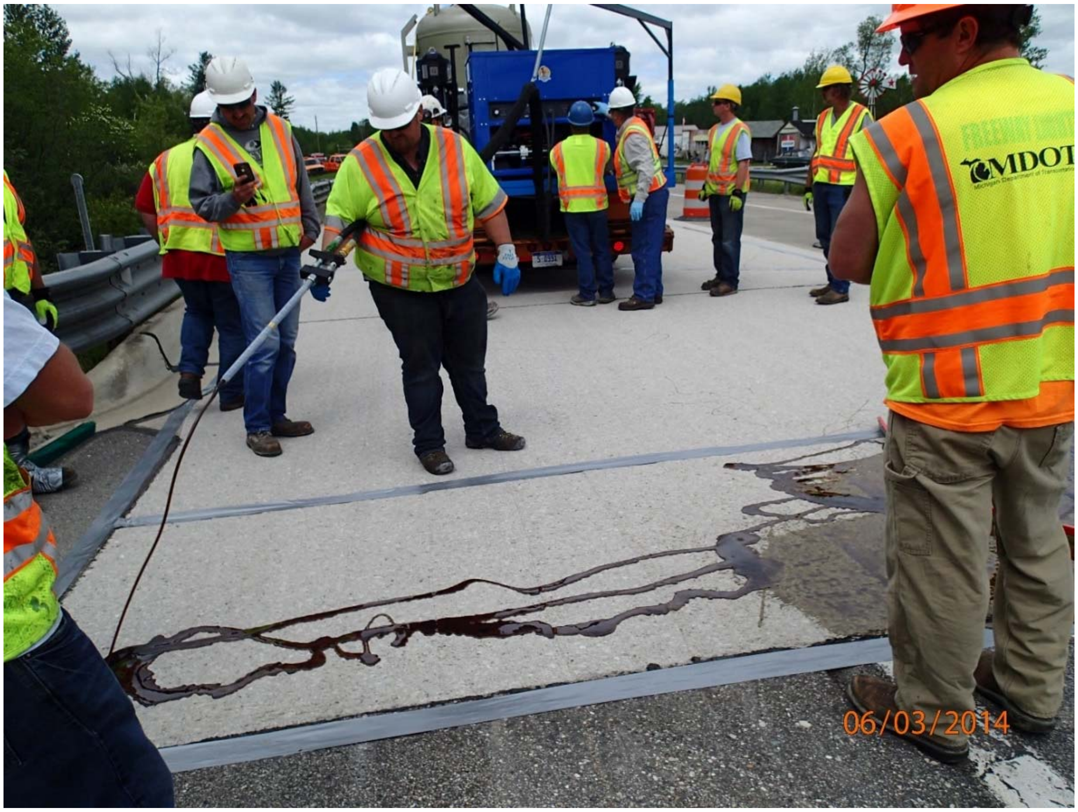

Figure 16 A Lily Epoxy Dispensing Pump delivers Part A and Part B to a mixing nozzle where the epoxy is dispensed onto the deck.

Figure 17 Drip locations appear "wet", and are easily peeled up.

It is important to spread the mixed epoxy material in a timely manner after it is poured on the bridge deck. Containers should be completely emptied after each batch to avoid placing cured material on the deck that will eventually scale off.

Figure 18 Notched squeegees (1/4 inch) spread thin overlay epoxy at the correct thickness.

Thin overlays are two course systems. The application rate for the first course must be a minimum of 2.5 gallons per 100 square feet. Immediately, after pouring the mixed material onto the deck, ¼ inch notched squeegees shall be used to distribute the epoxy evenly. Distribute the epoxy in a continuous manner that ensures the mixed material does not segregate, dry or otherwise harden prior to broadcasting the aggregate. Traffic is not permitted on the first course at any time. After the first course has cured sufficiently that brooming will not tear the surface, broom all excess aggregate from the deck prior to placing the second course. The same process is used for the second course; however, the application rate shall be a minimum of 5 gallons per 100 square feet.

Figure 19 Asphalt seal-coating brushes are used to spread healer sealer epoxy from deck surface.

A healer sealer is a one coat system that is applied at approximately 100 square feet per gallon. Once the material is mixed, immediately and uniformly apply it to the surface of the bridge deck. Spread the epoxy with brooms at a rate that allows it to pool and penetrate the deck surface per the manufacturer's recommendations. Most often, this means waiting 20 minutes between placement of epoxy on the deck and placement of aggregate. Asphalt sealing brushes are especially helpful to spread epoxy on uneven surfaces. Removing excess epoxy from uneven areas of the deck to maintain the existing profile and skid number.

Aggregate

Multiple suppliers of aggregate are approved for thin overlays. Refer to table 2.2 below for gradation requirements and MDOT Frequently Used Special Provision 12SP-712B for an updated list of approved suppliers. These aggregates are angular, have a minimum Moh's hardness of 7, and consist of natural silica sand, basalt, or other nonfriable aggregate. Michigan requires aggregate having a minimum Moh's hardness of 7 because of the use of tungsten carbide inserts for moldboard assemblies on the cutting edge of their snow plow blades. The tungsten carbide inserts have a Rockwell Hardness, "A" Scale Range of 87.5-89.0 that roughly converts to a Moh's hardness range of 7.0-7.5. The requirement for such a high degree of aggregate hardness allows the approved materials to provide exceptional skid resistance for multiple seasons while resisting the polishing effects of the State's winter maintenance operations. Aggregate should be supplied in super sacks, containing less than 0.2% moisture as determined by ASTM C566. The aggregate must remain dry prior to and during placement.

Sieve Size	Minimum % Passing	Maximum % Passing
3/8	100	100
4	98	100
8	30	75
16	0	5
30	0	1
Pan	0	0
	Minimum	Maximum
Fineness Modulus	2.28	2.81

Table 4 – Aggregate Gradation Requirements for thin overlays per ACI 548.8-07 Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay for Bridge and Parking Garage Decks

There are multiple techniques to broadcast aggregate. Broadcasting by hand ("chicken feeding") or using a gravity fed spinning distributor such as a fertilizer spreader is effective, but is labor intensive and results in excessive waste. A venturi system connected to an air compressors creates a vacuum that draws aggregate from bulk bags and distributes it onto the freshly placed epoxy through a 4 inch hose. Each venturi system requires 375 cfm of air. A single 375 cfm air compressor can support one venturi and hose and a 750 cfm air compressor can support two venturi systems and hoses. Most recently the department developed a distribution system where aggregate is dispensed from a blast pot under low pressure. This new method evenly distributes the aggregate like the venturi system, but uses less air volume while dispensing a higher volume of aggregate.

Figure 20 Two venturi units spreading aggregate substantially increase production.

Figure 21 Blast pot delivering aggregate to operator

Figure 22 – Full Epoxy Operation

Apply aggregate to refusal, or so that no wet spots are visible. If epoxy bleeds through the aggregate the area should be covered with additional aggregate prior to initial set.

Figure 23 A modified aggregate drop pipe for venturi systems

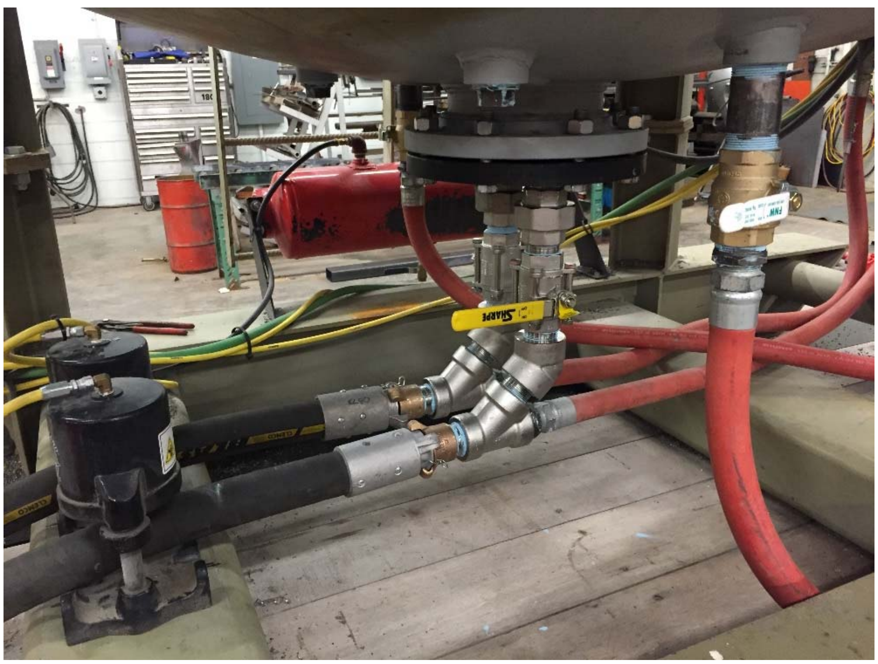

Figure 24 - Modified blast pot showing two dispensing lines with pinch valves.

Figure 25 - Interior view of the bottom of the blast pot showing air manifold used to push aggregate towards middle/center dispensing lines.

Multiple suppliers of fine aggregate are approved for healer sealers, refer to Table 5 below for gradation requirements and MDOT Frequently Used Special Provision 12SP-710B for an updated list of approved suppliers. These aggregates have a minimum Moh's hardness of 6 and consist of natural silica sand, basalt, or other nonfriable aggregate. Aggregate should be supplied in super sacks, containing less than 0.2% moisture as determined by ASTM C566. The sand must be applied to excess and provide a dry appearance to the deck after placement. Additional sand will need to be placed immediately if the surface appears wet. The sand should be spread at a rate of approximately 2.0 pounds per square foot. Traffic may be reestablished after the epoxy has cured and excess sand has been removed.

Sieve Size	Minimum % Passing	Maximum % Passing
4	100	100
16	95	100
30	85	100
50	15	75
100	0	25
200	0	10
Pan	0	0

Table 5 – Aggregate Gradation Requirements for healer sealers

Figure 26 Sand placement during a healer sealer application.

Figure 27 - Excess sand removal from healer sealer application.

Life Expectancy

A thin epoxy overlay application is expected to last approximately 20 years. There are several factors that may cause a premature failure. Improper surface preparation, deck moisture content, weather conditions and mix ratios can all causes failures. It is vital that the *Thin Epoxy Overlay Log Sheet*, located in the appendix, is filled out for each thin epoxy overlay in order to properly determine the exact cause of failure. Isolated or small failure areas may be repaired by shotblasting the surface and reapplying the epoxy if the log sheet does not have any apparent errors that would indicate the beginning of a widespread failure.

Figure 28 A delamination in an approximately 12 year old thin overlay is repaired.

Healer sealer treatments typically last 8 to 10 years prior to additional applications. Repetitive treatments will significantly delay deck deterioration by preventing corrosion and/or freeze-thaw damage.

Summary

The following is a summary of the differences between the crack chasing, healer sealer and thin overlay methods and costs of bridge deck crack sealing.

Crack Chasing

- Seals cracks in bridge deck through direct application to crack
- Success is reliant on applicator filling cracks to refusal
- Reapply as often as cracks become visible
- Used for perimeters of deck patches and full depth joint replacements

Thin Overlay

- Seals cracks in bridge deck by bridging
- Integrally bonded overlay becomes the new deck surface
- Use on any deck greater than 1 year old with a fair or better deck top and bottom condition
- Colored aggregates may provide aesthetic wearing surface
- Increases skid resistance
- Dark aggregates deter icing of the bridge
- Success is heavily dependent on deck preparation and application
- Susceptible to snow plow damage

- Life expectancy of approximately 20 years
- Deck preparation rates up to 600-850 square feet per hour (Rate based on one BW SCB16 Shotblaster)
- Production rates up to 1,000 – 3,500 square feet per hour per layer
- Typical two hour cure time per layer

Healer Sealer

- Seals cracks in bridge deck by penetration
- Aggregate wears off the surface and existing deck surface is still visible
- Less reliant on preparation
- Life expectancy of 8 to 10 years
- Deck preparation rates up to 1600-1700 square feet per hour (Rate based on one BW SCB16 Shotblaster)
- Production rates up to 1,000 – 3,500 square feet per hour
- Typical two hour cure time

Costs

	Thin Overlay	Healer Sealer
Cost of Epoxy per Gallon	$18.00	$28.00
Cost of Epoxy per Square Foot	$1.35	$0.28
Cost of Aggregate per Pound	$0.10	$0.06
Cost of Aggregate per Square Foot	$0.40	$0.12
Cost of Shot Blasting per Square Foot	$0.71	$0.34
Combined Cost per Square Foot	**$2.46**	**$0.74**

Table 6 – Purchase Order Material Costs – Square foot costs based on average application rates given in Table 1 and 2

For estimating healer sealer and thin epoxy overlay contracts, the MDOT public website for Bridge Management and Scoping publishes the *Bridge Cost Estimating Worksheet for CPM, Rehab, Replace, and CSM Projects.* For 2016, Healer Sealers are estimated to be contracted at $2.45 / SFT and thin epoxy overlays are estimated to be contracted for $3.75 / SFT.

Regardless of the preventive treatment you choose, complete documentation of the installation is required for Region Support to be able to estimate quantities and understand the cause of any problems that may occur in the future. For your use, a project log sheet is located in the appendix of this document for Healer Sealers and Thin Overlays.