



Performance Evaluation of KYTC Bridge Deck Overlays Used for Maintenance Activities

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Kentucky Transportation Center
College of Engineering, University of Kentucky, Lexington, Kentucky

in cooperation with
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Commonwealth of Kentucky

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Research Report

KTC-26-01

Performance Evaluation of KYTC Bridge Deck Overlays Used for Maintenance Activities

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16. Abstract State departments of transportation use bridge deck overlay systems to prolong bridge deck service lives. Consisting of a thin layer of material applied to a concrete bridge deck surface, overlays form a protective barrier that improves ride quality, protects embedded reinforcement from harsh environmental conditions, enhances structure durability, and improves deck drainage. Over the past 20 years, the Kentucky Transportation Cabinet has made significant investments in overlays, rehabilitating nearly 5,000 bridge decks with them — roughly $\frac{1}{3}$ of all bridges statewide. Given the significant investment in overlays, and the fact they degrade over time — eventually re-exposing bridge decks to harsh environmental conditions, — it is critical to understand what factors influence their performance and condition. This study sought to identify predictors or metrics that can account for variability in overlay performance throughout Kentucky and support accurate forecasting of future conditions. Using data from the Cabinet's Bridge Management System, along with field inspections, chloride analysis, and imagery captured with a forward looking infrared (FLIR) camera, researchers attempted to identify statistical relationships between variables such as crack width/depth, crack length, average daily traffic, and amount of deck patching, and overlay condition. Limited by the constraints of a small data set (93 bridges), researchers did not uncover robust statistical relationships. Analysis found, however, that epoxy overlays exhibited the least linear cracking as well as the narrowest cracks. Asphalt overlays had the least amount of deck patching, but generally suffered from the deepest cracking. Epoxy overlays were in the best condition overall. The FLIR camera has utility for taking photos of bridge decks, however, image capture must occur under very precise conditions (e.g., no traffic, favorable weather) and image interpretation must be done by trained experts.			
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Executive Summary

State departments of transportation use bridge deck overlay systems to prolong bridge deck service lives. Overlays consist of a thin layer of material (e.g., asphalt concrete, Portland cement–based concrete, latex modified concrete, epoxy polymer concrete, polyester polymer concrete) applied to a concrete deck surface. Once installed, overlays form a protective barrier that improves ride quality, protects embedded reinforcement from harsh environmental conditions, enhances structure durability, and improves deck drainage. With a range of overlay options available, agencies can select a product best suited to the environments in which they will be used. Like all materials, overlays eventually deteriorate. As deterioration progresses, underlying bridge decks inevitably degrade when they are re-exposed to harsh environmental conditions.

Over the past 20 years, the Kentucky Transportation Cabinet has rehabilitated nearly 5,000 bridge decks with overlays — roughly $\frac{1}{3}$ of all bridges statewide. Given the ubiquity of overlays and their importance for maintaining the structural integrity of bridges, it is critical to understand their long-term performance and identify relationships between overlay condition and variables such as service life, route type, average daily traffic (ADT), and deck distress (e.g., delamination, patching, potholes).

This study combined field inspection of 93 bridges and analysis of data from KYTC's Bridge Management System (BrM) to identify robust predictors of overlay performance. Field data collection entailed visually inspecting decks while walking along shoulders, using a forward looking infrared (FLIR) camera to photograph decks, and retrieving concrete samples that for chloride analysis. Researchers statistically analyzed data on several parameters, including linear feet of cracking, area of deck patching, chloride content, crack width, overlay depth, ADT, and number of bridge spans. Preliminary evaluations suggested the presence of chlorides in concrete decks below overlays could be a good indicator of overlay performance. But correlation and regression analysis did not uncover clear relationships between overlay condition and the variables mentioned above. Researchers found epoxy overlays exhibited the least linear cracking as well as the narrowest cracks. Asphalt overlays had the least amount of deck patching but generally suffered from severe cracking. Epoxy overlays were in the best condition overall, although, interestingly, decks that had these overlays also had the highest measured chloride levels.

The FLIR camera used to capture deck images can be an effective tool but also has numerous drawbacks. Only those pictures taken when not traffic is present yield good results (a challenge on routes with high ADT); weather conditions must also be favorable. Additionally, decks must have a thermal differential for the FLIR to detect delamination. Shadowing and water pooled on deck surfaces negatively impact image quality as well. Other key drawbacks include sensitivity to environmental conditions, difficulty penetrating certain materials, inconsistent accuracy in measuring temperatures, and difficulty handling interference caused by reflective surfaces. Operators must also have a great deal of experience to accurately interpret images.

Ultimately, the limited number of field inspections and small set data stymied the research team's efforts to identify predictors or develop a metric that could be used to gauge overlay performance. As such, a more in-depth follow-up study is warranted, one focused on detailed reviews of bridge inspection reports and conducting additional deck inspections. When identifying candidate structures for inspection, factors such as overlays, traffic volume, and salt applications should be considered. In addition to pinpointing trustworthy predictors of overlays performance, additional research will shed light on which types of overlays are the most durable and longest lasting.

Chapter 1 Introduction

1.1 Background

State departments of transportation (DOTs) have used bridge deck overlay systems since the 1960s to extend the service lives of concrete bridge decks. An overlay is a thin layer of material (e.g., asphalt concrete, Portland cement-based concrete, latex modified concrete, epoxy polymer concrete, polyester polymer concrete) placed atop a concrete deck surface to establish a protective barrier. Bridge deck overlays improve ride quality, protect embedded reinforcement from environmental factors such as deicing salts and water ingress, enhance structure durability, and/or modify the transverse profile and vertical alignment of an existing roadway to improve deck drainage. Table 1.1 summarizes the key benefits of several overlay types.

Table 1.1 Benefits of Overlays

Asphalt Overlays Commonly used due to their flexibility and cost-effectiveness. A waterproof membrane is applied followed by a layer of hot mix asphalt. They typically have briefer service lives than other types of overlays, especially on high-traffic bridges.	
High-Temperature (HT) Asphalt	Performs well in warm climates where high temperatures are common. Formulated to resist softening and rutting under hot conditions.
Low-Temperature (LT) Asphalt	Performs well in colder climates. Formulated to be more flexible and resistant to cracking at low temperatures.
Polymer Overlays Form a seal to prevent chlorides from penetrating concrete. They improve skid resistance and are better suited to major roads with high traffic.	
Epoxy Overlays	Thin while offering excellent bonding and resistance to chloride penetration.
Polyester Polymer Concrete (PPC)	Cures rapidly and has high strength. Particularly useful when a bridge needs to be reopened to traffic quickly.
Multilayer Polymer Overlay	Applied to improve skid values and seal cracks. Consists of multiple layers of epoxy or other polymer materials. Provides a durable and protective surface.
Ultra-Thin Polymer Overlay	Applied at a thickness of $\frac{1}{16}$ in. – $\frac{1}{8}$ in. Protects concrete surfaces from salts, deicing materials, petroleum, and harsh chemicals.
Concrete Overlays	
Latex Modified Concrete (LMC)	Known for high bonding strength, water impermeability, durability, and resistance to cracking. Used often in regions with significant freeze-thaw cycles.
Silica Fume Concrete	Combines reduced permeability with increased durability.
Ultra-High Performance Concrete (UHPC)	Has exceptional durability and strength. Often applied in thin layers and can significantly extend bridge deck service lives.
Dense Concrete Overlay	Uses high-performance concrete (HPC) with a coarse aggregate factor of at least 0.55. Enhances structural capacity and provides chloride/corrosion protection.
Reinforced Concrete Overlay	Incorporate fibers or reinforcing steel into the HPC mix. Improves bridge deck structural integrity and durability.

Thin-Bonded UHPC Overlay	Used for new bridge decks, especially when grades and slopes are out of line. Applied at a minimum thickness of 1.5 in. and provides exceptional durability.
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Overlays have multiple field applications and deliver a range of benefits depending on deck age and condition:

- **New Bridge Decks**
 - Overlays applied to new bridge decks provide a durable wearing surface and protect against deicing salts. This mitigates chloride ingress, which corrodes steel reinforcement and compromises the structural integrity of the bridge.
- **Existing Bridge Decks**
 - For existing bridges, overlays can be used as a rehabilitation measure to extend deck service lives. They can address surface deterioration attributable to high traffic loads and harsh environmental conditions.
- **Preventative Maintenance**
 - Overlays can be used as a preventative measure on decks that are structurally sound but have surface wear. This helps to avoid more extensive and costly repairs in the future.

Over the past 20 years, nearly 5,000 Kentucky bridges have been rehabilitated successfully using overlays. Table 1.2 inventories overlays used throughout the state. By far, asphalt overlays and latex overlays have been the most popular choice.

Table 1.2 Common Overlays Used on Kentucky Bridge Decks

Overlay Type	Number of Decks
Asphalt	2,703
HT Asphalt	20
LT Asphalt	23
Epoxy	62
Latex	1,597
PCC (Portland Cement Concrete)	510

Overlays deteriorate over time, and will eventually begin to debond from underlaying concrete decks. As this process unfolds, exposure to environmental conditions and stressors causes decks to degrade. Seeking insights into the long-term overlay performance the Kentucky Transportation Cabinet (KYTC) commissioned this study to:

- Identify overlaid decks in KYTC Districts with variable service lives.
- Conduct field inspections to determine overlay condition.
- Evaluate the utility of forward looking infrared (FLIR) cameras for analyzing overlay condition.
- Identify relationships between overlay condition and variables such as service life, route type, ADT and total percentage of deck distress (delamination, patching, potholes).

Chapter 2 Literature Summary

This chapter synthesizes findings from two studies (Lin et al. 2021, Robison et al. 2012) that used nondestructive evaluation (NDE) technologies to assess the performance of concrete bridge decks with overlays. Once an overlay is installed, underlying concrete can no longer be inspected visually. As such, NDE technologies can be used to identify localized deterioration, including corrosion, delamination and debonding between the overlay and underlying concrete. These studies looked at several types of overlays:

- Asphalt Overlays
 - Including those with liquid membranes, fabric membranes, and no membranes. Asphalt overlays with waterproof membranes are widely used.
- Rigid Overlays
 - Portland cement concrete and silica fume-modified concrete
 - Latex-modified concrete (LMC)
 - Epoxy polymer concrete (EPC) — Typically applied in thin layers on decks with minimal damage, offering reduced permeability, increased skid resistance, and rapid curing.
 - Polyester polymer concrete (PPC) — A two-part system offering rapid strength development, low water permeability, excellent freeze-thaw resistance, and high temperature resistance. Typically applied at 0.5 in. – 1 in. thickness.

Lin et al. (2021) explored nine technologies while Robison et al. (2012), on behalf of the Wyoming DOT, focused on three NDE methods in addition to traditional techniques. Descriptions of each technology evaluated are provided below.

- Infrared thermography (IRT) / thermal imaging
 - Detects subsurface defects by measuring surface temperature differences. Advantages include portability and potential for vehicle mounting, but limitations include dependence on environmental conditions (requires direct sunlight) and no depth information. Robison et al. (2012) did not recommend this for bridge investigations in Wyoming.
- Ground-penetrating radar (GPR)
 - Uses electromagnetic waves to map internal structure by recording reflections. Can detect rebar, delaminations, voids, honeycombing, and moisture. Advantages include versatility, portability, effectiveness, low cost, suitability for overlays, and potential for minimal traffic control with vehicle-mounted systems. Limitations include difficulties with interpretation and potential traffic interference with cart-mounted systems.
- Impact echo (IE)
 - Uses stress wave reflections to identify delaminations, voids, and measure concrete thickness. Advantages include detecting multiple defects and portability, but it requires experienced users for interpretation and can be affected by surface conditions.
- Ultrasonic surface waves (USW)
 - Uses dispersion of surface waves to indicate defects like delaminations or voids by detecting lower moduli.
- Electrical resistivity (ER)
 - Measures concrete resistivity to characterize corrosive environments.
- Half-cell potential (HCP)
 - Electrochemical technique that measures potential difference to evaluate active rebar corrosion. A potential below -350 mV indicates a 90% probability of corrosion. Wyoming DOT traditionally uses this method.

- Ultrasonic tomography (UT)
 - Uses ultrasonic waves to create subsurface images.
- Impulse response (IR)
 - Measures pavement surface mobility, where lower mobility indicates stiffer areas (i.e., underlying defects).
- Sounding / chain dragging
 - Manual technique involving tapping or dragging (e.g., with a hammer or chain) and listening for differences in sound to detect delaminations. This method is subjective, depends on operator skill, and may only identify delaminations in progressive stages. Wyoming DOT traditionally uses chain dragging.

Lin et al. (2021) investigated the effectiveness of NDE techniques under controlled laboratory conditions and in the field to provide bridge owners with practical information and a selection protocol for NDE technologies.

- Laboratory Testing: Eight identical concrete specimens with artificial defects (shallow/deep delaminations, honeycombing, voids, vertical cracks, pre-corroded rebar) were fabricated. Seven specimens received different overlay types (EPC, LMC, sheet membrane asphalt, liquid membrane asphalt, silica fume concrete, asphalt without a membrane, PPC), while one remained bare. Tests were conducted without and with overlays.
- Without Overlays (Baseline): Most NDE methods could detect multiple defects on bare concrete.
- Key findings of laboratory testing with overlays:
 - Sounding and IR were effective at detecting overlay debonding across all seven overlay types but generally could not detect underlying defects through bonded overlays.
 - USW and IE detected overlay debonding and underlying defects (shallow/deep delaminations, honeycombing, voids) through bonded EPC, LMC, silica fume, and PPC overlays. However, detecting underlying defects through asphalt overlays was significantly limited, especially with waterproof membranes. IE testing on asphalt required cold temperatures (32°F or below).
 - GPR performed well in detecting underlying defects (shallow/deep delaminations, honeycombing, voids) and rebar/specimen thickness through all seven overlay types, in both bonded and debonded areas. GPR condition maps also quantified elevated chloride environments in most cases. However, GPR could not detect overlay debonding or vertical cracks.
 - ERT was ineffective on high-resistivity overlays such as EPC, PPC, and asphalt. It detected debonding in LMC and silica-fume overlays but could not spot underlying corrosive environment through them.
 - HCP reliably detected active rebar corrosion in the underlying deck only through LMC and PPC overlays. The electrical insulation of other overlays stymied reliable detection.
 - IRT detected overlay debonding in all cases and some shallow underlying defects (delaminations, voids) through multiple non-asphalt and asphalt with membrane overlays, but not deeper defects or honeycombing.
 - UT detected the overlay-specimen interface for some overlays but was generally unable to distinguish bonding/debonding or detect underlying defects through any overlay type.

Field testing verified laboratory findings. Lin et al. (2021) concluded that GPR is the most effective method for detecting defects in underlying concrete specimens through both bonded and debonded overlays. However, GPR could not detect overlay debonding itself. Stress-wave methods (USW, IE, UT) were effective for detecting underlying defects under bonded non-asphalt overlays but not asphalt overlays. Sounding and IR were effective for spotting overlay debonding but not underlying defects through bonded overlays.

Robison et al. (2012) work aimed to recommend practical solutions the Wyoming DOT could use to improve safety, efficiency, and accuracy in managing bridge repairs. The agency's traditional methods include chain dragging, HCP, and chloride sampling.

- **Methods:** IE, thermal imaging, GPR, traditional chain dragging, and HCP evaluations were assessed. Researchers prepared damage maps, and a pairwise comparison method was developed, with cores retrieved for visual confirmation.
- **Field Testing and Results:** Three Wyoming bridge decks were evaluated: a bare concrete bridge, an LMC overlay bridge, and an asphalt overlay bridge.
 - **Bare Concrete** — Four test methods (chain dragging, IE, thermal imaging, GPR) indicated large areas of damage, which was confirmed by visual inspection. GPR correlated most strongly with core condition (73%), followed by IE (59%), thermal imaging (47%), and chain dragging (45%).
 - **LMC Overlay** — Chain dragging showed significant variability. Cores often did not reveal damage where NDE predicted with the overlay present.
 - **Asphalt Overlay** — Evaluation was affected by the asphalt overlay. Half-cell data could not be collected due to epoxy coating on the rebar. GPR analysis also encountered complications evaluating the asphalt overlay and shallow rebar. This aligns with the Lin et al.'s (2021) finding of NDE being less effective with asphalt overlays.
- **Time Comparisons and Vehicle-Mounted Systems:** GPR systems took longer to evaluate in the field but provided more comprehensive analyses (detecting both delamination and corrosion), potentially eliminating the need for HCP evaluations. Vehicle-mounted systems (e.g., Rii's GPR van system) were investigated and found to deliver improved safety and efficiency, though they may have some loss of accuracy compared to slower methods.

Robison et al. (2012) concluded that:

- Combining IE and GPR testing offers the most accurate predictions of bridge deck condition.
- For a system-wide program, a vehicle-mounted GPR system offers improved safety and efficiency by minimizing scan time, however commercial availability and affordability remained as obstacles.
- For local, bridge-by-bridge evaluations, IE and GPR have merits. Thermal imaging was not recommended for Wyoming. GPR with appropriate analysis thresholds for corrosion detection may eliminate the need for HCP evaluations.

Both studies highlighted challenges associated with evaluating underlying concrete bridge deck conditions when an overlay is present while emphasizing the critical role of NDE technologies:

- GPR was the most versatile and effective NDE method for detecting underlying defects (delaminations, voids, honeycombing) and rebar condition through all types of overlays, in bonded and debonded areas. It is also effective for identifying corrosive environments. However, GPR is generally not effective at detecting overlay debonding.
- Stress-wave methods (IE, USW) can effectively detect underlying defects through bonded rigid overlays (EPC, LMC, silica fume, PPC) but asphalt overlays significantly limit their effectiveness, especially those with waterproof membranes. IE combined with GPR produces the most accurate results.
- Sounding (chain dragging) and impulse response (IR/IRT) effectively detect overlay debonding across multiple overlay types but generally fail to detect underlying defects through bonded overlays. IRT is limited by environmental conditions and may not reveal deeper defects.

- Electrochemical methods (ER, HCP) are limited by the electrical insulation properties of high-resistivity overlays like asphalt, EPC, and PPC, making them less reliable for detecting underlying corrosive environments or active corrosion when these overlays are present.

Chapter 3 Bridge Deck Overlay Data Acquisition and Analysis

3.1 Deck Overlay Field Data Acquisition

Querying KYTC's Bridge Management System (BrM), we collected data on bridge substructure rating, superstructure rating, deck rating, overlay type, year of overlay application, thickness of overlay and ADT (average daily traffic). To select bridges for detailed field inspections, we plotted and then statistically analyzed deck ratings for structures with different types of overlays (see Table 1.1). Plotting these data revealed that deck ratings were normally distributed, with most bridges scoring near the average and fewer structures toward the extremes (Figures 3.1 – 3.6). We identified 97 bridges for field inspection (20 for Asphalt, 10 for HT, 10 for HT, 17 for Epoxy, 20 for Latex and 20 for PCC). By the time fieldwork began, four bridge decks had been replaced, leaving 93 bridges in our sample (Figure 3.7). To minimize travel disruptions and streamline the research process, we did not close lanes during inspections.

Field data collection entailed visually inspecting decks while walking along shoulders and using a forward looking infrared (FLIR) camera to take photographs (Figure 3.8). We collected data on deck patching, visible efflorescence, and crack location, severity, and width (Appendix A). A general survey of each bridge was carried out to document consequential micro issues. KTC inspected driving surfaces for cracking and estimated linear feet of cracking and patching areas. Our team also estimated crack severity, identified major cracks in bridge spans, and inspected under bridge decks to document efflorescence. In December 2024, KYTC drone operators helped KTC record thermal imaging data (Figure 3.9) on 11 bridges that lacked shoulders from which we could safely gather data. All data were logged in ArcGIS Field Maps to support future analysis.

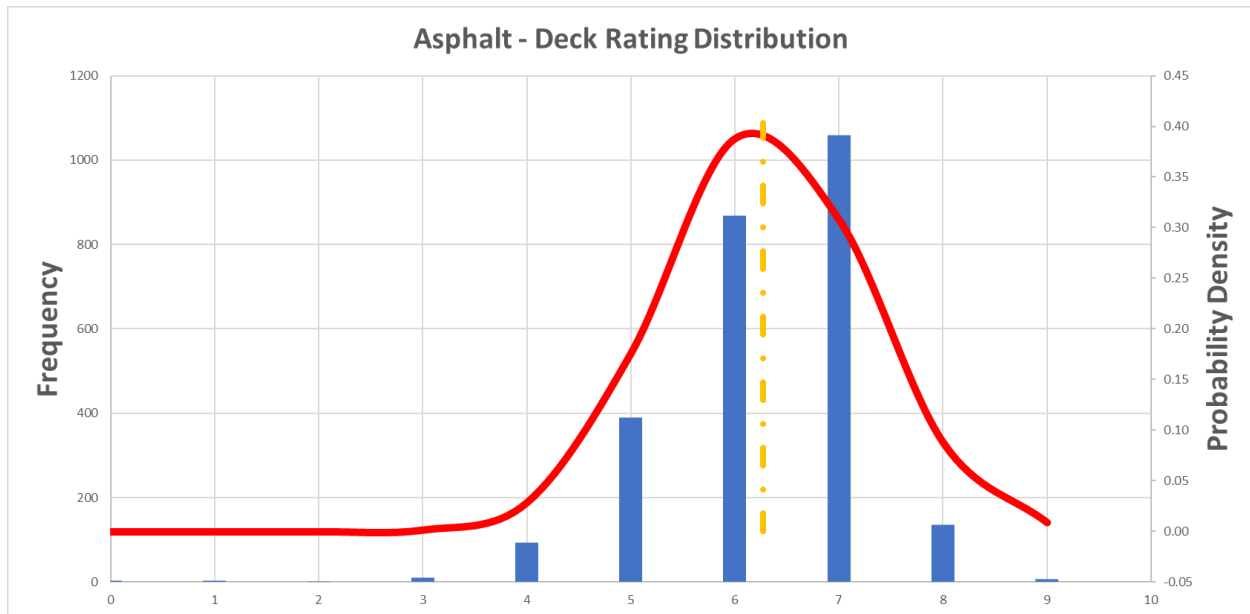


Figure 3.1 Distribution of Deck Ratings for Asphalt Overlays

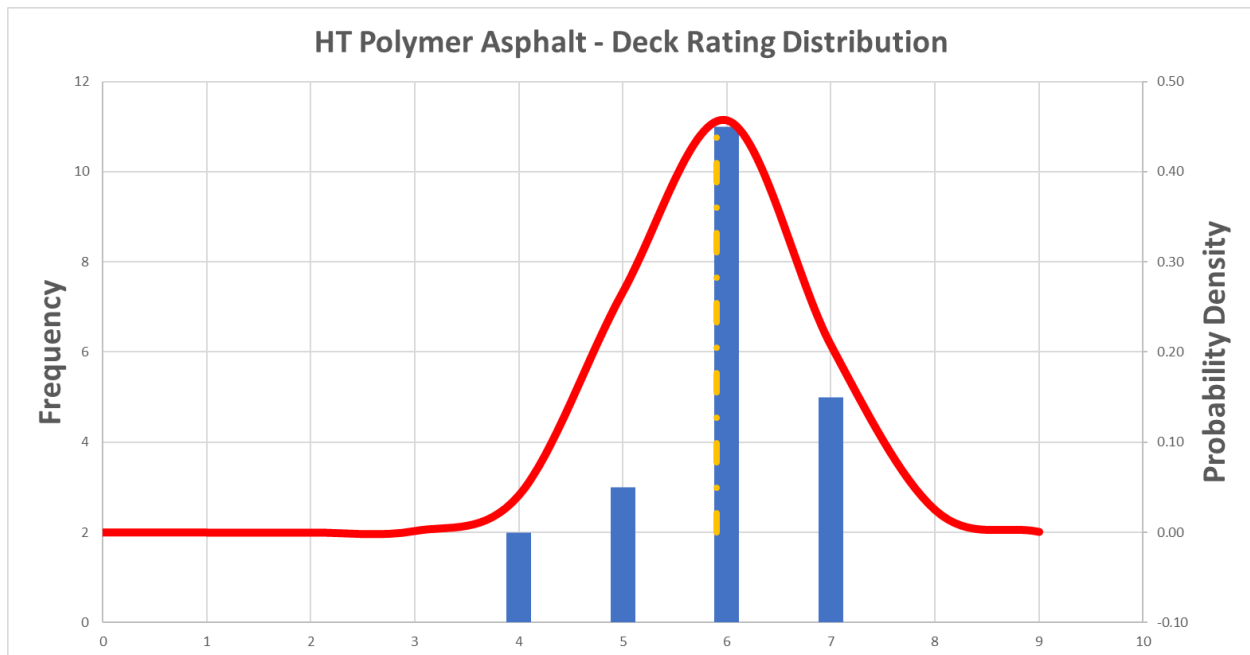


Figure 3.2 Distribution of Deck Ratings of HT Polymer Asphalt Overlays

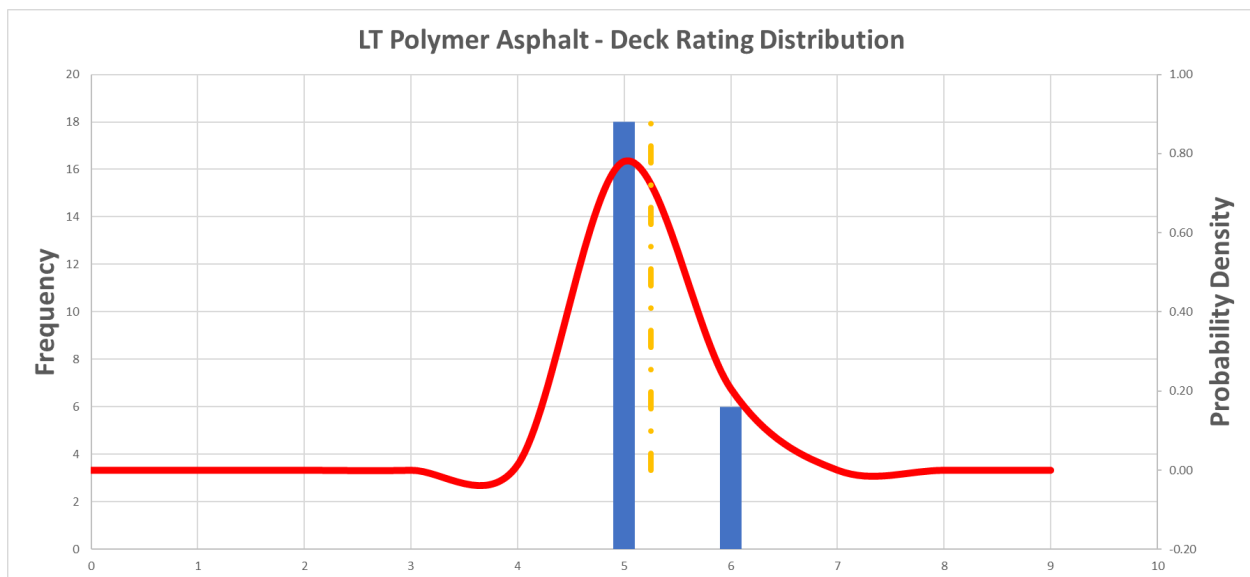


Figure 3.3 Distribution of Deck Ratings for LT Polymer Asphalt Overlays

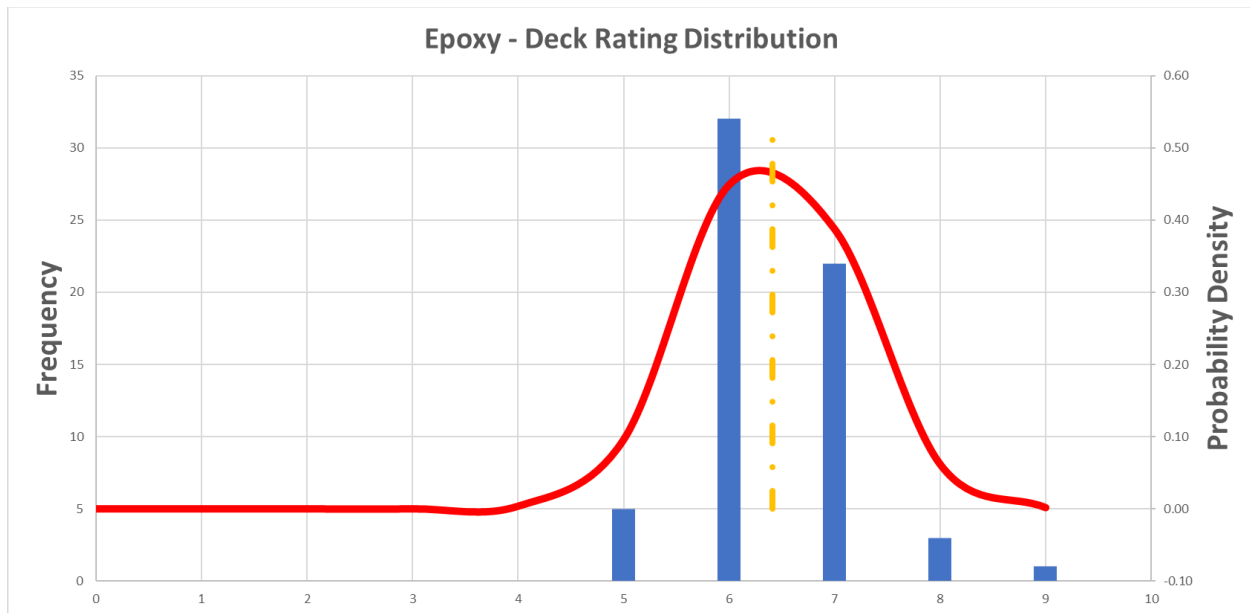


Figure 3.4 Distribution of Deck Ratings for Epoxy Overlays

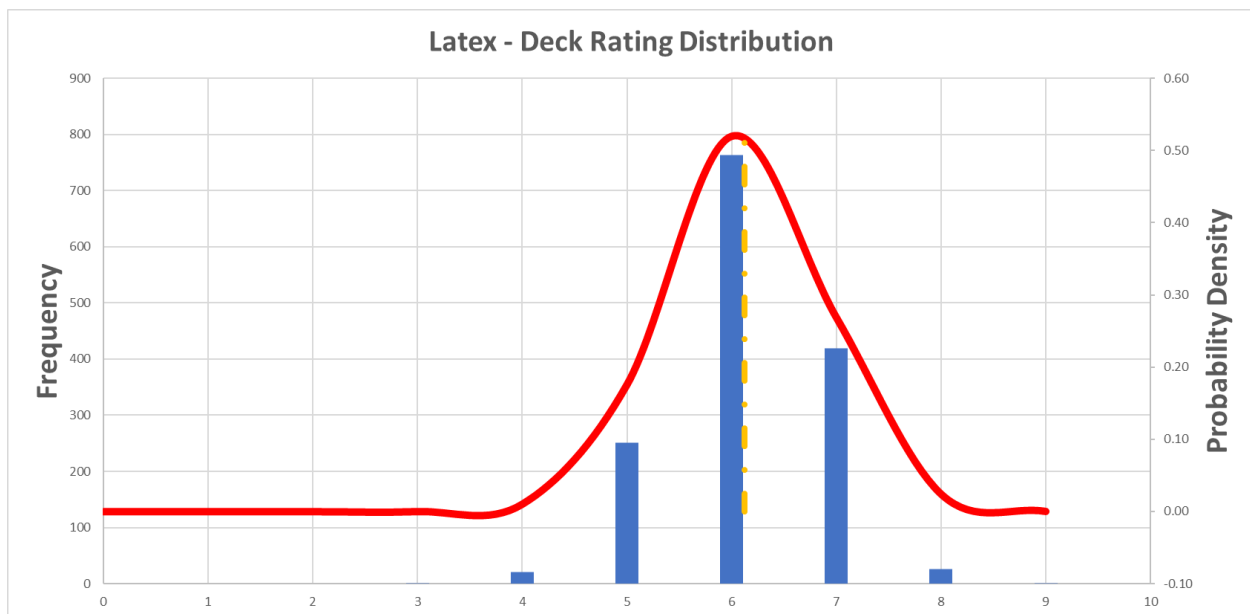


Figure 3.5 Distribution of Deck Ratings for Latex Overlays

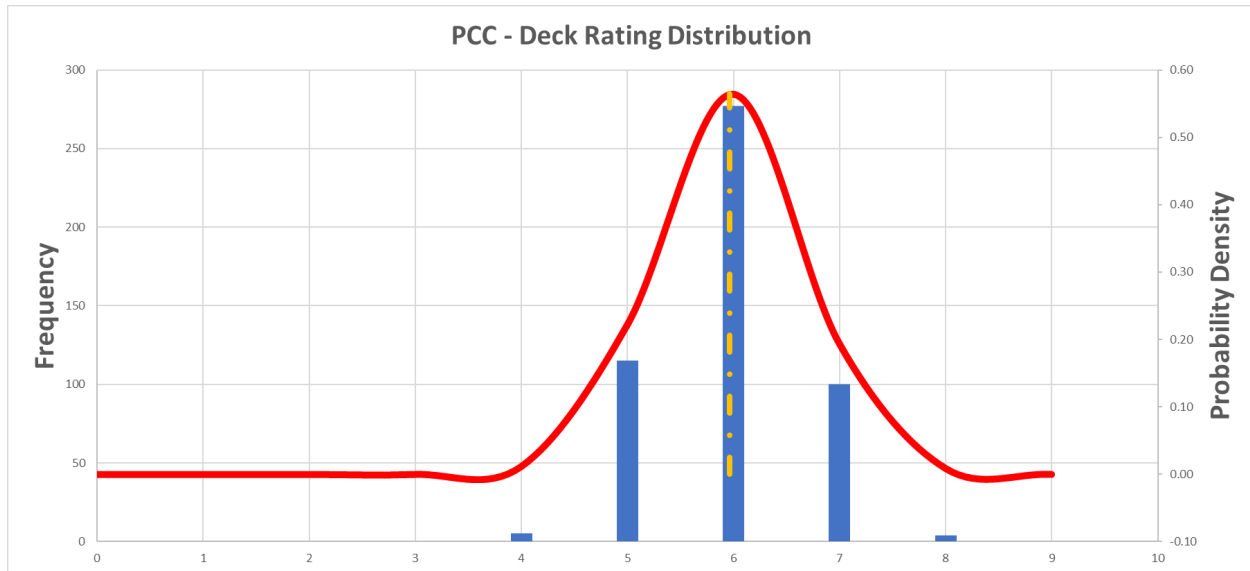


Figure 3.6 Distribution of Deck Ratings for PCC Overlays

Bridge Deck Overlay Field Map

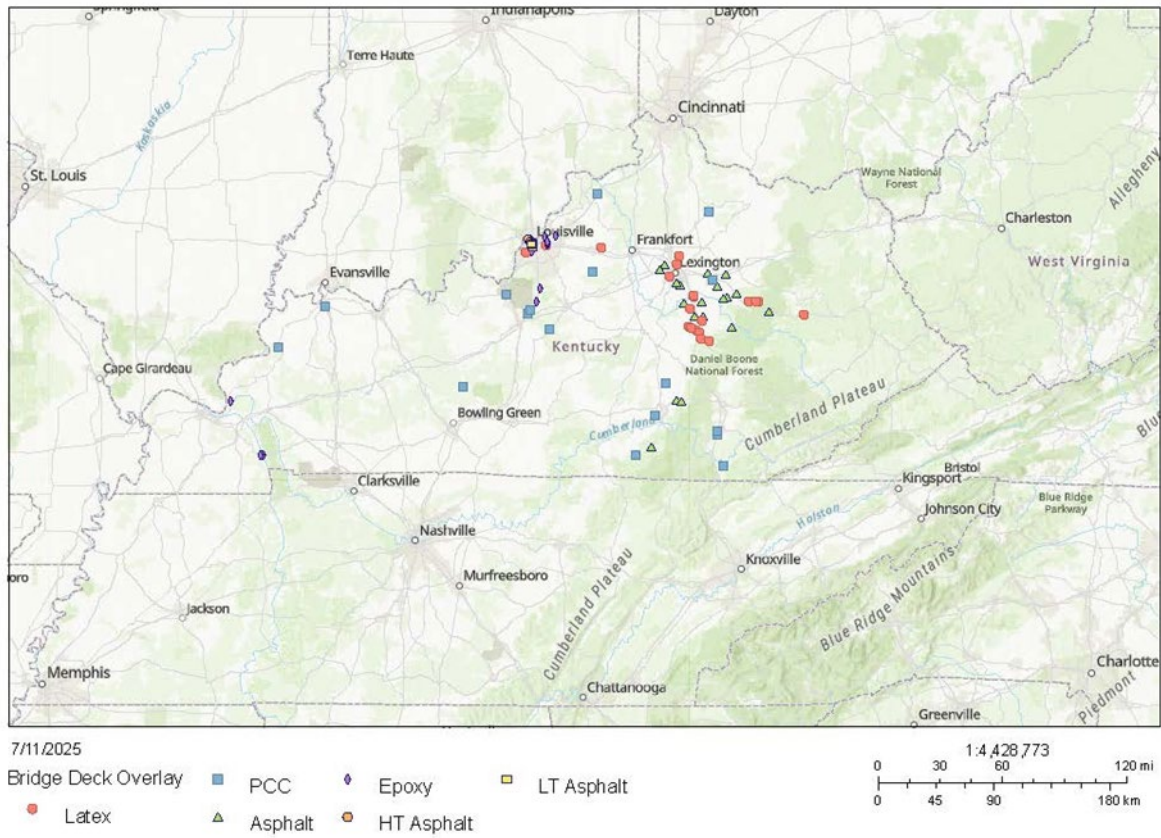


Figure 3.7 Bridge Decks Selected for Field Inspection.

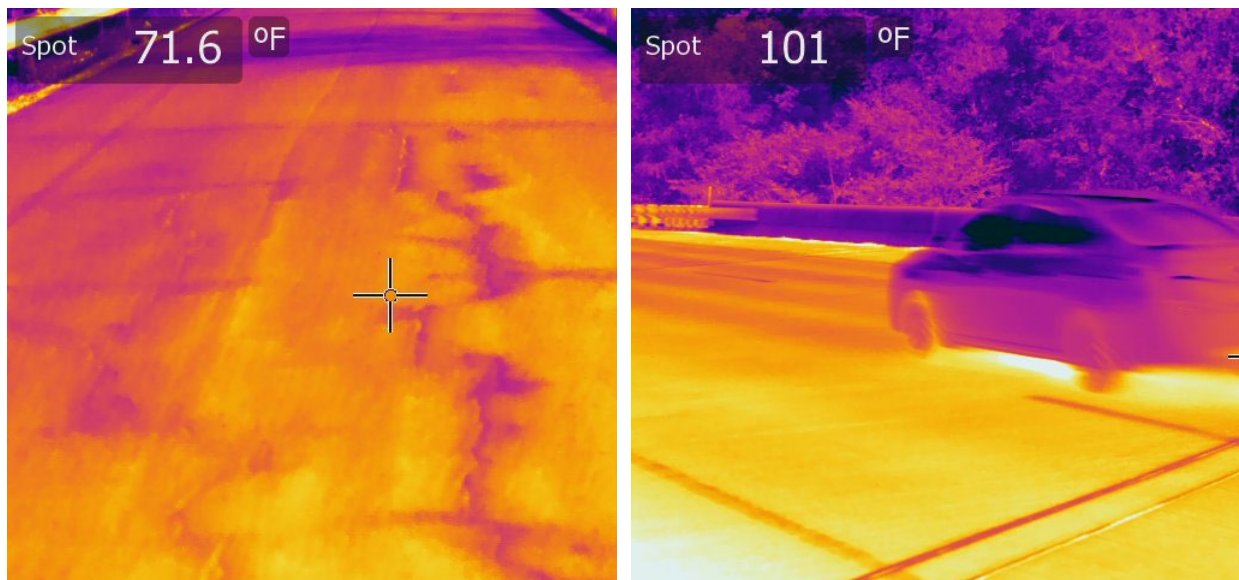


Figure 3.8 FLIR Camera Images

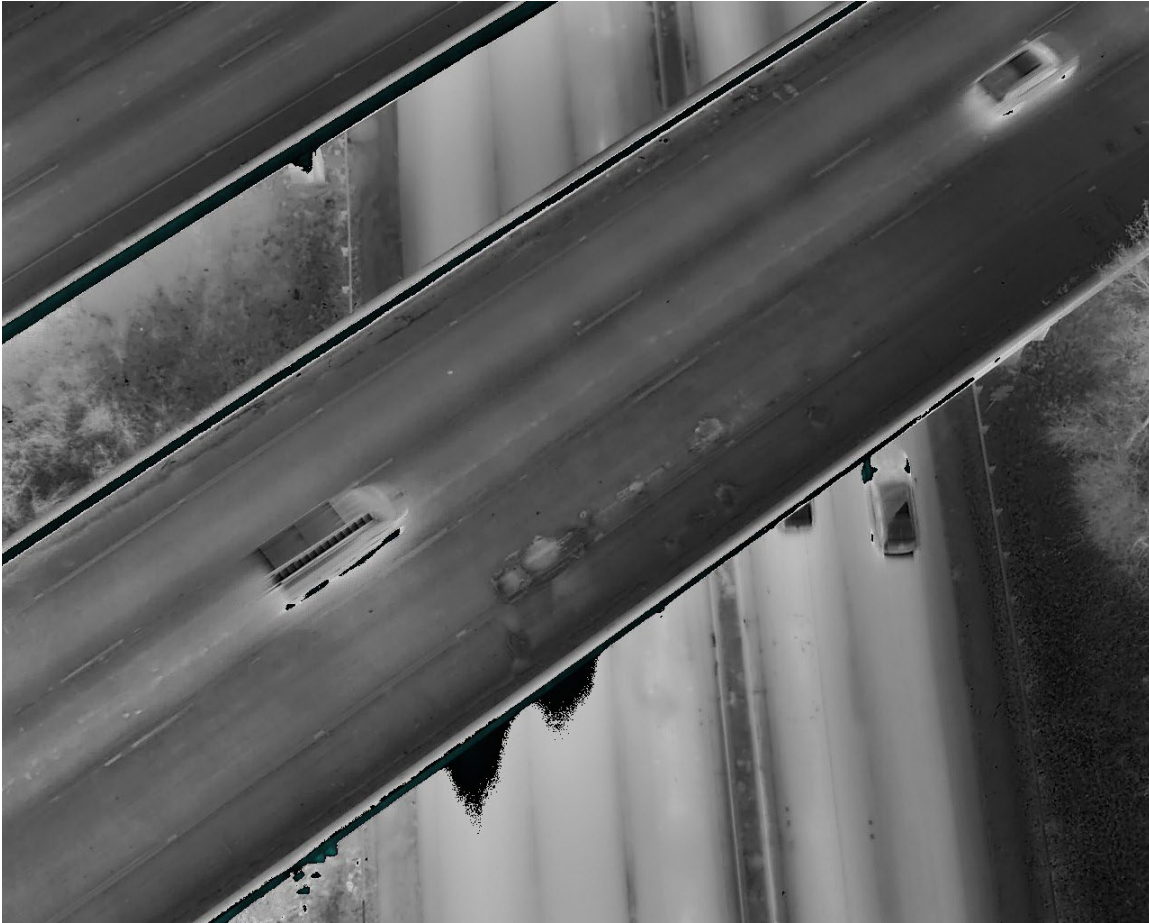


Figure 3.9 Drone Image of Patched Bridge Deck

Analysis of our field data revealed the presence of chlorides in the concrete decks below overlays is a good indicator of overlay performance. Chlorides accelerate deterioration by corroding steel reinforcement and triggering debonding of concrete. To perform chloride analysis, we obtained three concrete samples from 19 bridge decks at multiple depths (Depth 1: 0.5 – 1 in.; Depth 2: 1.5 – 2 in.). Samples were taken by drilling into wheel paths that had minimal signs of deck cracking. Holes were drilled using a $\frac{7}{8}$ -in. bit. This let us penetrate through overlays to structural concrete. At this point, the first $\frac{1}{4}$ in. of concrete deck was cleaned out and samples were extracted using a $\frac{3}{4}$ -inch drill bit (Figures 3.10 and 3.11). This process was repeated to extract samples from lower depths. All samples were retrieved in accordance with the AASHTO T260 standard. Chloride analysis was performed using Germann Rapid Chloride Test (RCT 1024).



Figure 3.10 Drilling for Chloride Sample in the Wheel Path



Figure 3.11 Sampling Hole After Collection of Concrete Deck Dust

3.2 Bridge Deck Overlay Performance Analysis

Multiple attributes can impact overlay performance, including overlay depth, ADT, overlay age, amount of cracking, crack width, depth of cracks, amount of deck patching undertaken as maintenance activity, and deck chloride content. KTC researchers combined LT and HIT asphalt overlays with asphalt overlay type for analysis. KTC researchers began by converting raw data on linear feet of cracking, area of deck patching, crack width, overlay depth, ADT, and number of bridge spans into semi-quantitative scores as this would facilitate analysis. Table 3.1 shows how raw data for each variable were rescaled. For example, decks with no linear cracking received a score of 1 while decks with more than 250 of cracking earned a score of 4.

Epoxy overlays had the least linear cracking (Tables 3.2 and 3.3) as well as the narrowest cracks (Table 3.4). Asphalt overlays had the least amount of deck patching but also tended to exhibit severe cracking.

Table 3.1 Rescaled Attribute Scores

Linear Feet of Cracking	Score	Area of Deck Patching	Score	Crack Width	Score	Overlay Depth	Score	ADT	Score	No. of Spans	Score
= 0	1	= 0	1	= 0	1	<=1	1	<=1350	1	=1	1
<= 60	2	1 - 100	2	<=0.0625	2	<=2	2	<32000	2	=2	2
<= 250	3	> 100	3	<=0.125	3	>2	3	>=32000	3	=3	3
> 250	4			<=0.25	4					=4	4
				<=0.5	5						
				>0.5	6						

Table 3.2 Linear Cracking By Overlay Type

ESTIMATED LINEAR FEET OF CRACKING RANKING (11 BLANKS)				
Linear Feet of Cracking	Asphalt	Epoxy	Latex	PCC
0 feet	9	14	5	8
1 – 60 feet	5	1	6	5
61 – 250 feet	10		3	2
251 – 500 feet	4		6	4

Table 3.3 Linear Cracking By Overlay Type (Percentage)

ESTIMATED LINEAR FEET OF CRACKING (PERCENTAGE) by OVERLAY TYPE (82 TOTAL)				
	Asphalt (n = 28)	Epoxy (n = 15)	Latex (n = 20)	PCC (19)
0 feet	32%	93%	25%	42%
1 – 60 feet	18%	7%	30%	26%
61 – 250 feet	36%	0%	15%	11%
251 – 1500 feet	14%	0%	30%	21%

Table 3.4 Crack Width By Overlay Type

CRACK WIDTH RANKING (13 BLANKS)				
	Asphalt	Epoxy	Latex	PCC
0 inches	8	14	5	8
0 – 0.0625 inches	4	1	4	4
0.0625 – 0.125 inches	10		11	7
0.125 – 0.25 inches	1			
0.25 – 0.5 inches	3			
Greater than 0.5 inches	1			

Table 3.5 Deck Patching By Overlay Type

ESTIMATED SQUARE FEET OF DECK PATCHING RANKING				
	Asphalt	Epoxy	Latex	PCC
0 sq ft of Deck Patching	28	13	8	13
1 – 100 sq ft of Deck Patching	6	2	7	5

ESTIMATED SQUARE FEET OF DECK PATCHING RANKING				
	Asphalt	Epoxy	Latex	PCC
101 or more sq ft of Deck Patching	2	2	5	2

Table 3.6 Crack Depths By Overlay Type

OVERLAY DEPTH RANKING				
	Asphalt	Epoxy	Latex	PCC
<=1.0 inches	3	16	9	5
1.01 – 2.00 inches	13	1	9	8
2.01 or greater inches	20		2	7

Table 3.7 Relationship Between Cracking and ADT

ADT RANKING (1 BLANK)				
	Asphalt	Epoxy	Latex	PCC
0 – 1,350	8	10	5	8
1,351 – 31,999	17	2	4	7
32,000 or more	10	5	11	5

Correlations between deck patching and cracking on overlays (Figure 3.12), deck patching/cracking and ADT (Figure 3.13), and cracking and ADT (Figure 3.14) indicated no robust predictor of overlay performance.

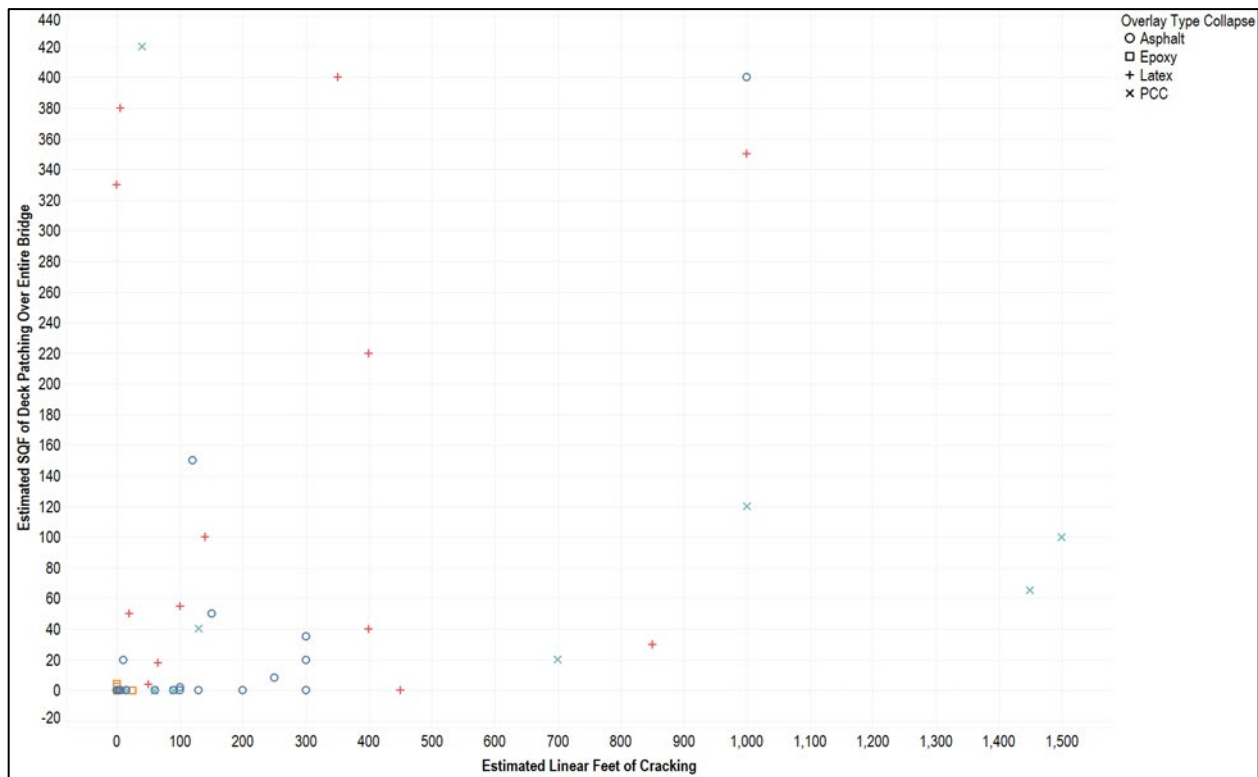


Figure 3.12 Relationship Between Linear Feet of Cracking and Deck Patching

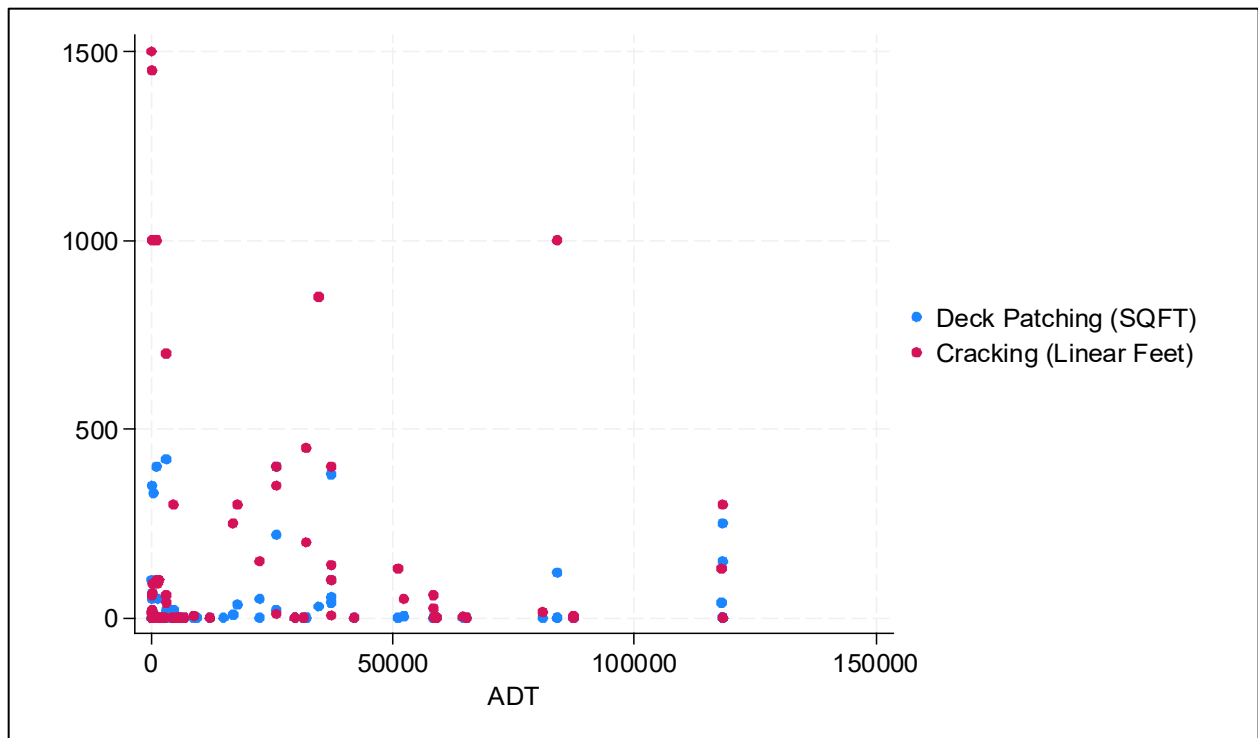


Figure 3.13 Relationship Between Deck Patching/Cracking and ADT

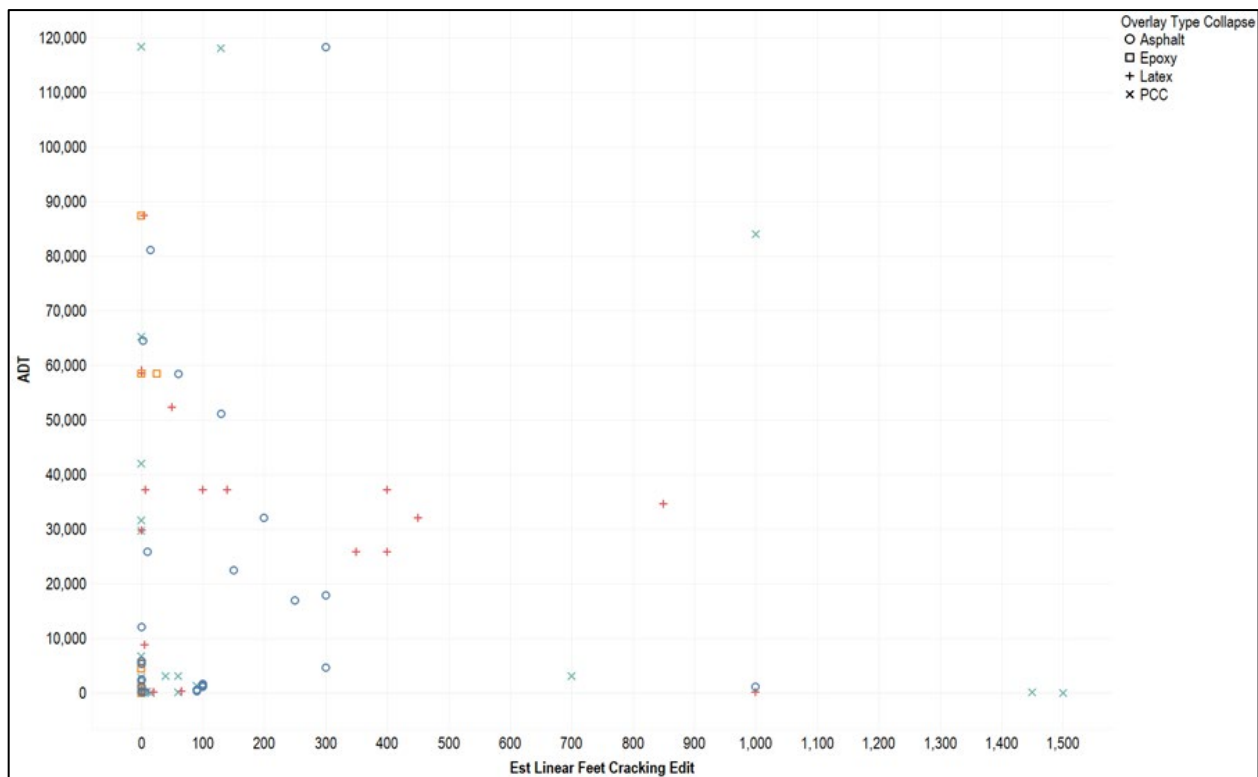


Figure 3.14 Relationship Between Cracking and ADT

Table 3.8 shows aggregate rankings by overlay type. We computed these scores by adding the individual ranks for the six variables listed in Table 3.1. Epoxy overlays were in the best condition overall. Table 3.9 reviews the results of chloride analysis — interestingly, despite epoxy overlays garnering the highest rankings, decks where these overlays were used had the highest chloride levels. High chloride numbers for epoxy overlays as compared with other overlays can be an indicator of potential long-term problems with corrosion and deterioration of the deck.

Table 3.8 Overlay Rankings

OVERALL RANKING (14 BLANKS)					
Rank Plus Detail	Asphalt	Epoxy	Latex	PCC	Total
1 = EXCELLENT	2	13	2	3	20
2 = GOOD	11	2	8	10	31
3 = FAIR	11	0	7	4	22
4 = POOR	1	0	3	2	6
5 = VERY POOR	0	0	0	0	0

Table 3.9 Chloride Sample Data

Overlay Type	Bridge ID	% Cl at Depth in Year 2025		% Cl at Depth in Year 2012
		Depth 1: 0.5" - 1"	Depth 2: 1.5" - 2"	Depth 2: 1.5" - 2"
Asphalt	116B00021N	0.0764	0.0651	
Asphalt	034B00020N	0.0729	0.0591	
Asphalt	076B00120N	0.0215	0.0201	
Latex	076B00039N	0.0954	0.0770	
Latex	097B00024R	0.0600	0.1253	
Latex	076B00012N	0.0357	0.0293	
Epoxy	015B00073L	0.2242	0.1221	
Epoxy	015B00068R	0.1427	0.0361	
Epoxy	015B00073R	0.2750	0.1177	
Epoxy	015B00074L	0.1387	0.1035	
HT Asphalt	056B00197R	0.0329	0.0173	
HT Asphalt	056B00283N	0.0264	0.0148	
HT Asphalt	056B00193N	0.0479	0.0224	
LT Asphalt	056B00192N	0.1058	0.0403	0.01
LT Asphalt	056B00181N	0.0118	0.0170	0.038
LT Asphalt	056B00181N	0.0154	0.0483	0.038
PCC	047B00119R	0.0803	0.0081	
PCC	047B00119L	0.1420	0.0631	
PCC	047B00118R	0.0373	0.0084	

3.3 FLIR Camera Evaluation

The FLIR camera used to capture deck images has some limitations (Table 3.10). Useful pictures can only be taken when no traffic is present (a challenge on routes with high ADT) and there are favorable weather conditions. Additionally, decks must have thermal differential for the FLIR to correctly identify delamination. Shadowing and water pooling negatively impact image quality as well (Figures 3.16 – 3.18). Other key drawbacks include sensitivity to environmental conditions, difficulty in penetrating certain materials, limitations in temperature measurement accuracy, and interference caused by reflective surfaces. Operator experience is also critical for ensuring accurate interpretation.

Table 3.10 FLIR Camera Limitations

Environmental Conditions	
Obscurants	FLIR can peer through some obscurants better than visible light cameras, but it is not perfect. Smoke, fog, and haze can still reduce visibility.
Temperature Differences	FLIR relies on temperature differences to generate an image. If the temperature difference between the target and the background is too small, detection can be difficult.
Wind	Strong winds can distort temperature readings and make it harder to detect heat signatures.
Reflective Surfaces	Highly reflective surfaces like glass, polished metals, and even some types of clothing can reflect ambient heat, leading to inaccurate readings or difficulty in seeing objects behind them.
Material Penetration	
Walls and Barriers	Thick materials like walls, clothing, and some types of glass can block infrared radiation, preventing the camera from detecting what is behind them.
Water and Liquids	Infrared radiation cannot penetrate water or most liquids, making the FLIR ineffective for underwater surveillance or detecting objects submerged in liquid.
Temperature Measurement Accuracy	
Accuracy Range	FLIR cameras have a specified temperature measurement accuracy, which is usually a range rather than a single point. For example, the FLIR K series accuracy is $\pm 4^{\circ}\text{C}$ ($\pm 7.2^{\circ}\text{F}$) or $\pm 4\%$ of reading.
Ambient Temperature	Ambient temperature can impact image accuracy. For instance, the accuracy range mentioned above is typically valid for ambient temperatures between 50°F and 95°F.
Operator Dependence	
Training and Experience	Proper interpretation of FLIR images requires training and experience. Operators need to understand how environmental conditions and material properties affect readings.
Artifacts and False Positives	FLIR images can sometimes show artifacts or produce false positives that can be misinterpreted by an untrained operator.
Distance Limitations	
Practical Limits	While FLIR can see great distances in clear conditions, practical limitations arise from the size of the object in pixels. For temperature measurement, an object should appear as at least a 5 x 5 pixel object in the image, and preferably 10 x 10, according to the FLIR technical support center.

Lens Choice	Lens choice plays a role in how far one can see. A narrower field of view (longer focal length) allows for greater magnification and can improve detection at longer distances.
Other Limitations	
Energy Dissipation	Waste heat dissipation can affect readings, particularly with metallic objects.
Limited Penetration	While FLIR can detect temperature differences, it cannot penetrate thick clothing or other materials to reveal internal body heat.



Figure 3.15 Trees Blocking Sunlight

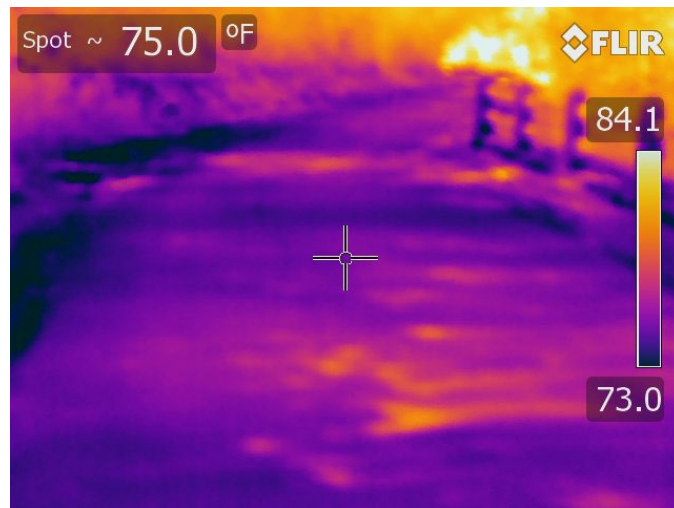


Figure 3.16 FLIR Image Shows No Pronounced Temperature Difference



Figure 3.17 Water Pooling in gutter line Following Cold Rain.



Figure 3.18 FLIR image of Water Pooling Showing Up as Possible Delamination

Chapter 4 Conclusions and Recommendations

The small number of field inspections (93 bridge decks) foreclosed our efforts to develop an robust index or metric to gauge overlay performance. Missing data in the BrM (e.g., age of overlay) exacerbated these difficulties. Statistical analysis did not reveal meaningful relationships between overlay condition and multiple variables (e.g., patching, distress, ADT). Nonetheless, based on overall rankings, as well as data on cracking length and severity, it appears that epoxy overlays deliver the best performance. Although our assessment of the FLIR camera found it has utility, users need to be aware of its limitations — pictures must be captured under highly specific weather conditions and only when no traffic is present. Interpretation of images can be a challenge, so it is that important camera operators and individuals processing and interpreting pictures have good knowledge of the camera system as well as its benefits and drawbacks.

4.1 Recommendations

Because data limitations stymied our attempts to identify robust predictors of overlay performance, we recommend a follow-up study that would review inspection reports and conduct field evaluations of additional bridge decks. When choosing bridge decks for further investigation, factors such as overlay, traffic volume, and deicing salt usage should be considered. Several other recommendations can guide future work:

- Gather more field data on each overlay type (more than 20 bridge deck per overlay type).
- Develop an overlay performance measure that synthesizes data on number of cracks and crack depth.
- More data will enable better analysis of the amount of patching and the amount of distress (e.g., linear cracking) in relation to total deck area for each overlay type. Findings could then be related to ADT. Data could be compared between different overlay groups (e.g., comparing the percentage of decks with asphalt overlay that have patching versus those with distress). Additional data would also facilitate analysis based on the year of overlay application.

References

- 1) Texas Department of Transportation Webinar Presentation on Bridge Deck Concrete Overlays: Challenges and Inspection by Doug Beer, P.E., 2018 [BRIDGE DECK CONCRETE OVERLAYS](#)
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- 3) [When is a Deck Overlay Applied to a Bridge Deck? - UHPC Solutions](#)
- 4) "Performance Evaluation of Bridges with Structural Bridge Deck Overlays (SBDO)" by James J. Griffin, P.E., Ph.D., Issam E. Harik, and Ching Chiaw Choo. Kentucky Transportation Center Research Report KTC-06-05/FRT81-82-97-1F, March 2006.
- 5) "Nondestructive Evaluation of Concrete Bridge Decks with Overlays" by Shibin Lin, Hoda Azari, Dewei Meng, and Sadegh Shams. Federal Highway Administration Publication No: FHWA-HRT-21-023, March 2021.
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- 7) "Evaluations of Concrete Overlays for Bridge Deck Applications" by Shiwei Luo. Graduate Theses, Dissertations, and Problem Reports. West Virginia University, 2002.
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Appendix A Bridge Data

Bridge ID	Overlay Type	Overlay age	Deck SQ	ADT	Overlay Depth Inches	Efflorescence Location	Major Crack Location and Width	Crack Width (Inches)	Linear Feet of Cracking for Bridge	% of Deck Cracking	SQF of Deck Patching	% of Deck Patching	Comments
076C00055N	Asphalt	2	1248	70	0	No seen Efflorescence	No cracks	0.0000	0	0.0000	0	0.000000	Deck has been replaced no overlay
025B00092N	Asphalt	9	700	745	0	No seen Efflorescence	No cracking	0	0	0.0000	0	0.000000	Deck has been replaced no overlay
100C00050N	Asphalt	2	6200	175	2	Mid Span	Only one small crack on the entire deck	0.0625	5	0.0008	0	0.000000	Very little efflorescence
034C00012N	Asphalt	11	802	3104	5	No seen Efflorescence	0.125 At mid span	0.1250	15	0.0187	0	0.000000	
099X00004N	Asphalt	6	2100	203	2	No seen Efflorescence	The deck has only one crack near the abutment	0.1250	3	0.0014	0	0.000000	No Distress seen
034C00026N	Asphalt	9	7191	8760	4	At or near a joint location	No cracks seen on deck. cracks just off the abutments on both side	0	0	0.0000	0	0.000000	Efflorescence seen at joints of deck beams
025C00033N	Asphalt	9	933	251	4	No seen Efflorescence	20% of the deck is within 10 feet of a crack.	0.0625	90	0.0965	0	0.000000	No distress seen

Bridge ID	Overlay Type	Overlay age	Deck SQ	ADT	Overlay Depth Inches	Efflorescence Location	Major Crack Location and Width	Crack Width (Inches)	Linear Feet of Cracking for Bridge	% of Deck Cracking	SQF of Deck Patching	% of Deck Patching	Comments
116B00021N	Asphalt	9	809	98	3	No seen Efflorescence	Cracks are longitudinal and mainly on the center line of the deck	0.1250	90	0.1112	0	0.000000	
034C00020N	Asphalt	12	1505	119	5	No seen Efflorescence	Cracking all over deck 70% of the deck is within 10 feet of a crack.	0.1250	200	0.1329	0	0.000000	
076C00001N	Asphalt	3	571	185	10.5	No seen Efflorescence	50% of the bridge is within 10 feet of a crack mostly all over	0.1250	60	0.1051	0	0.000000	Small bridge with cracking all over
076B00120N	Asphalt	7	1049	346	3	No seen Efflorescence	1% of the deck is cracked mostly in the southbound wheel path	0.1250	130	0.1239	0	0.000000	FLIR is 515-519 show 2 potential areas of distress or delamination
034B00138N	Asphalt	13	1081	761	6	Mid Span	Major cracking at the center of the lane about .5" thick	0.5000	100	0.0925	0	0.000000	Efflorescence at the precast beam joints on the upstream side

Bridge ID	Overlay Type	Overlay age	Deck SQ	ADT	Overlay Depth Inches	Efflorescence Location	Major Crack Location and Width	Crack Width (Inches)	Linear Feet of Cracking for Bridge	% of Deck Cracking	SQF of Deck Patching	% of Deck Patching	Comments
025R00614N	Asphalt	13	1494	183	10	No seen Efflorescence	50% of the bridge is within 5 feet of a crack	0.1250	150	0.1004	50	0.033467	FLIR Shows delamination in a few spots
099C00039N	Asphalt	7	480	33	7	No seen Efflorescence	Map cracking over 25% of the deck	0.1250	100	0.2083	0	0.000000	FLIR will not work in this weather light rain
025C00004N	Asphalt	13	1026	233	3	All over the underside of the deck	100% of the deck is within 5 feet of a crack	0.1250	250	0.2437	8	0.007797	
033B00039N	Asphalt	15	1670	650	2	No seen Efflorescence	Deck has patching and cracking throughout	0.5000	300	0.1796	35	0.020958	FLIR unable to be used do to over cast colder conditions
100C00051N	Asphalt	>13	2202	604	2	All over the underside of the deck	Cracking at mid span and at both abutments	0.2500	120	0.0545	150	0.068120	Major efflorescence all over the underside of this deck
076C00091N	Asphalt	>10	1693	8181	3	At or near a joint location	Cracking at joints 100% of the deck is within 1.5 feet of a crack	1.0000	300	0.1772	20	0.011813	No issues seen
025C00025N	Asphalt		no data	BRM has no data	4	At or near a joint location	No cracks	0	0	no data	0	no data	Efflorescence at the box beam joints

Bridge ID	Overlay Type	Overlay age	Deck SQ	ADT	Overlay Depth Inches	Efflorescence Location	Major Crack Location and Width	Crack Width (Inches)	Linear Feet of Cracking for Bridge	% of Deck Cracking	SQF of Deck Patching	% of Deck Patching	Comments
056B00302N	HT Asphalt	18	20463	16899	1.5	No seen Efflorescence	None seen	0	0	0.0000	0	0.000000	Limited access to the deck.
056B00288L	HT Asphalt	12	9398	29699	1.5	No seen Efflorescence	There was cracking in 3 small areas around pot holes	0.0625	10	0.0011	20	0.002128	
056B00197R	HT Asphalt	19	5507	42001	1.5	Mid Span	Linear cracking at joints 5% of the deck is within 10' of a crack	0.1250	100	0.0182	2	0.000363	
056B00300N	HT Asphalt	18	40276	58404	1.5	No seen Efflorescence	None	0	0	0.0000	0	0.000000	Not able to get on deck did a drive by
056B00302N	HT Asphalt	18	20463	58404	1.5	All over the underside of the deck	None	0	0	0.0000	0	0.000000	
056B00283N	HT Asphalt	18	95696	65180	1.5	All over the underside of the deck	None	0	0	0.0000	0	0.000000	Wry small amounts of spotty efflorescence
056B00193N	HT Asphalt	19	35361	84001	1.5	No seen Efflorescence	Drone photos it is hard to tell	0	300	0.0085	0	0.000000	From the pictures distress is seen on the deck in several locations
056B00299N	HT Asphalt	16	8066	87355	1.5	No seen Efflorescence	Unknown	0	0	0.0000	0	0.000000	

Bridge ID	Overlay Type	Overlay age	Deck SQ	ADT	Overlay Depth Inches	Efflorescence Location	Major Crack Location and Width	Crack Width (Inches)	Linear Feet of Cracking for Bridge	% of Deck Cracking	SQF of Deck Patching	% of Deck Patching	Comments
056B00301N	HT As-phalt	18	8969	87355	1.5	No seen Efflorescence	None	0	0	0.0000	0	0.000000	
056B00191N	LT As-phalt	13	127444	84001	2.25	No seen Efflorescence	None seen	0	0	0.0000	0	0.000000	Drone photos some distress at the joint areas
056B00192N	LT As-phalt	13	43878	84001	2.25	No seen Efflorescence	None seen	0	0	0.0000	0	0.000000	drone photos some distress at the joints
056B00181N	LT As-phalt	13	13159	118227	2.25	All over the underside of the deck	No cracking seen	0	0	0.0000	0	0.000000	Traffic makes the FLIR useless
056B00183N	LT As-phalt	13	37651	118227	0	No seen Efflorescence	Unknown	0	0	0.0000	0	0.000000	Drone photos distress at the joint areas
056B00188N	LT As-phalt	13	23496	118227	2.25	No seen Efflorescence	None seen	0	0	0.0000	0	0.000000	Drone photos, some distress at the joint areas
056B00189N	LT As-phalt	13	17879	118227	2.25	No seen Efflorescence	None seen	0	0	0.0000	0	0.000000	Drone Photos, some distress at the joint no clear patch areas or cracks
056B00190N	LT As-phalt	13	17913	118227	2.25	No seen Efflorescence	None seen	0	0	0.0000	0	0.000000	distress at the joint areas
056B00179N	LT As-phalt	13	38635	122766	2.25299966	No seen Efflorescence	Cracking at asphalt joint 2% of the deck is within	0.0625	1000	0.0259	400	0.010353	Shadowing the the deck through the lenses mostly not useful data

Bridge ID	Overlay Type	Overlay age	Deck SQ	ADT	Overlay Depth Inches	Efflorescence Location	Major Crack Location and Width	Crack Width (Inches)	Linear Feet of Cracking for Bridge	% of Deck Cracking	SQF of Deck Patching	% of Deck Patching	Comments
							10 feet of a crack						
070B00086N	Epoxy	2	81137	3024	0.25	No seen Efflorescence	No cracks	0	0	0.0000	0	0.000000	
079B00152N	Epoxy	6	271908	3070	0.375	All over the underside of the deck	None	0	0	0.0000	0	0.000000	Efflorescence seeping through the stay in place forms.
079B00153N	Epoxy	6	37376	3070	0.375	No seen Efflorescence	None	0	0	0.0000	0	0.000000	
056B00288R	Epoxy	12	9398	29699	1.63	No seen Efflorescence	None seen	0	0	0.0000	150	0.015961	
015B00068R	Epoxy	11	8931	32009	0.375	All over the underside of the deck	None	0	0	0.0000	0	0.000000	Efflorescence between every beam at localized cracked areas
015B00073L	Epoxy	11	10413	37197	0.375	No seen Efflorescence	None	0	0	0.0000	0	0.000000	No access to underside of bridge
015B00073R	Epoxy	11	10271	37197	0.375	No seen Efflorescence	None	0	0	0.0000	0	0.000000	Unable to access the underside of the bridge
015B00074L	Epoxy	11	3410	37197	0.375	No seen Efflorescence	None	0	0	0.0000	0	0.000000	No access under bridge
056B00287L	Epoxy	12	13119	34609	0.375	No seen Efflorescence	None seen	0	0	0.0000	250	0.019056	No Distress seen
056B00057N	Epoxy	13	5935	52234	0.375	No seen Efflorescence	None	0	0	0.0000	0	0.000000	No issues

Bridge ID	Overlay Type	Overlay age	Deck SQ	ADT	Overlay Depth Inches	Efflorescence Location	Major Crack Location and Width	Crack Width (Inches)	Linear Feet of Cracking for Bridge	% of Deck Cracking	SQF of Deck Patching	% of Deck Patching	Comments
056B00427R	Epoxy	14	76801	58500	0.375	Mid Span	No cracking seen	0	0	0.0000	2	0.000026	Some efflorescence seen
056B00447L	Epoxy	12	11035	59000	0.375	No seen Efflorescence	None	0	0	0.0000	0	0.000000	No issues in great shape
056B00447R	Epoxy	12	11035	59000	0.375	No seen Efflorescence	None	0	0	0.0000	0	0.000000	In great shape
056B00450N	Epoxy	12	22081	11800 0	0	No seen Efflorescence	None	0	0	0.0000	4	0.000181	Unable to access the underside of the deck
056B00451R	Epoxy	12	13611	11800 0	0.4	Mid Span	none	0	0	0.0000	0	0.000000	Every little signs of efflorescence see pics
056B00451L	Epoxy	12	16119	16330 5	0.4	Mid Span	Transverse mid span only crack seen on deck	0.0625	25	0.0016	0	0.000000	Mild efflorescence seen
015B00074R	Epoxy	11	3410	37197	0.375	No seen Efflorescence	None	0	0	0.0000	0	0.000000	No access under bridge
099B00071N	Latex	7	986	175	1.5	No seen Efflorescence	No cracking	0	0	0.0000	0	0.000000	No distress seen
099B00003L	Latex	9	5330	4394	1.5	All over the underside of the deck	No cracking seen	0	0	0.0000	0	0.000000	FLIR not good fit for the weather today
099B00006L	Latex	6	5371	4394	1.5	At or near the abutments	No cracks	0	0	0.0000	0	0.000000	FLIR will not work in this weather no sun
076B00060N	Latex	9	891	436	1	At or near a joint location	No major cracks	0.0625	4	0.0045	0	0.000000	Westbound lane shows potential

Bridge ID	Overlay Type	Overlay age	Deck SQ	ADT	Overlay Depth Inches	Efflorescence Location	Major Crack Location and Width	Crack Width (Inches)	Linear Feet of Cracking for Bridge	% of Deck Cracking	SQF of Deck Patching	% of Deck Patching	Comments
													deamination area is 30sqft
076B00088N	Latex	>8	4484	1093	1	No seen Efflorescence	No cracks	0.0625	5	0.0011	0	0.000000	IR shows a 2'x3' possible delaminating area.
034C00015N	Latex	4	3192	541	1	No seen Efflorescence	One small area with cracking near a joint	0.1250	5	0.0016	0	0.000000	No distress seen
076B00061N	Latex	>10	4524	1278	6	No seen Efflorescence	Deck .3% cracks, near the joint areas but not limited to the joints.	0.1250	65	0.0144	18	0.003979	No distress seen
119B00042N	Latex	6	5266	4573	3	At or near a joint location	90% of the west bound is within 10 feet of a crack	0.0625	450	0.0855	0	0.000000	No FTIR at this location.
076B00056N	Latex	>10	912	624	1	At or near the abutments	Abutment/mid span. 30% of the deck is within 10 feet of a crack	0.1250	50	0.0548	4	0.004386	FLIR show no problem areas
076B00027N	Latex	>10	4810	2827	1	At or near a joint location	90% of the bridge is within 5 feet	0.1250	400	0.0832	40	0.008316	Lots of cracking FLIR shows 5 areas with possible delamination

Bridge ID	Overlay Type	Overlay age	Deck SQ	ADT	Overlay Depth Inches	Efflorescence Location	Major Crack Location and Width	Crack Width (Inches)	Linear Feet of Cracking for Bridge	% of Deck Cracking	SQF of Deck Patching	% of Deck Patching	Comments
							of a major crack						
076B00039N	Latex	>10	9968	2452	1	All over the underside of the deck	90% of the deck is within 5 feet of a crack	0.1250	6	0.0006	380	0.038122	The top and the under side of the deck are in poor shape
076B00012N	Latex	3	3030	9350	1.5	At or near a joint location	No major crack or cracks of any kind	0	0	0.0000	0	0.000000	FLIR shows one very small 1'x1' possible de-lamination mid span 1
106B00034N	Latex	26	4770	1596	1.25	All over the underside of the deck	90% of the deck is within 5 feet of a crack	0.1250	850	0.1782	30	0.006289	FLIR 580-585 shows a couple areas of potential delaminated overlay
034B00024R	Latex	13	8039	33721	1	At or near a joint location	1% of the bridge is within 10 feet of a crack at South end	0.1250	100	0.0124	55	0.006842	No distress seen
034B00153N	Latex	4	214150	64439	1.5	No seen Efflorescence	Non seen	0	0	0.0000	330	0.001541	No distress seen
076B00050N	Latex	>12	804	1270	0	At or near the abutments	Very minor cracking	0.0625	20	0.0249	50	0.062189	Deck has one patched area
076B00011N	Latex	>10	2235	17806	1	No seen Efflorescence	50% of the deck is within 10 feet of a crack	0.1250	140	0.0626	100	0.044743	Deck patched in several areas lots of cracking all over the deck

Bridge ID	Overlay Type	Overlay age	Deck SQ	ADT	Overlay Depth Inches	Efflorescence Location	Major Crack Location and Width	Crack Width (Inches)	Linear Feet of Cracking for Bridge	% of Deck Cracking	SQF of Deck Patching	% of Deck Patching	Comments
034B00089R	Latex	>11	18352	51049	1.5	All over the underside of the deck	Mostly all over the deck	0.1250	1000	0.0545	350	0.019071	No issues seen
056B00052R	Latex	24	4863	31513	1.25	All over the underside of the deck	75% of the deck is within 10 feet of a crack	0.1250	400	0.0823	220	0.045240	Efflorescence is spotty mostly all over but not sever
056B00267N	Latex	22	8123	81002	1.25	All over the underside of the deck	75% of the deck is within 10' of a crack	0.1250	350	0.0431	400	0.049243	Lots of patching and potholes with cracks
116C00071N	PCC	9	960	30	5	No seen Efflorescence	No cracks	0	0	0.0000	0	0.000000	No distress seen
113B00094N	PCC	16	4560	108	1.5	All over the underside of the deck	No major issues no cracks	0	0	0.0000	0	0.000000	No distress seen
049B00062N	PCC	2	2400	297	5	No seen Efflorescence	None	0	0	0.0000	0	0.000000	No distress seen
118B00068N	PCC	2	576	1329	3	No seen Efflorescence	No cracks there is a horizontal joint	0	0	0.0000	0	0.000000	No Distress seen
031B00008N	PCC	1	5268	1376	1.75	No seen Efflorescence	Deck looks brand new no cracks	0	0	0.0000	0	0.000000	This is a full deck replacement not an overlay.
090B00051N	PCC	>12	10664	2352	1.5	At or near a joint location	5% of the deck is within 10 feet thin cracks	0.0625	130	0.0122	40	0.003751	No issue seen using FLIR
100B00029N	PCC	>10	36491	5242	2	No seen Efflorescence	None seen	0	0	0.0000	50	0.001370	Unable to access deck safely

Bridge ID	Overlay Type	Overlay age	Deck SQ	ADT	Overlay Depth Inches	Efflorescence Location	Major Crack Location and Width	Crack Width (Inches)	Linear Feet of Cracking for Bridge	% of Deck Cracking	SQF of Deck Patching	% of Deck Patching	Comments
025B00078N	PCC	>11	6340	5473	1	No seen Efflorescence	0.1% of the bridge is within 10 feet of a crack	0.0625	15	0.0024	0	0.000000	Very little distress on this bridge
021B00038R	PCC	9	12029	14909	5	At or near a joint location	None seen	0	0	0.0000	0	0.000000	Bridge deck has no shoulder traffic too heavy to walk deck
118B00050L	PCC	>10	7771	22410	1	At or near a joint location	No cracks seen on deck	0	0	0.0000	0	0.000000	Deck in really good shape
118B00050R	PCC	>10	7771	22411	1	At or near the abutments	No cracks seen	0	0	0.0000	0	0.000000	Very little efflorescence seen
047B00112N	PCC	19	17987	12066	0	At or near the abutments	1% of the deck is within 10 feet of a cracked area	0.0625	90	0.0050	0	0.000000	Very little efflorescence under the deck
047B00118L	PCC	19	7125	25853	12	Mid Span	1% of the deck is within 10 feet of a crack.	0.1250	60	0.0084	0	0.000000	Just a few spots of efflorescence seen
047B00119L	PCC	19	3672	25853	12	No seen Efflorescence	1% of the deck is within 10 feet of a crack	0.1250	60	0.0163	0	0.000000	No Distress seen
047B00119R	PCC	19	3672	25854	12	No seen Efflorescence	0.1% of the deck is with pin 10 feet of a crack linear	0.1250	10	0.0027	0	0.000000	No distress seen

Bridge ID	Overlay Type	Overlay age	Deck SQ	ADT	Overlay Depth Inches	Efflorescence Location	Major Crack Location and Width	Crack Width (Inches)	Linear Feet of Cracking for Bridge	% of Deck Cracking	SQF of Deck Patching	% of Deck Patching	Comments
100B00004N	PCC	13	4653	1158	2	At or near a joint location	Deck cracked all over, 90% of the deck within 10feet of a crack	0.1250	700	0.1504	20	0.004298	Minor efflorescence only seen one spot
118B00015N	PCC	7	7537	836	1	All over the underside of the deck	70% of the bridge is within 10 feet of a hairline crack	0.0625	1500	0.1990	100	0.013268	No Distress seen
090B00050N	PCC	>12	7022	2352	1.5	At or near a joint location	95% of the bridge is within 4 feet of a crack	0.1250	1450	0.2065	65	0.009257	Many areas of potential delaminating concrete
108B00024N	PCC	>13	5738	1085	1.5	All over the underside of the deck	Major cracking 90% for the deck is within 5 feet of a crack	0.1250	1000	0.1743	120	0.020913	There are some interesting areas on the FLIR images
051B00052N	PCC	>13	2621	5807	2	No seen Efflorescence	5% of the deck is within 10 feet of a cracked	0.1250	40	0.0153	420	0.160244	No access below to check for efflorescence