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Proposal for Monitoring Concrete Painting as a Preventive Maintenance Tool (Abutments and Pier Caps)

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KENTUCKY TRANSPORTATION CENTER

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Kentucky Transportation Center Technical Assistance Report —
KTC-TA-17-03/IPN16-57-8
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UNIVERSITY OF KENTUCKY College of Engineering

KTC's Mission

We provide services to the transportation community through research, technology transfer, and education. We create and participate in partnerships to promote safe and effective transportation systems.

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Proposal for Monitoring Concrete Painting as a Preventive Maintenance Tool (Abutments and Pier Caps)

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In Cooperation With
Kentucky Transportation Cabinet
Commonwealth of Kentucky

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Introduction

One of the growing number of preventive bridge maintenance activities conducted by the Kentucky Transportation Cabinet (KYTC) is washing and applying thin film protective coatings to bridge abutments and piers. Previous work conducted by Kentucky Transportation Center (KTC) under KYSPR 10-406 documented increased chloride contamination of these bridge components and the need for protective coatings. KYTC Contract ID 162952 includes, among other tasks, cleaning and coating specific concrete elements of eighteen bridges in Anderson and Woodford counties (District 7). These elements are interior faces of the barrier walls, pier caps, and abutment seats. The contract was let on July 29, 2016, with the primary completion date as July 31, 2017. There were five bids that ranged from $326,870.61 to $810,645.00 with the engineering estimate as $475,155.08. The contract was awarded to the low bidder, M&M Services Co. Inc., on August 5, 2016. For most of the project the contractor had two crews — a pressure washing crew, consisting of two foremen and six workers, and a painting crew with one foremen and six applicators. Various crew members changed at times due to other commitments of the contractor.

Of the coating systems identified in KYSPR 12-433 and KYSPR 05-291 the contractor selected the PPG Amerlock 2/Devoe Devflex HP system. Most of the systems were identified by laboratory testing with limited field application. This study focused on monitoring and documenting surface preparation, coating application, and field performance to determine the potential for use on future projects and possible inclusion of the coating on a List of Approved Materials for Concrete Coatings.

Six of the eighteen bridges in this contract were monitored, and critical elements in the overall process were assessed and documented. This included initial substrate condition, surface preparation, application method, applied film conditions (e.g., thickness, continuity), and weather conditions.

The bridges selected for monitoring were:

- Continuous Span – B00027N and B00019N
- Simple Span – B00026N and B00037N
- Steel Multi Span – B00007L and B00007R

Initial Assessment

In January 2017 KTC personnel conducted preliminary assessments of the six bridges. Initial observations are listed below:

B00027N Huntertown Rd. over BGP

1. Sliding plate joint south end
2. Severe corrosion on steel plate at back wall (south end)
3. North end joint is neoprene seal
4. Abutment seat cracked on both ends (south end is worse)
5. All bearings heavily corroded
6. Spalling on beams and abutment show shallow reinforcement cover (~1/2")

B00019N KY 1964 (McCowans Ferry Rd.) over BGP

1. North end abutment has minor cracking
2. Heavy corrosion on bearings (both ends)
3. South end compression seal is gone, joint is partially filled with asphalt
4. Heavy spalling of abutment seat (south end)
5. Minimal cracking
6. Severe slope erosion

B00026N Scotts Ferry Rd. over BGP

1. Integral abutments at both ends (appear to be retrofit)
2. Sliding plates at piers 1 and 3
3. Moderate corrosion of bearing on piers 1 and 3
4. Moderate spalling of piers and pier caps (1 and 3)
5. Center pier (2) in good condition. Light corrosion on bearings

B00007R & L BGP over KY River

1. Concrete in good condition, minor cracking and staining (east end)
2. Bearings and beam ends — moderate to heavy corrosion (east end)
3. Pier 4 on both bridges are wet but in good condition with very little cracking
4. Pier 1 on both bridges have moderate to heavy spalling at the cap and exposed reinforcement
5. Abutment 1 on both bridges are in good condition
6. Bearings are in good condition but rock, soil, and debris have accumulated around them

B00037N Johnson Rd. over BGP

1. Integral abutments
2. 4 simple spans w/ silicon joint seals
3. Concrete in good condition

Surface Preparation

Surface preparation of the concrete began on April 18, 2017, and consisted of debris removal and pressure washing. After debris removal was complete, pressure washing began from the top down. The KYTC contract did not specify a surface preparation standard but did require following the "*coating supplier recommended conditions for application*." One of the requirements on the coating supplier's product data sheet was to "*achieve surface profile – ICRI CSP 3 to 5*." Although the surface condition was not addressed by KYTC or contractor personnel, it appeared adequate for coating application.

A low-pressure hand sprayer was used to apply bleach as a pre-treatment to the areas to be washed (Figure 1). The coating supplier's representative provided email documentation on April 19, 2017 stating: "*once the bleached surface is thoroughly rinsed by pressure washing and allowed to dry, I see no issues with adhesion of the epoxy prime coat*."[1] All elements were "pre-treated" with bleach except the south bound barrier wall from Abutment 1 to Pier 2 on bridge B00027N (Huntertown Rd).

The contract required washing pressures from 1,000 psi to 4,000 psi using a 0° spinner tip and/or fan tip as determined by the engineer. Pressure washing wands were equipped with pressure gauges to monitor actual working pressures. Two pressure washers were used by the contractor a large unit and a smaller one. The larger pressure washer was trailer-mounted with a holding tank for wash water that was replenished using a transfer pump from an onsite tanker truck. The only means to monitor pressure on this unit was an unstable gauge at the pump, fluctuating between 4,000 psi to 6,000 psi. The small pressure washer was a residential style rated at 2,800 psi and had no gauge. A spinner tip was initially tried. The contractor and the KYTC inspector determined that a fan tip would be adequate and provide better production. The size of the fan tip used on the large washer was not known but estimated to be approximately 25°. The small washer was equipped with a 15° fan tip. The minimum flow rate was specified at 3.5 GPM (gallons per minute), however, there was no means to monitor actual usage. The wand stand-off distance was at 6" with the wand kept perpendicular to the surface. Adherence to this requirement was adequate throughout most of the project (Figure 2). The KYTC inspector approved the surface preparation.

The contract specified a minimum drying time of 24 hours and coating within 72 hours of washing. The contractor complied with that provision only on the Huntertown Rd (B00027N) bridge. The wash crew finished bridges much quicker than the coating applicators could paint them. This deviation was also accepted by the KYTC inspector.

The surface preparation was completed by April 24, except for the piers, on the four overpass bridges KTC monitored. Due to traffic control issues and equipment logistics, the pier caps of the overpasses and the two mainline bridges over Kentucky River were scheduled to be completed last. The contractor scheduled the bridge over Kentucky River, B00007L and B00007R, at the end of the project due to the amount of time necessary for completion. Joint replacement, which KTC did not monitor, was another activity that had to be considered by the contractor when planning the sequence of work.

Coating Application

The coating system used for this project was PPG Amerlock®400, a two-component epoxy, and Devoe Devflex™ 4216 HP, a single-component acrylic. Both products were applied using a brush and roller. Originally the epoxy was slated to be PPG Amerlock 2. The properties of the two products are essentially

the same with exception of the cure rate. The catalyst for the Amerlock 2 allows curing down to 32°F. At the temperatures observed during this project, the Amerlock 400 had a pot life twice that of Amerlock 2 and a longer cure time. The contractor felt a longer pot life would be beneficial due to the warm weather.

The recommended total dry film thickness (DFT) for the Amerlock 400 is 4.0 – 8.0 mils. This product was applied in two coats. The product data sheet does not specifically recommend application in two coats, however, it does state that proper application with brush or roller will provide approximately 3.1 mils (DFT) in a single coat. After some early issues with coating consistency, the contractor attempted to maintain a wet film thickness (WFT) of 4.0 – 6.0 mils per coat. At 85% solids, this equates to a DFT of approximately 3.4 – 5.1 mils per coat.

The Devflex™ product data sheet states that if applied by brush or roller, multiple coats may be necessary to achieve adequate film build. It was also applied in two coats. Initially the contractor attempted to maintain an average of 6.0 mils WFT per coat. At 36% solids, this would be approximately 2.2 mils DFT. The recommended total DFT is 1.5 – 4.0 mils. There were consistent issues with drips and runs, which could have been readily repaired on the spot by painters, but were not.

The wash crew was far ahead of the painting crew after a few days. As a result, the painting crew could not comply with the application requirement of coating within 72 hours of washing. A leaf blower was used prior to painting to remove any loose debris that had accumulated due to wind and traffic (Figure 3).

The contractor began the painting operation on the barrier walls and abutment seats on bridge B00027N (Huntertown Road) on April 20 and proceeded west to B00037N (Johnson Road). Once the barrier walls and abutments were complete on the entire project, the contractor started work on the piers. Bridge B00037N (Johnson Rd) was the only overpass where KTC monitored both the washing and coating of the piers. The bridges over Kentucky River, B00007L and R, were scheduled to be painted at the end of the project due to their size and the length of time necessary for cleaning and painting. That work was completed on June 23, 2017. Table 1 provides a timeline of washing and coating activities.

The following sections include specific information for each bridge:

B00027N Huntertown Road

Pressure washing was completed at 2:00 PM on April 18, 2017, and the first of two coats of Amerlock 400 were applied beginning approximately 42 hours later. Ambient conditions recorded by KTC personnel, two hours after application began, indicated acceptable conditions. An inspection kit was not provided to the KYTC inspector at this time. Wet film thicknesses were not measured until midway through the northbound barrier wall. Several thick areas of pooled coating were observed as well as other thin areas. KTC personnel measured 1 – 12 mils in the non-pooled areas. The pooled areas were not measured until the crew went over these areas to smooth them out. The foreman began using a WFT gauge, attempting to maintain 4 – 6 mils. The contractor provided a WFT gauge for the KYTC inspector and initially appeared unsure of how to measure thickness.

This was the first of two coats of the PPG Amerlock 400. The total recommended dry film thickness is 4 – 8 mils (4.7 – 9.4 WFT) after the application of both coats. The contractor started watching the WFT more closely on the second half of the bridge. The coating was much more consistent than initially observed, maintaining 4 – 6 mils; however, there were still numerous drips and runs, especially at the

joints in the barrier wall (Figure 4). A brush was used in an attempt to coat the bug holes that also left several runs.

The top coat was applied in two coats as well. The contractor paid close attention to WFT attempting to maintain 5 – 7 mils, but still had the issues with runs. At 36% solids this equates to a DFT of 1.8 – 2.5 mils per coat.

B00019N KY 1964 (McCowans Ferry Rd).

Pressure washing was complete approximately 96 hours prior to coating. The contractor continued to wash and coat in a similar fashion as the previous bridge. Although repair work was not within the scope of this project there were spalled areas with exposed reinforcement on the abutments that needed repair prior to coating (Figure 5). Washing these areas was not sufficient to remove stratified rust (Figure 6).

The WFT was maintained in most areas, however, there continued to be a few thick spots primarily due to runs. Once the washing crew's progress was sufficient, the painting crew applied one coat and moved to next bridge, thereby allowing time for curing on the previous bridge. The crew of six coating applicators completed the application of one coat of Amerlock on two bridges per day, including moving traffic control between bridges. With a minimum recoat time of 4 hours for applying acrylic on acrylic, both coats of Devflex™ could be applied in a single day. There were special requirements concerning recoat windows when applying acrylic on epoxy that were not addressed adequately. This is discussed further in the following section.

During the application of the Devflex™ to Abutment 1 (south) it began to rain, causing some of the coating to be washed off. The contractor had to return for a repair once that area had dried. Abutment 2 was completed prior to the rain and no apparent damage was observed.

B00026N Scotts Ferry Rd.

The pressure washing continued as previously observed and bridge washing was completed approximately 5 days prior to coating application. The painting crew began moving at a faster pace and quality seemed to suffer as a result. The contractor began application of the second coat of epoxy the morning of April 28, 2017. KTC personnel checked ambient conditions upon arrival at 8:15AM. The temperature and dew point were acceptable for coating, however, relative humidity was 91% and visible moisture was observed on the guard rail. KTC personnel also measured WFTs of the epoxy at 2 to 20 mils and little effort was observed to coat bug holes as had been observed on previous bridges.

According to the Amerlock 400 product data sheet the recoat window is 20 to 60 hours (at 68°F) when applying acrylic to epoxy (Table 2). On this bridge, the Devflex™ was applied approximately 92 hours after the epoxy had been applied. The second coat of epoxy was applied on Friday, April 28, 2017, and the acrylic was not applied until Tuesday May 2, 2017.

During the top coat application, KTC personnel measured WFTs of 5 to 6 mils. There were multiple places with severe runs as well as large areas that were completely missed (Figure 7). These areas were coated during the second coat application. The minimum recoat interval for applying acrylic to acrylic is 4 hours at 77°F. Application of the second coat of acrylic began prior to the minimum recoat interval as both coats of acrylic were applied to this bridge in approximately 5.5 hours.

B00037N Johnson Rd.

Pressure washing was completed approximately 48 hours prior to the start of the coating application. During the application of the first coat of epoxy, KTC personnel measured WFTs of 5 to 6 mils in most areas. The second coat of epoxy was not monitored by KTC, however, it was examined prior to application of the top coat. In most areas, the coverage appeared continuous except for bug holes. There were problems with excessive coating build and runs (Figure 8). The acrylic top coat application began the day after the epoxy was applied, well within the recommended recoat window. KTC personnel measured WFTs between 5 and 10 mils. The second top coat application was not observed, but examined shortly after completion. A few areas were observed where coating had been applied over debris (Figure 9). There were repeated issues with frequent pooling of the coating on horizontal surfaces and runs on the vertical surfaces with all coats. In general, the coating application exemplified poor workmanship.

The piers were pressure washed after the coating of the barrier walls and abutments was complete. Man-lifts were used to access the piers. KTC personnel observed the crew working from the man-lift not wearing fall protection. After the KYTC inspector was consulted, a KYTC worker safety representative was contacted about the KOSH violation. Subsequently, the crew was observed using fall protection gear.

Pier 1 had a considerable amount of efflorescence remaining after pressure washing was complete (Figure 10). The crew had little success removing it with a small scraper. These areas were coated. Coating proceeded in a similar manner as the barrier walls and abutments. Each pier took approximately one hour per coat, including moving traffic control.

B00007R

Pressure washing was completed in three days utilizing a small 2,800 psi pressure washer for the abutments and piers caps. The pressure washer used for the barrier walls was rated at 3,000 psi and 40 GPM, although no gauges were available to determine actual working pressure or usage. The contractor was unable to adequately clean the back walls of the abutment due to its height and proximity to the floor beam (Figure 11). The back wall of the abutment is approximately 14 feet tall and there is about 16 inches of clearance to the adjacent floor beam making accessibility difficult. The KYTC inspector told the contractor's workers to do the best they could to clean the back wall. KTC personnel observed the contractor's workers standing on the abutment seat attempting to clean by directing the spray toward the top of the 14-foot back wall. This did little more than wet the surface and did not comply with the contract specification of maintaining the wand perpendicular to the surface. When pressure washing the pier caps, one of the crew would crawl across the full length of the pier utilizing extra lanyards tied together as fall protection. This was a clear safety violation. The pressure washing was completed in three days. Traffic control was moved to the west bound bridge (B00007L) for pressure washing. B00007L was coated before moving back to this bridge.

Application of the first coat of epoxy began nine days after pressure washing was complete. The contractor had run out of Devflex™, making it necessary to suspend epoxy application until the KYTC Division of Material's lab had approved the next batch of acrylic. Application of the epoxy resumed four days later, after completion of B00007L. Coating application continued as observed on other bridges. There were multiple spalled areas, some with exposed corroding steel rebars that were coated (Figure 12). The contract did not include concrete repair, so these areas could result in on-going rebar corrosion. Approximately

one-half of the northern wall (west end) went well beyond the maximum recoat interval before application of the acrylic top coat.

B00007L

Pressure washing was not monitored by KTC, however, discussions with the KYTC inspector and two of the contractor's foremen on the day coating began concluded that no one remembered when it was washed. There was only one day available between cleaning B00007R (which took three days to wash) and the beginning of coating application B00007L, so apparently the bridge was washed then. Piers 1 and 4 had considerable spalling (Figure 13). The contract did not include concrete repair, so these areas were washed and coated.

During the second day of epoxy application KTC personal verified acceptable ambient conditions upon arrival at 1:30 PM and again at 4:15 PM. Coating application began at 7:30 AM and when asked about conditions at that time the KYTC inspector stated that he does not check conditions if the temperature is above 50° F. The KYTC inspector was also asked if WFTs were being monitored; he stated that he was not checking WFTs because two coats were being applied and was sure that thickness would be fine. When asked about WFT measurements, the contractor's foreman stated they do not have any gauges to perform the measurements. KTC personnel measured a few places and found thin areas in the range of 2 to 3 mils with most areas measuring 6 to 8 mils (within the recommended DFT range). The original paint crew had left for another job and the pressure washing crew took over the coating application. There were fewer drips, runs, and very few pooled areas. Little effort was observed to fill the bug holes when using the epoxy, although that improved when the top coat was applied. There was an existing concrete slurry on the horizontal portion of the barrier wall (plinth); KYTC personnel decided to let the contractor apply a single coat of the epoxy instead of the normal two coats since it appeared to be intact.

The contractor ran out of the Devflex™ acrylic top coat and was waiting on KYTC Division of Material's lab to approve the next batch. Knowing the testing time could delay approval for up to ten days, the contractor continued application of the epoxy without consideration of the maximum recoat window. After being notified of this issue, KYTC personnel checked on the status of the testing. The new batch of coating had been approved prior to running out of coating and an email had been sent by the Materials Lab, but was not read in a timely manner. The application of Devflex™ began within 48 hours of finishing the epoxy. The recoat interval between epoxy and acrylic on the pier caps is unknown.

Conclusions/Recommendations

The contractor began work on this project on April 18, 2017, and completed all work on June 22, 2017. There are several observations made by KTC personnel that should be addressed on future projects, including issues from the initial planning stages to final inspection as well as the contractor qualifications. Some of the issues KTC staff observed could lead to premature failures on this project in the next few years. Through observation and discussions with KYTC personnel, as well as contractor personnel, the following conclusions were drawn.

1. Future KYTC concrete coating contracts should require qualified coating applicators and/or concrete coating qualification training. The experience level of the painting crew, for this project, was limited and there were no qualified coating applicators. One crew member had some experience painting houses. This contractor's expertise was in deck overlays.

2. For future projects KYTC personnel should be better prepared to ensure all aspects of the project are understood. There was an inexperienced inspector onsite who did not have an inspection kit until after the project started. The inspector was unfamiliar with the use of a WFT gauge. Initially the electronic ambient temperature monitor was not working properly. The inspector was also unfamiliar with the product data sheets.
3. The product data sheets for the selected coating system should be read thoroughly and understood by the contractor and KYTC personnel before the project begins. There was an issue of non-compliance with the recommended recoat window when applying acrylic to epoxy. Page one of the Amerlock 400 product data sheet specifies a 16-hour minimum recoat interval, and there is also a note to "see over coating tables" (Table 2). Apparently these tables, where the information about application of acrylic to epoxy is located were not reviewed, creating some confusion. This issue was not only overlooked by the contractor and KYTC personnel; the supplier's representative was unaware of it and stated that they would have to check on it. There were a few areas throughout the monitored portion of this project that may warrant further investigation or at least future monitoring (Table 3). Long-term issues could include adhesion problems.
4. There was no specific concrete coating standard referenced within the contract, however, it required compliance with KYTC's "Standard Specifications for Road and Bridge Construction" and the manufacturer's product data sheets. The product data sheets referenced four ASTM standards and an ICRI standard that pertain directly to concrete, none of which were addressed.
5. The Inspector's role and authority should be clearly defined. An inspector's responsibility is to assure quality, which should require the performance and documentation of specific tasks on a periodic basis. Basic tasks include periodic inspections at defined hold points to verify conformance to specifications. An inspector should observe and document all aspects of daily activity on the job site. On this project film thickness was not measured consistently since two coats of the product were applied and that was considered sufficient. At times, ambient conditions were not measured if the temperature was over 50°F.
6. The contractor should have a designated quality control (QC) representative on site with the sole duty of ensuring that the specification requirements are properly addressed. That representative should have SSPC or NACE coating inspection qualifications.
7. There seems to be differing opinions within KYTC as to the necessity of some of the contract contents, and even the necessity of coating concrete. While there may be portions of a contract that are not relevant to the specific project, these items need to be addressed prior to the beginning of a project to clearly define contractor requirements and eliminate confusion.
8. KYTC should have a concrete coatings course for training both state inspections and contractor QC personnel. As in the past, those trained personnel should be used on concrete coating projects and the specifications revised to address a more formal QC/QA approach to achieve the specified end product.
9. Future KYTC concrete painting projects should incorporate repair of damaged concrete prior to the onset of coating work. That will typically entail the use of polymeric concrete repair materials as most cementitious repair materials require at least 14 days of curing prior to being painted over.

Of the issues observed during this project none could be considered as immediate problems, other than possibly aesthetics (Figure 14). After the project was complete, KTC personnel made a final visit on July 10 and 11, 2017, to the bridges that were monitored. The following issues were observed.

- Concrete that had spalled to the point of exposing the reinforcement was beginning to exhibit signs of rust bleeding through the coating (Figure 15).
- Pin holes had developed in several places that had excessive coating thickness (Figure 16).
- A long-term concern, due to noncompliance to recoat intervals, is adhesion properties between the epoxy and acrylic coatings due to lack of attention to the recoat window.

Time Line for Pressure Washing and Coating Barrier Walls and Abutments				
Bridge	Activity	Start	Complete	Comment
B00027N	Washing	4/13/17	4/18/17	
	1st coat epoxy	4/20 9:00 AM	4/20 5:00 PM	
	2nd coat epoxy	4/14 9:00 AM	4/24 12:00 PM	
	1st coat acrylic	4/25 7:45 AM	4/25 11:15 AM	
	2nd coat acrylic	4/25 12:30 PM	4/25 3:00 PM	
B00019N	Washing	4/19/17	4/20/17	
	1st coat epoxy	4/24 1:15 PM	4/24 6:00 PM	
	2nd coat epoxy	4/26 7:45 AM	4/26 11:00 AM	
	1st coat acrylic	4/27/17	4/27/17	Time was not documented
	2nd coat acrylic	4/27/17	4/27/17	Time was not documented
B00026N	Washing	4/20/17	4/21/17	
	1st coat epoxy	4/26 12:30 PM	4/26/17	Completion time was not documented
	2nd coat epoxy	4/28 8:15 AM	4/28 11:00 AM	The maximum recoat interval for epoxy to acrylic is 60 hours. Minimum acrylic to acrylic recoat interval is 4 hours.
	1st coat acrylic	05/02 7:20 AM	05/02 8:30 AM	
	2nd coat acrylic	05/02 9:30 AM	05/02 1:00 PM	
B00037N	Washing	4/21/17	4/24/17	
	1st coat epoxy	4/28 1:00 PM	4/28/17	Time was not documented
	2nd coat epoxy	5/2/17	5/2/17	Time was not documented
	1st coat acrylic	5/3 7:00 AM	5/3 8:45 AM	
	2nd coat acrylic	5/8 7:00 AM	5/8 8:30 AM	
B00007R	Washing	5/22/17	5/30/17	
	1st coat epoxy	6/8/17	6/13/17	Only western half of the northern wall was coated on 6/8/17
	2nd coat epoxy	6/13/17	6/13/17	
	1st coat acrylic	6/14/17	6/16/17	Applied to northern barrier wall only on 6/14/17. Delayed due to rain.
	2nd coat acrylic	6//19/17	6/19/17	
B00007L	Washing	6/1/17	6/1/17	No KTC monitoring
	1st coat epoxy	6/2/17	6/6/17	
	2nd coat epoxy	6/6/17	6/7/17	
	1st coat acrylic	6/9/17	6/9/17	
	2nd coat acrylic	6/12/17	6/12/17	
There is no documented time for washing and coating the pier caps. Utilizing two crews at a time let the contractor expedite washing and coating of the piers. Since there was no other documentation available, it would have been necessary for KTC personnel to remain onsite fulltime. The washing and painting operation averaged approximately one hour each per pier per crew, including moving traffic control. There was very limited monitoring, however, it appears that the coating application of B00019N, B00026N, and B00027N complied with the recoat windows as stated on the product data sheet. The piers of B00037N were monitored but a timeline was not documented. The coating application of piers and abutments of B00007R and B00007L were well beyond maximum recoat interval for applying acrylic to epoxy.				

Table 1 Time Line of Work

Overcoating interval for DFT up to 125 µm (5.0 mils)

Overcoating with...	Interval	10°C (50°F)	20°C (68°F)	30°C (86°F)	40°C (104°F)
itself and various two-pack epoxy coatings	Minimum	36 hours	16 hours	6 hours	4 hours
	Maximum	3 months	3 months	2 months	1 month
urethane and PSX	Minimum	36 hours	16 hours	6 hours	4 hours
	Maximum	1 month	1 month	14 days	7 days

Notes:

- PPG 861 (AMERCOAT 861) accelerator (1 pint per 5 gallons) will reduce min. and max. recoat interval to half (US supply only)
- Surface should be dry and free from any contamination
- A detergent wash with PREP 88, SIGMARITE 88 or equivalent is required prior to application of topcoats after 30 days of exposure
- If maximum recoat time has been exceeded, roughen surfaces
- Alkyd coatings and waterborne acrylic coatings should be applied after the film is dry to handle and not greater than three times dry to handle time
- Maximum recoating time is highly dependent upon actual surface temperature - not simply air temperatures. Sun-exposed or otherwise heated surface will shorten the maximum recoat window

Curing time for DFT up to 125 µm (5.0 mils)

Substrate temperature	Dry to touch	Dry to handle	Full cure
10°C (50°F)	24 hours	48 hours	21 days
20°C (68°F)	6 hours	20 hours	7 days
30°C (86°F)	3 hours	12 hours	4 days
40°C (104°F)	1 hour	8 hours	3 days

Table 2 Over coating intervals from PPG Amerlock 400 Product Data Sheet

Bridge	Problem	Specific Location
B00027N	Unrepaired spalling concrete and exposed reinforcement	Both abutment seats
B00019N	Unrepaired spalling concrete and exposed reinforcement	Abutment 1
B00026N	Unrepaired cracking and spalling concrete and exposed reinforcement	Piers
	Multiple areas of discontinuous film	Barrier walls
	Exceeded maximum overcoat window for application of acrylic to epoxy	Barrier walls
	Both coats of acrylic applied in 5 hours (4-hour minimum recoat interval)	Barrier walls
B00037N	Poorly cleaned efflorescence	Ends of piers
B00007R	Exceeded maximum overcoat window for application of acrylic to epoxy	Approximately one half of the northern barrier wall on the west end of the bridge
B00007L & R	Inadequate cleaning	Abutment (back wall) and pier caps
While not considered a problem, the barrier wall on the south bound side of B00027N from Abutment 1 to Pier 2 is the only area in the entire project that did not receive a pre-treatment of bleach.		

Table 3 Suspect problem areas

Figure 1 Application of bleach pre-treatment

Figure 2 Washing with appropriate stand-off

Figure 3 Removing debris with leaf blower

Figure 4 Pooled coating due to severe run (notice pin holing)

Figure 5 Spalled area on abutment after cleaning

Figure 6 Loose rust after washing

Figure 7 Top of barrier wall with no top coat

Figure 8 Excessive runs

Figure 9 Coated debris

Figure 10 Efflorescence on pier cap after cleaning

Figure 11 Back wall of abutment with floor beam in close proximity

Figure 12 Spalled concrete

Figure 13 Pier cap with severe spalling (post washing)

Figure 14 Severe runs — poor workmanship

Figure 15 Unrepaired spalling with exposed reinforcement 12 weeks after coating

Figure 16 Pinholes due to thickness coating application

Reference 1:

From: O'Bryan, John [mailto:john.obryan@ppg.com]
Sent: Wednesday, April 19, 2017 10:51 AM
To: Hale, Cedric Y (KYTC-D07) <Cedric.Hale@ky.gov>
Cc: star@mmservicesky.com
Subject: CID 162952 Bleach Question

Cedric,

Regarding the questions about the use of bleach to clean concrete surfaces prior to painting; once the bleached surface is thoroughly rinsed by pressure washing and allowed to dry, I see no issues with adhesion of the epoxy prime coat.

Thank you for your question. Please call if I can be of any further assistance.

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