Office of Research and Implementation
FFY2025 Request for Proposals

Reference SPR Item # 2318

Research Problem Statement Title:

Implement Bridge Deck Cure and Seal for Slip-Formed Parapet Walls and Sidewalks

Problem Statement:

Silencure DOT will be used as a combined curing and sealing agent for a section of a slipped formed parapet wall and a section of a bridge sidewalk and will meet the requirements of ASTM C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete. Silencure DOT is a water-based, white pigmented wax emulsion curing compound with penetrating silane/siloxane sealer for concrete. When applied to freshly placed concrete, Silencure DOT produces a continuous film, allowing it to retain water, enable its full hydration, and allowing it to achieve higher ultimate strengths while reducing surface cracks. The white pigmentation keeps the concrete surface cool and ensures the maximum achievement of its mix design specifications. Both the silane and siloxane penetrate the fresh concrete providing long term protection, even after the film has dissipated.

Proposed Research:

Field Work: Silencure DOT will be tested on a bridge that will be selected by ODOT Bridge Division. The bridge will have slip formed parapet walls and sidewalks on both sides so it will be easy to inspect the wall without having to impact traffic. A visual inspection will be made and documenting cracks in the slipped formed parapet wall and in the sidewalk section with and without the Silencure DOT. The following process will help evaluate the Silencure cure and seal material. A cure and seal are placed on the concrete during curing and then placed again after

several days to seal the concrete pores. The material will be finished and then the following treatments will be made:
No curing (control); cure with Silencure; cure with Silencure and then wait X days and apply Silencure again as a sealer; cure with poly-alphamethylstyrene (PAMS) curing compound; cure with PAMS and treat with approved silane sealer; wet cure with burlap for 7 days; wet cure with burlap for 7 days and treat with approved silane sealer; wet cure with pulpcure for 7 days; wet cure with pulpcure for 7 days and treat with approved silane sealer. After treatment the concrete will be dried at 73F and 50%RH for 21 days. The samples will then be placed in lime water to measure the mass uptake over 10 days. The samples will then be placed in NaCl solution to measure the mass uptake over 10 days. The chloride penetration will then be measured with an XRF microscope. Field cores will be taken to compare lab porosity and mass changes to lab specimens. The accelerated lab testing is the best way to evaluate the durability of the product, it may also desirable to test Silencure DOT in the lab under simulated climate variations modeling different temperatures using heat lamps, humility variations, and simulate wind speeds using fans.

Suggested Tasks (to include but not limited to):

Task 1 Perform a literature review.
Task 2 Perform testing in the laboratory.
Task 3 Perform field application and testing.
Task 4 Compare Silencure with PAMS curing compound, wet burlap, and pulpcure, both with and without and approved silane sealer.
Task 5 Measure chloride uptake on lab specimens and field samples.
Task 6 Provide recommendations and a final report.

Implementation:

After this research is completed, the results will determine if this type of seal and curing will be used on other bridge decks.

Benefits:

• Curing and sealing in one application for slipped formed parapets and sidewalks.
• Improved durability when compared to no curing.
• Reduced labor and construction time compared to more traditional water-cure methods

Deliverables:

All projects require the submission of the following reports:

- Monthly Progress Reports
- Multi-Year Projects require a Year-end Annual Report

- Copies of the project Draft Final Report in Microsoft Word and ADA accessible Adobe Acrobat pdf electronic formats
- Copies of the project Final Report in Microsoft Word and ADA accessible Adobe Acrobat pdf electronic formats

The Year-end Annual Report, Draft Final Report, Final Report and Color Article should be submitted to satisfy all federal and state requirements pertaining to the accessibility of documents including but not limited to:

- Oklahoma State Statute 62 § 41.5e and the Americans with Disability Act (ADA) of 1990, 42 USC 12.01 et seq.

The PI must also participate in the following project meetings:

- New project initiation meeting
- Semi-annual project meeting
- Close-out project meeting
- Continuing project meeting

Estimated completion time eighteen months.

Existing Research found in light literature search:

University of Kansas (2023)

"Construction of Low-Cracking High-Performance Bridge Decks Incorporating New Technology Phase II"

https://rosap.ntl.bts.gov/view/dot/72996

The construction, crack surveys, and evaluation of 12 bridge decks with internal curing provided by prewetted fine lightweight aggregate and supplementary cementitious materials following internally cured low-cracking high-performance concrete (IC-LC-HPC) specifications of Minnesota or Kansas are described, as well as those from two associated Control decks without IC (MN-Control). Nine IC-LC-HPC decks and one Control deck were monolithic, while three IC-LC-HPC decks and one Control deck had an overlay. The internally cured low-cracking high-performance concrete had paste contents between 23.8 and 25.8 percent by volume. Of the 12 IC-LC-HPC decks, nine were constructed in Minnesota between 2016 and 2020, and three were constructed in Kansas between 2019 and 2021. The performance of the decks is compared with that of earlier IC-LC-HPC bridge decks and low-cracking high-performance concrete (LC-HPC) bridge decks without internal curing. The effects of construction practices on cracking are addressed. The results indicate that the use of overlays on bridge decks is not beneficial in mitigating cracking. The IC-LC-HPC decks constructed exhibited lower average crack densities than those without internal curing. Good construction practices are needed for low-cracking decks. If poor construction practices, which may include poor consolidation and disturbance of concrete after consolidation, over-finishing, delayed application of wet curing, are employed, even decks with low paste contents and internal curing can exhibit high cracking. Delayed curing and over-finishing can also result in scaling damage to bridge decks.

Transportation Research Record (2022)
"Evaluation of Maintenance Procedures for Bridge Spalling on Parapet Walls"
https://journals.sagepub.com/doi/10.1177/03611981221075030
Parapet wall deterioration concerns the Ohio Department of Transportation as well as other transportation agencies. The spalling of parapet walls presents a danger to the traveling public, as pieces of deteriorated concrete may fall onto the road below. The current repair method is to chip off the weakened concrete using pneumatic chipping hammers. However, this process not only damages the sound concrete, but it also leaves an unprotected surface. This project implemented hydrodemolition as a means of removing spalled concrete. A hydrodemolition robot was utilized in the field to remove concrete on the interior and exterior face of a parapet wall. This method was determined as promising as it does not damage the sound concrete surface and exposed reinforcing steel, it mitigates silica dust, and it efficiently removes unsound concrete. Polyaspartic polyureas are a concrete protectant/sealant that may be rolled onto a prepped concrete surface using a paint roller. This material not only seals the concrete but may provide a reinforcing barrier that retains loose pieces of concrete. This material was used to coat several parapet walls in the field, and it was observed that three of the five polyaspartic products appeared effective in the field at providing a protective barrier. In contrast, all were equally effective in laboratory testing.

University of Cincinnati (2020)
"Evaluation of Maintenance Procedures for Bridge Spalling on Parapet Walls"
https://rosap.ntl.bts.gov/view/dot/55962
Parapet wall deterioration concerns the Ohio Department of Transportation. The spalling of parapet walls presents a danger to the traveling public as pieces of deteriorated concrete may fall onto the road below. The current repair method is to chip off the weakened concrete using pneumatic chipping hammers. However, this process not only damages the sound concrete, but it also leaves an unprotected surface. This project implemented hydrodemolition as a means of removing spalled concrete. A hydrodemolition robot was utilized in the field to remove concrete on the interior and exterior face of a parapet wall. This method was determined as promising as it does not damage the sound concrete surface and exposed reinforcing steel, it mitigates silica dust, and it efficiently removes unsound concrete. Polyaspartic polyureas are a concrete protectant/sealant that may be rolled onto a prepped concrete surface using a paint roller. This material not only seals the concrete but may provide a reinforcing barrier that retains loose pieces of concrete. This material was used to coat several parapet walls in the field, and it was observed that three of the five polyaspartic products appeared effective in the field at providing a protective barrier. In contrast, all were equally effective in laboratory testing.

Western Michigan University (2022)
"Effects of Concrete Cure Time on Epoxy Overlay and Sealant Performance"
https://rosap.ntl.bts.gov/view/dot/62966
Applying flood coats (thin epoxy overlays and healer sealers) improves bridge deck condition and extends service life. The current Michigan Department of Transportation (MDOT) policy is to maintain a total curing period comprising 28 days of wet and dry curing before applying a flood coat on bridge decks with new concrete for patches and repairs. Consequently, the contractors must wait 28 days to start surface preparation for a flood coat application, which increases project completion time, traffic management, and user costs. Therefore, there is an interest to evaluate the possibility of applying a flood coat during the dry curing period. Hence, two

performance-based procedures were developed to identify the minimum concrete age to receive a thin epoxy overlay or a healer sealer. Two epoxy overlays and two healer sealers were identified from MDOT approved product lists to evaluate their performance on the standard bridge deck joint repair (BDJR) and Grade DM concrete mixes. The overlay performance was evaluated under standard laboratory conditions, simulated summer exposure conditions, wet and dry conditions, and the outdoor conditions representing southwest Michigan exposure. The performance under outdoor conditions was evaluated during the fall, winter, and summer seasons. The overlay performance was assessed primarily by conducting the tensile bond pull-off strength test. Also, the effectiveness of the overlay against chloride ingress was evaluated. The performance of healer sealers was assessed by evaluating the effectiveness of sealers to prevent chloride ingress through sealed cracks. The experimental results support applying overlays and healer sealers during the dry curing period. The rational and implementable procedures developed through this research evaluate the minimum age of concrete to receive epoxy overlays or healer sealers without compromising concrete durability and overlay/healer sealer performance. Even though the process requires evaluating several parameters, this process needs to be implemented only once per each standard or approved mix resulting in significant savings from project and road user costs.

Journal of Coatings Technology and Research (2022)
"Recent Developments in the Anti-Graffiti Coatings: An Attentive Review. Journal of Coatings Technology and Research" https://link.springer.com/article/10.1007/s11998-021-00580-z
An anti-graffiti coating (AGC) is a protective layer applied on the surface (all types including cultural heritage and metallics) to limit possible vandalism phenomena. AGCs are one of the elementary classes of coating materials, creating a barrier layer between substrate and graffiti, preventing the penetration of graffiti into the substrate and helping easy graffiti removal. AGC can be applied on porous and nonporous substrates, including concrete, mortar, stone, granite, metals, etc. AGCs are mainly classified as permanent, semi-permanent, and sacrificial. Sacrificial AGCs include waxes, polysaccharides, and polysiloxane, whereas permanent AGCs include fluorinated polymers, nanoparticles-based coating, silicon, and polyurethanes (PU). The use of hybrid polymers in AGCs containing silane or siloxane and fluoropolymers-based compounds with effective anti-graffiti (AG) properties is an introductory class in the future AGC market. Nowadays, nanotechnology is widely used in AG pretreatment. These polymer chemistries of AGCs find the application on historical walls, public places, trains, houses, etc. The present article focuses on various types of AGCs, their current market trends based on multiple chemistries, mechanisms, and their performance with the structure–property relationships.

FHWA (2021)
"Nondestructive Evaluation of Concrete Bridge Decks with Overlays"
https://rosap.ntl.bts.gov/view/dot/54794
Concrete bridge deck overlays have been used in the United States since 1960 to extend the service life of deteriorated concrete bridge decks and improve reliability. Concrete bridge decks with overlays suffer various types of deterioration, so it is necessary to identify and assess the effectiveness of different nondestructive evaluation (NDE) technologies in the laboratory under controlled conditions and in the field under actual conditions. This report provides an overview of seven types of widely used overlays: asphalt with a liquid membrane, asphalt with a fabric membrane, asphalt without a membrane, silica fume-modified concrete, latex-modified concrete (LMC), epoxy polymer concrete, and polyester polymer concrete. This report identifies and ranks available and promising NDE technologies to assess the performance of different types of overlays and concrete bridge decks. This report describes laboratory validation on overlays for nine commonly used NDE technologies. The nine NDE technologies are: sounding, ultrasonic surface waves (USW), impact echo (IE), ultrasonic tomography (UT), impulse response (IR), ground-penetrating radar (GPR), electrical resistivity (ER), half-cell potential (HCP), and infrared thermography (IRT). This report details the results of laboratory tests validating the NDE technologies for the seven different types of overlays. Field validation using the RABITTM bridge deck assessment tool and manual testing equipment was also performed. Results from the study on which this report is based indicated that GPR was the most effective method for detecting defects in underlying concrete specimens through both bonded and debonded overlays; however, GPR could not detect overlay debonding. Results also showed that USW, IE, and UT were effective stress-wave-based methods for detecting defects under bonded overlays but not asphalt overlays. Researchers found that asphalt overlays at low temperatures (i.e., 32°F or below) improved the applicability of IE. Sounding and IR were effective methods for detecting overlay debonding but could not detect defects under bonded overlays. HCP measured the potential difference between areas with and without active corrosion but could only detect active corrosion on LMC and polyester overlays due to the electric insulation of the other overlay materials. Researchers also found that IRT was an effective method for detecting overlay debonding and

shallow defects under some overlays. Results concluded that ER was the least effective method due to the resistivity of overlays.

Oregon Department of Transportation (2020)
"Bridge Deck Asphalt Concrete Pavement Armoring"
https://www.oregon.gov/odot/Programs/ResearchDocuments/SPR815Bridgedeckasphalt.pdf
Deterioration of the concrete bridge deck is one of the most significant problems affecting the service life of bridges in the United States. Moisture penetration into the asphalt overlay and standing water on the concrete bridge deck result in expansion and contraction at the interface on the bridge deck during freeze-thaw cycles. This causes debonding at the interface and results in an increased rate of deterioration for the asphalt concrete overlay. Additionally, the deicing salts permeate into the deck and cause corrosion of the steel reinforcement, weakening the structural integrity of the bridge. Waterproofing membranes with an asphalt overlay were developed as a strategy to protect concrete bridge decks. The main goals of this study were to provide the industry and Oregon Department of Transportation (ODOT) with better insight on the failure mechanisms of asphalt overlays on concrete bridge decks and establish field and laboratory experiments to evaluate the performance of these overlays. The most effective deck waterproofing systems and overlay strategies (in terms of both cost and performance) were determined for concrete bridge decks in Oregon. By determining the most effective waterproofing methods and strategies, this research will serve to decrease repair and replacement costs, and increase the service life of asphalt overlays on concrete bridge decks in Oregon.

Virginia Transportation Research Council (2019)
"Performance of Bridge Deck Overlays in Virginia: Phase II: Service Life Performance"
https://vtrc.virginia.gov/media/vtrc/vtrc-pdf/vtrc-pdf/20-R6.pdf
Overlaying bridge decks has remained one of the best rehabilitation methods to extend their service life, and the Virginia Department of Transportation (VDOT) has been a leader in the use of bridge deck overlays. Although VDOT has extensive experience in overlays, the long-term performance of overlays has not been entirely understood. One of the biggest challenges for studying the performance of overlays is that only minimal information is available in bridge inventory and inspection records. This limits any scientific assessment of this system. Therefore, the purpose of this study was to provide a strong framework for the understanding of the long-term performance of overlays and the factors affecting them. This Phase II report reports on an extensive data collection process that led to the development of a robust database of 133 overlaid bridge decks after verification of historical inspection reports, verification of as-built plans and communication with VDOT district bridge engineers. This helped in developing a model for understanding the amount of time it takes for bridge decks to require the first major rehabilitation and the major factors influencing the durability. A database of information about overlays that were replaced at the end of their functional service life was compiled. This helped develop a multiple regression model for understanding the factors that affected the durability of overlays. Survival analyses were conducted to estimate the service life of overlays and corresponding risk. As a preventive method, epoxy concrete (EC) overlays were predicted to serve an average of 20.9 years, with 18 to 22 years at a 95 percent confidence level. As a rehabilitative method, rigid concrete overlays were predicted to serve an average of 25.9 years, with 21 to 32 years at a 95 percent confidence level. The recent trend of preferred overlay types has been identified as EC and very-early-strength latex-modified concrete (VELMC) overlays. EC overlays

have proven to be one of the better performing overlays through extensive VDOT experience. VELMC overlays are an improvement upon latex-modified concrete overlays by vastly reducing the time of construction and thus become more suitable for decreased construction time, reduced traffic disruption, and lessened worker exposure to the field environment. An important discovery was the identification of the influence of the degree of deck damage prior to overlaying on the service life of overlays. Preventive EC overlays should be used in a preventive sense, as the name suggests. If preventive EC overlays are installed on bridge decks with spalls, patches, or delaminations, irrespective of the amount of damage, an increased rate of deterioration in the overlays is likely to follow. The future performance of rehabilitative overlays such as latex-modified concrete, silica fume, and VELMC overlays will not be influenced by the presence of bridge deck damage prior to overlaying. This might be because of the removal of deteriorated concrete before these rigid overlays are constructed. This emphasizes the importance of proper removal of poor quality concrete from bridge decks before overlaying during rehabilitation.

Transportation Research Record (2019)
"Impermeable Asphalt Concrete Layer to Protect and Seal Concrete Bridge Decks"
https://journals.sagepub.com/doi/10.1177/0361198119841041
Deterioration of the concrete bridge deck is one of the most significant problems affecting the service life of bridges in the United States (U.S.). The early failure of asphalt pavement overlays on concrete bridge decks with spray-on waterproofing membranes has been recognized as a significant issue by the Oregon Department of Transportation (ODOT). Potential reasons for the failure of the asphalt overlays were thought to be the poor adhesion between the waterproofing membrane and the asphalt-wearing course, and the material properties of the asphalt layer. Moisture penetration into the asphalt overlay and standing water on the concrete bridge deck result in expansion and contraction at the interface on the bridge deck during freeze-thaw cycles. Expansion and contraction because of freeze-thaw cycles cause debonding at the interface and result in an increased rate of deterioration for the asphalt concrete overlay. Additionally, the de-icing salts used to prevent hazardous roadway surfaces in the winter permeate into the deck and cause corrosion of the steel reinforcement, weakening the structural integrity of the bridge. The main goal of this study is to develop an impermeable asphalt mixture with high cracking and rutting resistance that can seal and protect the concrete bridge deck by preventing water and de-icing salts from penetrating into the concrete deck. Permeability of developed asphalt mixtures was quantified by permeability testing and moisture sensor measurements. Rutting and cracking resistance of the developed impermeable asphalt mixture strategies were also evaluated by conducting flow number (FN) and semi-circular bend (SCB) tests in the laboratory.

Tran-SET (2019)
"A Comprehensive Framework for Life-cycle Cost Assessment of Reinforced Concrete Bridge Decks"
https://rosap.ntl.bts.gov/view/dot/62558
Corresponding data set for Tran-SET Project No. 18STOKS02. Abstract of the final report is stated below for reference: "Various environmental and mechanical stressors cause deterioration of concrete bridge decks. Normal wear and tear, freeze and thaw cycles, and chloride penetration due to deicing salts can cause aggressive deterioration that usually require frequent interventions during the life-cycle of the bridge. These interventions include deck maintenance and repairs (e.g., application of sealers or overlay placement) as well as bridge deck replacement. The

quantification of the life-cycle cost of bridge decks considering maintenance and repair activities represents a significant challenge facing local and state transportation agencies. The life-cycle maintenance activities not only increase the direct life-cycle cost of the bridge, but they also lead to significant indirect user costs due to increasing traffic delays, work zone crashes, and operating cost. Moreover, these traffic delays increase the carbon footprint of the bridge and adversely affect the life-cycle bridge sustainability. Accordingly, the proper quantification of indirect costs associated with life-cycle bridge management activities including maintenance, repair, and rehabilitation activities is of paramount importance. The research attempts to fill in the knowledge gaps in quantifying the indirect costs associated with bridge deck maintenance activities and their impact on the overall bridge life-cycle cost."

Kentucky Transportation Center (2018)
"Longer Lasting Bridge Deck Overalys"
https://rosap.ntl.bts.gov/view/dot/35509
The objective of this report is to determine the most effective method for bridge deck overlay construction and repair by assessing current practices; examining new products and technologies; and reviewing NCHRP (National Cooperative Highway Research Program) guidelines, state standard specifications, ASCE (American Society of Civil Engineers) infrastructure ratings, and original bridge core chloride penetration data. Based on the review, this report offers the following conclusions. Latex modified concrete (LMC) overlays perform well, provide a long service life, and are the most commonly used method of bridge deck rehabilitation. Ohio considers microsilica concrete (MSC) overlays as state of the art due to their lower permeability. Superplasticized dense concrete (SDC), fly-ash modified concrete (FAMC), and polymer modified concrete (PMC) are other acceptable choices for bridge deck overlays. Silane or epoxy sealers may be used as a low-cost preventative approach to slow the deterioration of concrete bridge decks. Waterproofing membranes have produced mixed results but have the potential to be an effective system if installed correctly. Rosphalt® can be an expensive material but offers benefits such as minimizing traffic disruption due to shorter installation periods and increased durability. The two most important conclusions drawn from this research are the importance of a comprehensive approach when selecting a bridge deck rehabilitation method, and the importance of properly following instructions when installing overlays or waterproofing membrane systems.

VTRC (2017)
"Performance of Bridge Deck Overlays in Virginia: Phase 1: State of Overlays: Final Report"
https://rosap.ntl.bts.gov/view/dot/32335
Maintaining the existing transportation infrastructure is a major concern of the Virginia Department of Transportation (VDOT). The increased user travel costs, safety concerns, and financial burdens involved in replacing deteriorating decks are reasons for finding appropriate rehabilitation actions that can safely extend the service life of structures. Virginia has been a leader in employing overlays as a rehabilitation method for bridge decks. VDOT's Manual of the Structure and Bridge Division contains guidance for the decision-making process related to maintenance and repair of structures. Yet there is a need to update the guidelines based on contemporary experience and the knowledge gained through technological advances. This report presents and discusses the preliminary findings of Phase I of a multi-phase study to determine the performance of bridge deck overlays in Virginia. Phase I focused on obtaining information regarding the experiences of VDOT's nine districts with regard to their use of different kinds of

overlays and the factors that influence which overlays are used. In addition, VDOT's bridge inventory was analyzed to gain an understanding of the types of overlay systems used in Virginia. The overlay types identified to be the most commonly used by the nine VDOT districts were latex-modified concrete, epoxy concrete, silica fume concrete, very-early-strength latex-modified concrete, and hot-mix asphalt concrete with a water-resistant membrane. From interviews, wide ranges in service life, even for the same overlay type, were found in every VDOT district. The performance of overlays, irrespective of the type, was highly dependent on the construction workmanship and the attention paid to the crucial details. Another commonly observed influential factor was the degree of deck damage (i.e., deterioration) that existed when the overlay was installed; the higher the pre-overlay deck damage, the worse the performance of the overlay. The study recommends that a Phase II study be conducted that will involve an investigation of the overlays for bridges in VDOT's bridge inventory, including a review of inspection reports and a field survey of a selected number of bridge decks. The study further recommends that factors identified in the Phase I study, such as age of overlays, traffic volume, and salt usage, be taken into account when the bridges are selected. The results will support appropriate modifications to the bridge maintenance guidelines as they pertain to deck overlays in VDOT's Manual of the Structure and Bridge Division.

Construction and Building Materials (2016)
"Study of the Effect of Three Anti-Graffiti Products on Physical Properties of Different Substrates"
https://www.sciencedirect.com/science/article/pii/S0950061815308527
To protect the surface of materials from the effects of graffiti paints, there are anti-graffiti products that prevent the penetration of these paints into the pore system of the substrates, making the substrates water- and oil-repellent, thus facilitating their removal. This paper presents a comparative study of three commercial anti-graffiti products (two sacrificial and one permanent) applied on three substrates, in order to evaluate the changes caused by these products on the physical properties of the substrates. Thus, the anti-graffiti products were applied on a Portuguese limestone and on painted and unpainted lime-based mortars. The experimental work was focused on various laboratory tests such as open porosity, capillary water absorption, water absorption under low pressure, water vapor permeability, drying behavior and color variations. The results have shown that these products introduced variations on the physical performance of the substrates, especially the water absorption, drying behavior and water vapor permeability.

Colorado Department of Transportation (2014)
"Evaluation of Bridge Deck Sealers. Denver, Colorado : Colorado Department of Transportation"
https://rosap.ntl.bts.gov/view/dot/27455
This study focuses on the evaluation of bridge deck sealers commonly used on highway bridge decks and their relative performance. After reviewing the most up-to-date research findings on chemical sealers used by state departments of transportation (DOTs), four sealer products that could potentially be used by the Colorado Department of Transportation (CDOT) were selected for evaluation. High molecular weight methacrylate (HMWM), two epoxies, and a silane were assessed for their skid resistance and ability to block or slow down moisture and chloride ion penetration into concrete bridge decks. Bridge structure E-17-QM (westbound US 36 to I-270 over I-25) was selected for the field study. The four sealers were installed on the deck surface of Bridge E-17-QM by professional contractors on 06/02/2010. Skid resistance, temperature variation, moisture fluctuation, and chloride concentration profiles in concrete were selected as

the four experimental parameters for evaluating the performance of the four sealers. Eighteen integrated sensors were installed in the bridge decks in the five testing sections and at different depths for monitoring the internal temperature and relative humidity distributions in concrete. Concrete cores were taken at four periods during the project to test for chloride concentration profiles. The British Pendulum Tester (BPT) was used to measure the skid resistance of the concrete surface with and without sealers. From the analysis and comparisons of the test data, the performances of the four sealers were ranked in terms of the four experimental parameters. Without further long-term data, the use of sealers is recommended as a viable short-term protection system. If CDOT chooses to use a long-term bridge deck sealing system, HMWM is recommended over the other sealers. Eligible bridge decks should be selected based on the assessment of percent deck deterioration, estimated time to corrosion, deck surface condition, and concrete quality

Cement and Concrete Research (2010)
"Interaction Between Two Anti-Graffiti Treatments and Cement Mortar (Paste). Cement and Concrete Research" https://www.sciencedirect.com/science/article/pii/S0008884610000049
Much of the twentieth century's built heritage is made of concrete, which is particularly unsceptible to graffiti "attacks". Since the traditional methods used to remove spray paint are not particularly effective on this type of material, the adoption of preventive measures by applying a new type of protective treatments, known as anti-graffiti coatings, may be a good way to tackle the problem. The present study aimed to evaluate the physical properties of a cement mortar coated with two such products and to study the possible molecular interactions between the coatings and the cement paste. Neither product induced chromatic changes on the surface of the material, while both made it water repellent. 29Si MAS NMR analysis detected a lower Q1/Q2 ratio, indicative of a longer chain length, in the C–S–H gel in the cement paste mixed with the anti-graffiti products. Adjust the spacing for this last lit review piece.