

Ongoing Research on the Performance of Bridge Deck Sealants and Coatings

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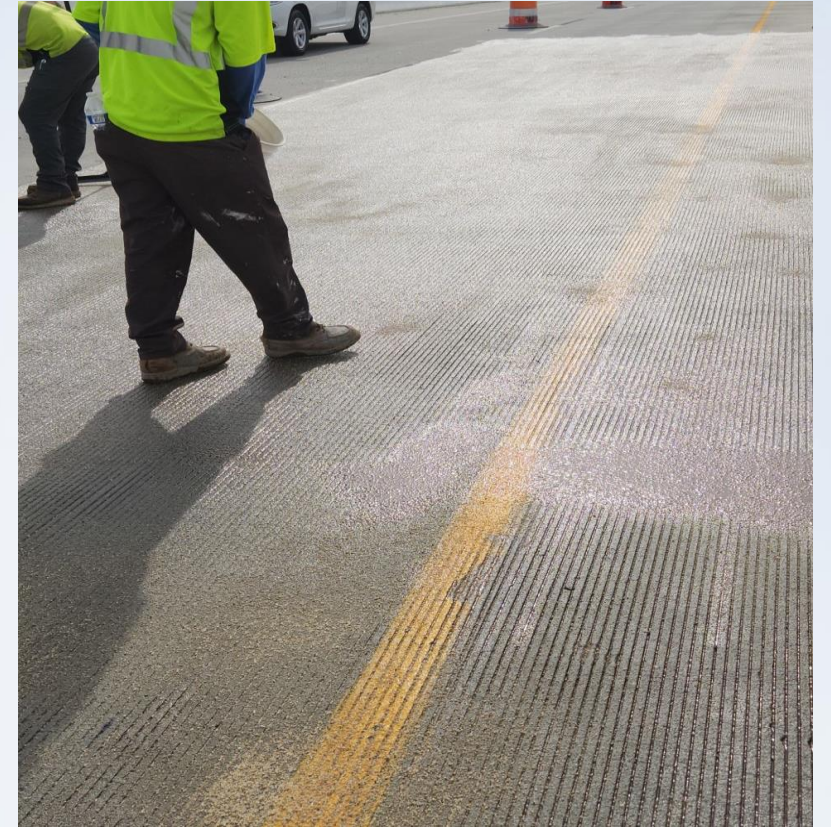
Kevin Lindell, P.E., Delaware DOT

Why Seal Concrete Bridge Decks?

- The ingress of chlorides into concrete is one of the greatest threats to the long-term performance of bridge decks
- Chlorides are mainly introduced via brining operations for snow and icy weather to provide safer traveling conditions
- High chloride levels in the concrete deck can lead to corrosion of the steel reinforcement and can cause deck spalling and deck delamination greatly reducing the service life
- Use of a sealer can reduce water & chloride penetration

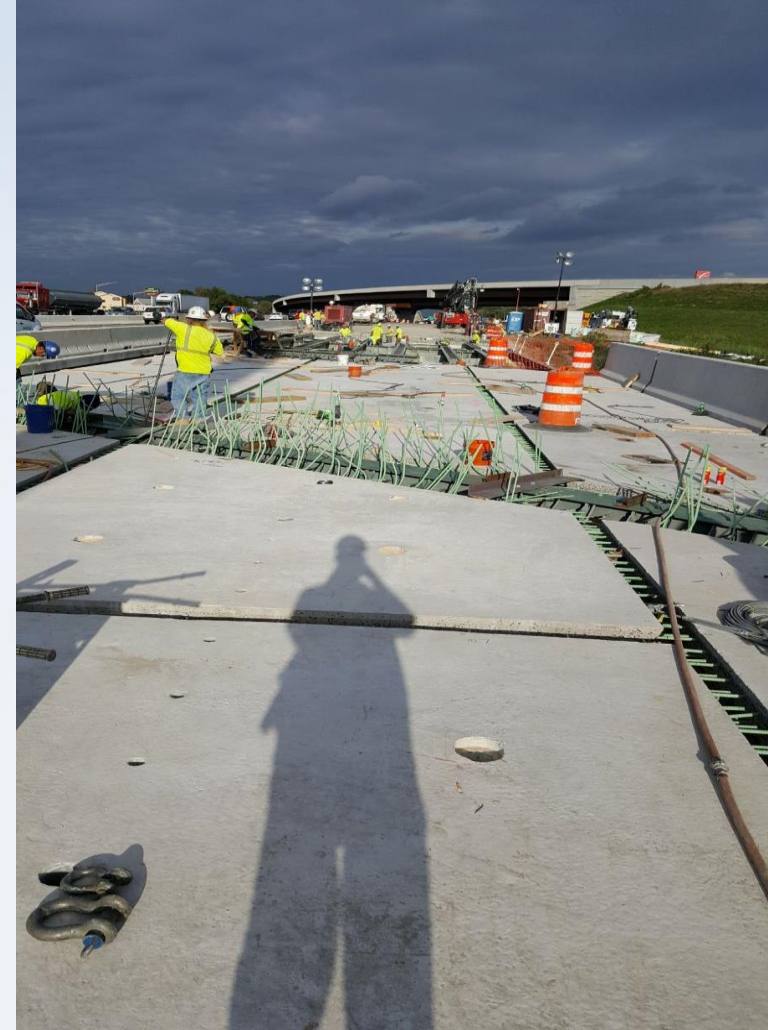
Common Types of Concrete Sealers to Prevent the Penetration of Water & Chlorides

- Silane Sealers
- Linseed Oil
- Methacrylate & Epoxy Sealers
- DelDOT uses silane, methacrylate, and epoxy sealers



DelDOT Bridge Inventory

- Total of 540 concrete deck/slab bridges
 - 420 - Bare concrete decks
 - 65 - LMC or Class D concrete overlay
 - 49 - Asphalt overlay with waterproof membrane
 - 16 - Epoxy or PPC overlay



DelDOT Preventative Maintenance Deck Sealing Program

- Silane sealers are applied to all new concrete bridge decks and concrete overlays after the 28-day curing period
- Multi-bridge contracts utilized to seal existing bridge inventory
- Concrete bare deck structures are sealed on a 5-year cycle
- Methacrylate or Epoxy is used in addition to silane coating for larger cracks

DelDOT Deck Sealing Program History

- 2017: single contract for Bridge 1-813 which carries interstate I-495 over the Christina River. Twin span structures with each having a span of 4,800 ft
- 2018: first multi-bridge contract - 20 structures total
- 2021: multi-bridge contract - 70 structures total
- 2023: multi-bridge contract – 50 structures total
- 2024: multi-bridge contract for US 301 – 26 structures total

DelDOT Contract Delivery Method

- Capital Bridge Project Contracts
 - All new concrete bridge decks or overlays have silane sealer included in the contract documents
- Single or Multi-location Contracts
 - Used mainly for existing concrete bridge deck/overlay inventory
- Open-End Structures Maintenance Contracts
 - Allows faster project identification and work application

DelDOT Silane Sealer Design Specifications

- Provide a one-component, deep penetrating solvent-based water repellent silane sealer
- Minimum of 40% silane solution by weight diluted in a suitable alcohol-based solvent
- Must comply with VOC regulations and be capable of application by spray or roller
- Materials must pass a chloride screen test using NCHRP 244 Series IV with a minimum 90% reduction

Surface Prep & Sealer Application



Assessing the current state-of-practice

Warm-up question: what's your favorite historic US bridge

Golden Gate



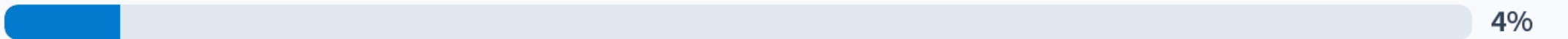
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Brooklyn



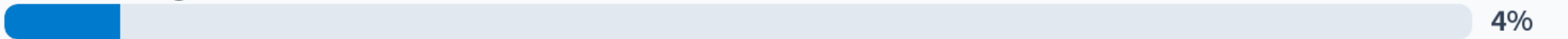
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Hell Gate



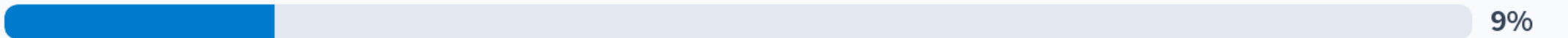
4%

Williamsburg



4%

Other



9%

What is your professional affiliation?

State DOT or agency

0%

Local DOT or agency

0%

Consultant

0%

Vendor/Supplier

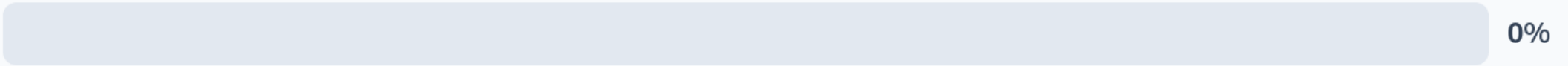
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Other

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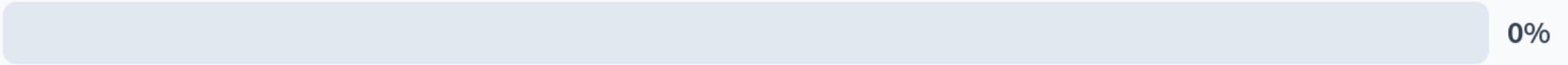
Do you seal your new or existing bridges?

Yes



0%

No



0%

What type of sealant(s) do you use?

Nobody has responded yet.

Hang tight! Responses are coming in.

What is your typical application interval? Every -

1 year

0%

2 years

0%

3 years

0%

4 years

0%

5 years

0%

More than 5 years

0%

It varies

0%

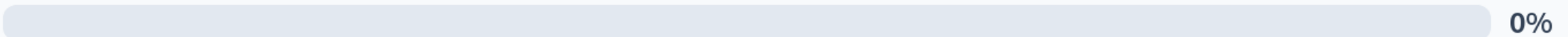
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What type of surface preparation do you use?

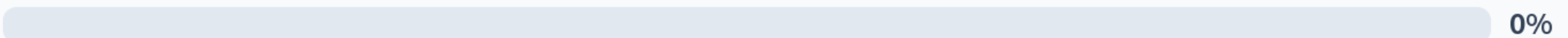
Sweep



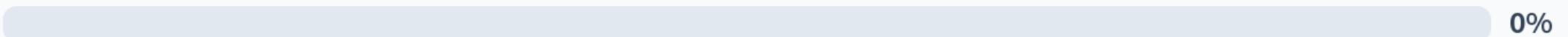
Power wash



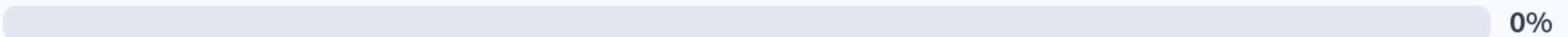
Shot or sand blast



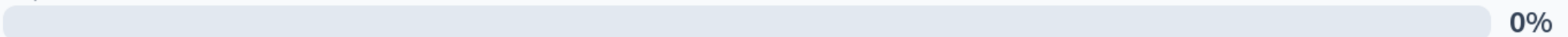
Some combination of these



Other

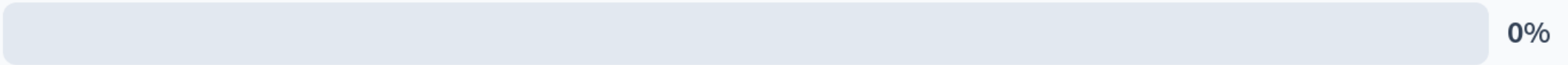


N/A

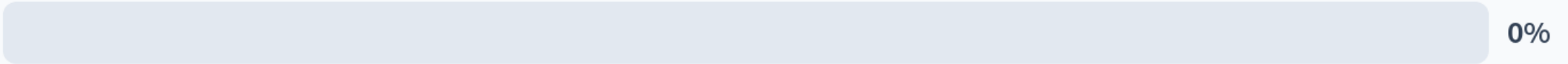


How does the work get done? Using what forces?

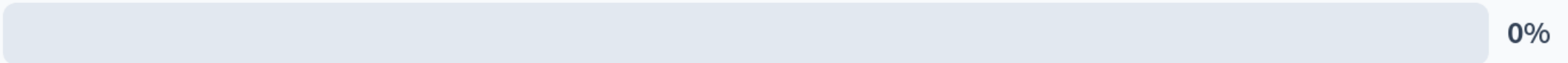
In-house crews



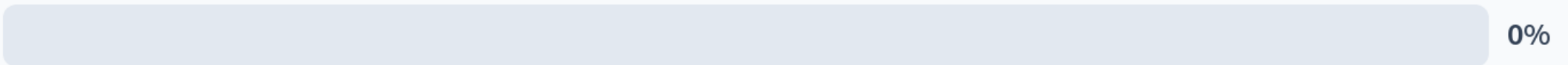
Contractor



Combination of both

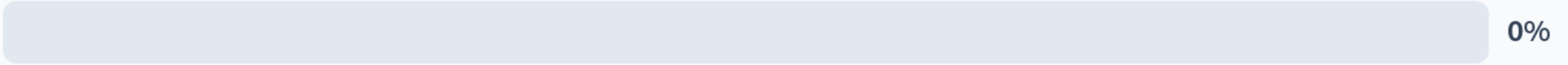


None of the above



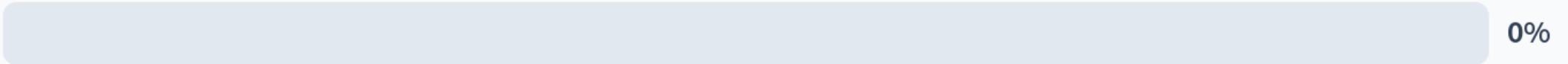
Do you have a deck washing program? If so do you coordinate sealing of decks post deck washing?

Yes



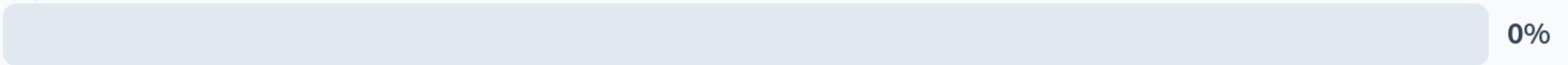
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No



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N/A



0%

If you dont have a deck sealing program - what are the main reasons that you dont have one?

Nobody has responded yet.

Hang tight! Responses are coming in.

DelDOT Research Project: Objective

To evaluate the current state-of-knowledge and -practice of the use of bridge deck sealants and coatings as a protection against water and chloride ingress into concrete.

Our goal is to provide recommendations on:

1. Treatment frequency
2. Product & concentration
3. Surface preparation
4. Recommended procedure for decks that are already cracked

Research Tasks

- Literature review
- Assessment of current state-of-practice
- Experimental investigations
- Findings and recommendations
- Reporting and recommendations

Two year project.....start July '24

Literature review

Year	Title	Funding Organization
2024	Concrete bridge deck crack sealing	Illinois DOT
2023	FHWA Peer Exchange Report on Corrosion Prevention and Mitigation for Highway Bridges	GPI
2022	Effects of Concrete Cure Time on Epoxy Overlay and Sealant Performance	Michigan DOT
2021	Exterior Protection of Precast Reinforced Concrete Culverts	Ohio DOT
2021	Concrete Bridge Deck Preservation Resource Guide	TSP2
2020	Protocols for Concrete Bridge Deck Protections and Treatments	Wisconsin DOT
2019	Developing Material Specification and Application Criteria for Sealing Concrete Bridge Decks	Kentucky Transportation Center
2018	Improving the Long-Term Performance of Concrete Bridge Decks using Deck and Crack Sealers	Solaris/Nevada DOT
2017	Proposed Testing of Concrete Sealers	Kentucky Transportation Center
2017	FHWA LTBP Summary—Current Information on the Use of Overlays and Sealers	FHWA LTBP

Literature review

Year	Title	Funding Organization
2017	Use of Polymer Overlays or Sealers on New Bridges	Iowa Highway Research Board
2016	Development of a Cost-Effective Concrete Bridge Deck Preservation Program: Volume 2— Final Results and Recommendations	Indiana DOT
2015	Evaluation of Sealers and Waterproofers for Extending the Life Cycle of Concrete	Indiana DOT
2015	Expected Life of Silane Water Repellant Treatments on Bridge Decks	Oklahoma DOT
2015	Comparative Evaluation of Concrete Bridge Deck Sealers	Alabama
2014	Sealants, Treatments and Deicing Salt Practices to Limit Bridge Deck Corrosion” and “Experimental Deck Sealants and Pier Cap Coating on Interstate 471	Kentucky Transportation Cabinet
2014	Evaluation of Bridge Deck Sealers	Colorado DOT
2009	Development and Layout of a Protocol for the Field Performance of Concrete Deck and Crack Sealers	Wisconsin
2009	Crack and Concrete Deck Sealant Performance	Minnesota DOT
2009	Guidelines for Selection of Bridge Deck Overlays, Seales and Treatments	WJE/NCHRP 20-07/Task 234
2002	Criteria and Benefits of Penetrating Sealants for Concrete Bridge Decks	Michigan DOT
1987	Comparative Evaluation of Concrete Sealers and Multiple Layer Polymer Concrete Overlays	Virginia Transportation Research Council

Literature review

TSP2 Bridge Deck Preservation – National Working Group

Publication: *Concrete Bridge Deck Preservation Guide*

Bridge Deck Sealing – under “Best Practices”

- Penetrating sealers need to be reapplied on a cyclical basis to continue to provide protection. Example agency recommendations include deck sealing every 3 to 6 years, but the reapplication interval will ultimately depend on site conditions, environmental exposure, traffic volumes, deck condition, product characteristics, and agency preservation guidelines.

NCHRP Synthesis 56-15: *Practices for Designing, Installing, Maintaining, Replacing, and Successively Using Complementary Bridge Deck Protection Systems*

“The objective of this synthesis is to document state DOT practices for the use and design of complementary bridge deck protection systems. The synthesis encompasses current practices for designing (e.g., selecting a deck treatment combination), installing, maintaining, replacing, and successively using complementary bridge deck protection systems to extend the service life of bridge decks.”

*** Contractor not yet selected*

*** Best guess - likely 2026 before a final report is published*

Questions?