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The research is documented in Report FHWA/MT-23-006/9757-705

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EVALUATION OF THIN POLYMER OVERLAYS FOR BRIDGE DECKS

https://www.mdt.mt.gov/research/projects/const/evaluation.aspx

The objective of the research project MDT 313265 "Evaluation of Thin Polymer Overlays for Bridge Decks" was to assess the factors that influence the long-term performance of polymer-based high-friction surface treatment (HFST) systems in Montana, specifically with respect to friction resistance and durability. The study primarily consisted of (1) a literature review and survey of the practices of select transportation agencies and (2) an investigation of the long-term field performance of sixteen HFSTs across Montana. The investigation included visual inspection, sounding surveys, laboratory testing of four HFSTs, and skid testing. The researchers used the findings of the study to identify reasonable performance expectations for the HFSTs that have been used in Montana so far and provide recommendations for how their performance can be improved.

The use of preventive maintenance strategies, such as the application of thin polymer overlays (TPOs) while the deck is in good condition, is generally considered to be more cost-effective than the traditional "worst-first" approach, wherein concrete bridge decks do not receive protective treatments or maintenance until conditions deteriorate to the point where deck rehabilitation or replacement is required1. However, quantifying the cost savings associated with preventive bridge maintenance strategies is an area of significant research itself that relies on extensive amounts of bridge performance, maintenance, and cost data, much of which is often not available2. Existing knowledge gaps in bridge performance and the impact of maintenance in particular are obstacles to identifying cost-effective maintenance strategies and accurately estimating the cost savings that can be realized.

The primary benefits of the results of MDT 313265 include defining the achievable performance of HFSTs on bridge decks (specific to the current HFSTs, conditions, and practices of Montana), characterization of existing overlay conditions, and having the knowledge gap addressed. The results of this study support the following conclusions as to the performance that can be expected of HFSTs that have recently been applied by the MDT:

Skid Resistance. While several HFSTs provided as little as 5 years of acceptable skid resistance, other HFSTs up to 8 years of age were still providing acceptable skid resistance as of the end of the study

Chloride-Induced Corrosion. The four HFSTs tested demonstrated excellent chloride penetration resistance at ages between 2 and 5 years, indicating HFSTs can effectively slow chloride intrusion into decks for at least 5 years or as long as the HFST remains intact and well-bonded.

Delaminations caused by ongoing corrosion of decks with existing chloride contamination underneath HFSTs were detected between 4 and 7 years after installation of the HFSTs indicating the service life benefits will be less on older chloride contaminated decks.

HFST Deterioration and Maintenance Needs. The governing deterioration mechanism of the HFSTs

was loss of skid resistance due to aggregate fracture at the level of the resin and surface polishing, particularly in the driving lane. Research identified that cyclic maintenance or replacement of the driving lane or wheel paths of the HFST may provide significant benefit to maintain required skid resistance while providing the desired resistance to chloride penetration.

Transverse cracking was observed in the HFSTs and appeared to increase with time. In order to maintain the protection that HFSTs generally offer against chloride penetration, follow-up crack sealing may be desired to extend overlay benefits.

Reflective cracking in the HFST around deck patches and associated spalls in the HFST and delaminations and spalls in the deck were observed at some deck patches. This type of deterioration is a risk, but can be mitigated by the use of compatible deck repair materials and improved procedures such that future maintenance needs can be minimized.

Damage at the ends of the HFSTs was observed but can be mitigated through improved design to minimize maintenance needs.

The progression of pop-out spalling was identified as an unusual deterioration mechanism. While it was observed in one lane of one of the HFSTs included in this study, this type of HFST deterioration is not anticipated to occur enough to be a concern.

HFST Opportunities. The field investigation and laboratory testing showed that the HFSTs evaluated were generally of good quality and beneficial to deck performance.

Investment in a polymer formulation that can retain skid resistance as the HFST wears may address the current governing deterioration mechanism and decrease HFST maintenance needs, and was recommended as a focus for future research.

The above information can be used by the MDT to make data-based assumptions when conducting cost analyses to inform future bridge maintenance decisions. The MDT spent less than $100,000 on collecting this information. As discussed above, the cost savings associated with using assumptions based on recorded field performance in Montana in the analyses cannot be accurately quantified by the researchers since analysis of state-wide deck cost and maintenance information is beyond the scope of this research. However, as a point of comparison, a thin polymer overlay (including the polymer overlay, primer, and deck preparation) costs approximately $50 to $60 per square yard according to the MDT's 2023 bid tabulations with total costs between approximately $34,000 and $75,000 depending on the area of the deck. Extending deck life up to 10 years or more, delays required deck maintenance saves

Montana significant funds and resources. Application state-wide to improve surface friction and extend deck life can result in millions of dollars of savings to the state. Further, motorist safety is improved. It should also be noted that this work helps the MDT meet the requirements of federal legislation "Moving Ahead for Progress in the 21st Century" (also known as MAP-21), which requires states to develop performance-based asset management plans for bridges on the National Highway System, by providing some of the performance information required to develop performance-based bridge management plans.

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