MONTANA
Department of Transportation
Research

Technical Brief

EVALUATION OF HIGH FRICTION POLYMER OVERLAYS ON MONTANA BRIDGES

Polymer overlays with high friction materials can extend the life of a bridge and provide skid resistance.

About This Research

Objectives

- Identify strategies to mitigate the degenerative factors impacting friction resistance.
- Improve the durability of bridge decks in Montana.

Benefits

- Provided HFSTs to extend the service life of bridge decks
- Increased safety and decreased costs

Research Need

High friction surface treatments (HFSTs) are thin polymer concrete overlays that can extend the service life of bridges by restoring surface friction and preventing deicer fluid from seeping into the concrete. While they can be costly, polymer overlays are preferred to traditional concrete overlays because they can be installed much faster, cure quickly, and have excellent mechanical and bond strength.

Research indicates that when installed properly, HFSTs can have service lives of 15 years or more. However, the Montana Department of Transportation (MDT) has observed shorter service lives. In 2014 and 2015, MDT installed HFSTs on four bridges to improve their skid resistance. Initially each bridge had a skid number of 80. (A higher skid number indicates better skid resistance of a pavement surface.) When bridge performance was evaluated in 2018, two of the bridges — the Bigfork and Kalispell bridges — had skid numbers of 36 and 17, respectively. (The minimum skid number for highway structures is 30 to 35.)

Montana weather can be harsh on polymer overlays, especially when cars with studded tires or snow chains traverse bridges. Developing a better understanding of the long-term performance of HFSTs in Montana and determining if they are the best solution for skid resistance and protection of Montana bridges will provide both safety and fiscal benefits.

About This Project

Project title: Evaluation of Thin Polymer Overlays for Bridge Decks

Project number: 9757-705

Technical Panel

Shane Pegram (Chair, MDT), John Benda (MDT), Stephanie Brandenberger (FHWA), and Paul Bushnell (MDT)

Principal Investigator

Paul Krauss
Principal
Wiss, Janney, Elstner Associates, Inc.
pkrauss@wje.com
847-272-7400

Research Process

A literature review of thin polymer overlays and HFSTs identified construction challenges, performance issues, and best practices for mitigating substandard installation and poor long-term performance. Additionally, a survey of select transportation agencies obtained further information about material performance, construction challenges, and best practices. For this project, the researchers monitored the conditions of 14 HFST overlay installations (up to 7 years of age) for three years. Four bridges received two detailed inspections and one visual inspection. The detailed investigations included both visual inspections and sounding surveys to identify any below-surface deterioration or cracking in the overlay and substrate. Seven of the remaining 10 installations received two visual inspections, and three received one visual inspection during the three-year period. Skid testing on select installations determined if there was any correlation between wear and traffic volumes or wear and HFST age. Laboratory testing of core samples collected from the four HFST installations that received detailed investigations evaluated the overlay and deck conditions, and the chloride penetration, durability, and deterioration of the HFSTs.

"These results will assist MDT in refining our specifications and planning for bridge deck polymer overlays and their future maintenance."

—Shane Pegram, Project Champion

Research Results

Results from the visual inspections indicated the HFSTs were in good condition, which was confirmed by the laboratory test results. During the inspections, researchers noted some wear, such as aggregate pop-outs and surface polishing, but surface loss tended to stabilize after the first few years of service. Cracking did appear to increase between inspections for some of the HFSTs, but overlay adhesion (bond) to the deck remained tight. The laboratory testing results indicated that the HFSTs retained a good bond to the deck substrates and withstood chloride penetration. Additionally, substrate cracks had been effectively filled by the polymer, and these preexisting deck cracks were not visible on the overlay. While driving lanes consistently had more wear and lower skid numbers than passing lanes on the same bridge, skid testing results did not show a clear correlation between the traffic volume of a bridge and HFST wear. Deck condition before overlay installation can have a significant impact on performance; it is not recommended to apply thin polymer overlays or HFSTs to badly deteriorated decks. Adequate deck repair before installation is advantageous to long-term performance, and patch materials must be compatible with the new overlay.

To enhance the service life of HFSTs, MDT should consider:

- Using only materials for bridge deck repairs that are compatible with the polymer overlay that is used and that are low shrinkage and thermally stable
- Using only polymer systems that have demonstrated successful performance in Montana and conducting trials of any new systems under consideration
- Upgrading the skid resistance of the aggregates used in the overlays, such as Armorstone
- Using a resin primer in bridge deck cracks before overlay installation to reduce the risk of reflective cracking and improve the deck–overlay bond
- Implementing quality assurance testing to ensure adequate installation conditions and practices
- Using a multiyear warranty clause in contracts

MDT Project Champion

Shane Pegram
Bureau Chief
Construction Engineering Services Bureau, MDT
spegram@mt.gov
406-444-6289

Research Implementation

Recommendations for future installations of HFSTs will be disseminated to MDT engineers to incorporate into the decision-making process for bridge overlays in Montana. Additionally, as recommended in the project findings, MDT is considering the use of a multiyear warranty for new HFST bridge overlay installations.

Learn More About This Project

Final report is available in ROSA P.