Research Brief

Wisconsin Highway Research Program
Project 0092-18-02
November 2019

Concrete Pavement Repairs with Non-Cementitious Materials

Research Objectives

- Evaluate performance of non-cementitious repair materials used on concrete pavements in Wisconsin
- Develop recommendations for proper selection and application of non-cementitious repair materials

Research Benefits

- Identified the main cause of repair failure: inadequate removal of unsound concrete from the existing pavement
- Proposed changes to WisDOT's specifications for preparing and constructing non-cementitious repairs to increase durability and improve safety

Background

The Wisconsin Department of Transportation (WisDOT) does its best to minimize traffic disruptions when repairing high-traffic roadways by limiting lane closures to off-peak (overnight) hours. WisDOT typically employs rapid-setting concrete or asphalt concrete, rather than conventional cementitious strategies, to meet the demands of these six-to-eight-hour windows of opportunity; however, it has been difficult to achieve consistent, durable results.

To help identify a more durable and sustainable concrete pavement repair strategy, WisDOT recently began employing non-cementitious materials for partial-depth repairs, with varying levels of success. The causes of poor performance are mostly attributable to improper workmanship or use of the materials on already poor and/or deteriorating concrete pavements, rather than the repair materials themselves. The objectives of this research were to evaluate the availability, applicability and performance of non-cementitious repair materials and to provide recommendations for best practices to increase the durability and sustainability of these repairs.

Methodology

Five non-cementitious repair materials were evaluated for their in-service performance on 23 sites across the state. The research team conducted visual investigations, coring and non-destructive tests with a portable seismic pavement analyzer (PSPA).

Pull-off, dynamic elastic modulus and ultrasonic pulse velocity laboratory tests were performed on three of the five materials to assess bond strength and dimensional stability properties at different temperatures. Static elastic modulus testing was performed on only one of the materials, as the other two lab-tested materials were too flexible to suit the test.

Portable seismic pavement analyzer testing of a repaired pavement section on WIS 66 in Stevens Point

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"Reliable performance of non-cementitious repair materials will allow for less disruptive, safer, and more cost-effective maintenance of Wisconsin's most heavily traveled highways."

– Jed Peters, WisDOT

Interested in finding out more?

Final report is available at:
WisDOT Research website

Results

The field study determined that non-cementitious repairs are most commonly applied on heavily distressed areas of pavement, such as spalled joints, transverse cracks and corner breaks. Most failures of the repair materials are attributable to inadequate removal of unsound concrete from the repair area. Most repair boundaries were not demarcated using saw-cuts; rather, unsound concrete was removed with jackhammers and compressed air. Continued deterioration of substrate concrete and inconsistency in mixes produced on site also contributed to repair failures.

All repair materials investigated in the laboratory became stiffer as temperatures decreased but remained flexible (relative to concrete) even at temperatures below 20° F. Higher flexibility increases the ability to withstand thermal stresses at low temperatures but also increases rutting and permanent deformation susceptibility at high temperatures. Modulus variations were not found to adversely impact the bond between repair material and sound substrate concrete.

Recommendations for implementation

The research team proposed changes to WisDOT's concrete pavement repair specifications to prevent premature deterioration of sections repaired with non-cementitious materials. Unsound concrete should be meticulously removed before placement of repair materials; otherwise, bond failures are likely to occur during freeze-thaw cycling. For long-term repairs with large quantities of material, the existing concrete substrate should be evaluated to ensure that it is not susceptible to freeze-thaw damage and other materials-related distresses.

Mixtures should be prepared and placed according to their material-specific manufacturer standards and applied to dry pavement that has been meticulously cleaned. When using hot-applied materials, construction personnel should take precautions to prevent burns and overexposure to fumes. Pavement sections should not be diamond ground for at least 24 hours after repairs are made, and extra care should be taken to not overload or overheat repaired sections.

In addition to suggestions in pavement repair specifications and mixture preparations, the research team proposed the material selection guidance and use of non-cementitious materials for partial-depth repair that could be incorporated into the specification and maintenance manual.

This brief summarizes Project 0092-18-02,
"Non-Cementitious Repair Materials Study"
Wisconsin Highway Research Program