

ACCELERATOR

mndot.gov/research

Putting your ideas in motion

FIGHTING POTHOLES WITH BETTER REPAIRS AND PREVENTION



Left: A researcher conducts an on-site permeability test to determine how well a pothole repair seals and resists water penetration.

Right: A worker levels off mastic material filling a longitudinal crack on Interstate 35.

There's more than one way to repair a pothole. The patching method that will work best depends on the specific characteristics of the repair: What time of year is it? How deep is the pothole? Is the damage in the centerline of the road? The shoulder? Somewhere else?

MnDOT research has produced a new flashcard-style guide that includes a simple decision tree for evaluating the situation and selecting the best repair method.

This guidance was informed by a two-year study of 20 pothole repairs at five sites in northern Minnesota and a comprehensive literature review that identified four repair methods best suited for Minnesota. The research study aimed to identify the effectiveness of various methods in terms of durability, road safety, ride quality, driver satisfaction and other factors. Read more about the guide in **Technical Summary 2017-25**.

Two of the innovative repair options presented in the guide were tested

“There are more ways to patch than just sitting in the back of a truck and throwing bituminous mix into holes. Some work better with concrete, some with bituminous. These taconite-based mixes can make durable patches.”

—Sue Lodahl, MnDOT Assistant State Maintenance Engineer

through the 2016 project, “Evaluate and Develop Innovative Pavement Repair and Patching: Taconite-Based Repair Options.” Rapid Patch uses a water-activated taconite mix for concrete, while the microwave method involves a 50,000-watt, truck-mounted microwave unit that heats both the pavement and a taconite-based patching material. Read more about them in **Technical Summary 2016-03**.

Of course, the best way to fight potholes is to keep them from forming. A soon-to-be-released report (2018-14) identifies critical factors in pothole formation to identify solutions for both delaying their formation and increasing the durability of repairs. One key recommendation: Repair cracks early, before they become potholes! Visit mndot.gov/research for ongoing developments in this effort.

TECHNICAL SUMMARY 2018-14

“With these flashcards, the maintenance crew can quickly figure out the most effective patching method based on the pothole dimension, location and construction season.”

—Manik Barman, Assistant Professor, University of Minnesota Duluth

In the News

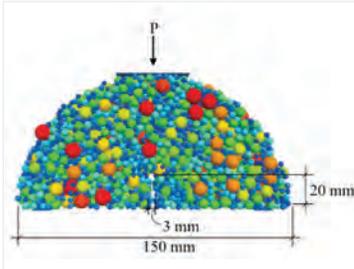


KARE 11 did a video story on the research-based flashcards that MnDOT is using to train pothole crews. <http://kare11.tv/2FKzchA>



For a copy, email research@state.mn.us.

Nanotechnology Reduces Cold-Weather Cracking in Asphalt Pavements



Using computer modeling, researchers can predict the durability of a semicircular asphalt core during a semicircular bend test.

MATERIALS & CONSTRUCTION – To improve pavement performance, engineers use additives to modify the asphalt that binds the aggregate. Recent research shows that adding very small particles (with a dimension of less than 100 nanometers) to asphalt mixtures can improve performance. Using the results of laboratory tests and computer modeling, researchers have developed a

cost-effective method to determine the optimum design of asphalt mixtures that are reinforced by graphite nanoplatelets, which consist of graphite layers less than 10 nanometers thick. Compared to mixtures with unmodified asphalt binders, mixtures with the right amount of graphite nanoplatelets demonstrate significantly improved pavement strength and fracture resistance.

“This project gives MnDOT an inexpensive way to incorporate the latest nanotechnologies into our asphalt mixtures, reducing cold-weather cracking and increasing the durability of Minnesota pavements.”

—Shongtao Dai, Research Operations Engineer, MnDOT Office of Materials and Road Research

TECHNICAL SUMMARY 2018-02

New Implementation Projects Selected

Bridge inspectors will continue to build on MnDOT’s innovative use of drones for inspecting hard-to-reach areas, thanks to new funding approved by the state transportation research program. The Transportation Research Innovation Group (TRIG), the governing board for MnDOT’s program, selected eight new research implementation projects for funding in fiscal year 2019. Among the requests was funding to develop a user/policy manual and an inspection plan for bridges best suited for drone use. Other approved projects:

- Development of training on new environmental protocols for construction materials.
- Implementation of new guidelines for tightening large anchor bolts on sign support structures.
- Integration of key climate change vulnerability metrics into agency decision-making tools.
- Development of full-depth reclamation (FDR) values for integration into the MnPAVE pavement design software.
- Evaluation of the performance of corrosion mitigation treatments that were applied to a reinforced concrete bridge in 1998.
- Installation of mobile sensors on maintenance supervisor pickup trucks and at select Road Weather Information System (RWIS) sites to collect road surface information, which will increase geographic coverage of the RWIS and possibly eliminate the need for invasive in-road sensors.
- Development of a system to automatically deploy weather-related messages to existing dynamic message signs across the state.

More information about these projects is available at mndot.gov/research/implementationawards.html.

TRANSPORTATION RESEARCH SYNTHESIS

High Friction Surface Treatments Increase Road Safety

A Transportation Research Synthesis (TRS) is a short-turnaround research project that summarizes research activity and/or practice among state departments of transportation. If you need answers, [request a TRS from MnDOT Research Services & Library today.](#)



TRAFFIC & SAFETY — The Federal Highway Administration has recommended applying a polish-resistant aggregate to pavement in areas with high friction demand such as curves and other crash-prone areas. High friction surface treatments enhance skid resistance, and MnDOT is exploring the best way to implement this technology on state roads. In a recent survey of state departments of transportation known to use these treatments, 15 respondents provided detailed information about their state’s practices. Four states surveyed have installed high friction surface treatments at 100 or more locations.

TRS 1802

Mussel Spat Rope Helps Small Fish Move Through Culverts



Mussel spat ropes are used in mussel aquaculture.

ENVIRONMENTAL – Environmental regulations require culverts that allow fish to pass freely through them. Small migratory species may have difficulty moving through culverts that are steep or have high-veloc-

ity currents. MnDOT followed up on recent research from New Zealand to evaluate whether placing mussel spat rope in culverts would improve passage. Long, dense fibers along the length of the rope reduce the current's velocity and turbulence, providing refuge for small fish as they pass through. This low-cost, low-maintenance technique proved highly effective and will be included in an upcoming guide for designing culverts in Minnesota that allow aquatic organism passage. This project is only one of several recent MnDOT studies into fish-friendly culverts. Read about the others in [Technical Summaries 2017-44 and 2015-08](#).

TECHNICAL SUMMARY 2018-13

Affordable Method for Repairing Bridge Girder Ends Restores Concrete Beams to Original Strength



which is sprayed from a hose. Testing repaired and unrepaired girders from the bridge showed that this technique successfully repaired severely deteriorated beam ends for a \$5,000 to \$10,000 investment. MnDOT is continuing to refine this method and will continue to use the beam end repair method if similar conditions are encountered in the state.

TECHNICAL SUMMARY 2018-07

BRIDGES & STRUCTURES – Damage in reinforced concrete bridges often appears first at bridge joints, where water can corrode reinforcing steel, cause concrete to flake or crumble, or even lead to joint failure. Researchers used a bridge in Hopkins built in 1975 as a test case for an innovative technique to repair the damaged ends of these girders. The method uses a reinforcement cage (pictured) and “shotcrete” cement,

Can MnDOT Use Low-Cost GNSS Receivers? For Some Uses, Yes

MATERIALS & CONSTRUCTION – MnDOT uses global navigation satellite system (GNSS) receivers to keep track of assets, take care of the environment and survey land before construction. Data from these receivers must be very accurate, and because of the high demands put on these devices, MnDOT must use models that often cost more than \$10,000 each. However, new, compact receivers cost less than \$1,000, so researchers tested these for accuracy while stationary or moving. They found that the lower-cost GNSS receivers performed well in certain applications, but the technology is not quite ready for use in safety-of-life applications that require centimeter-level accuracy.

TECHNICAL SUMMARY 2018-10

GIS Mapping Helps Departments Anticipate Slope Failures



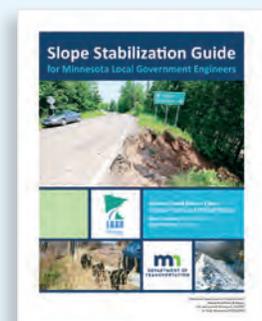
In a significant rainfall, a shallow slope failure like this one along County Highway 210 in Carlton County can lead to extensive cleanup and road detouring.

ENVIRONMENTAL – Roadside slopes susceptible to failure have been mapped in Carlton and Sibley counties so that county highway departments can develop preventive strategies for protecting roadways during floods. After studying known slope failures to identify risk factors, researchers used geographic information system technology and available data on soils and hydrology to create the maps. Beyond providing a decision-making tool for these two Minnesota counties, this project served as a proof of concept for other counties.

MnDOT is building on these efforts with a research project to identify, map and rank vulnerable slides that could impact the trunk highway network. More at mndot.gov/research/projects/slopes.html.

The Local Road Research Board also recently released the [Slope Stabilization Guide for Local Engineers](#) (Report 2017-17G), shown below.

TECHNICAL SUMMARY 2018-05





RESEARCH SERVICES & LIBRARY

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Calendar

- 4/23** Abstracts due for Center for Transportation Studies annual conference
- 5/11** MnDOT and LRRB research ideas due for RFP (mndot-lrrb.ideascale.com)
- 5/30** MnDOT research program governing board (TRIG) summer meeting, Arden Hills
- 6/20-21** LRRB and RIC summer meetings, Rochester

Contact

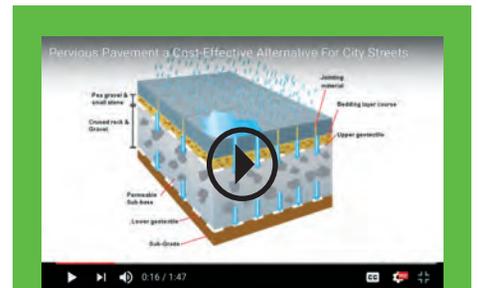
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New Project Video



Watch a video about the seven-year performance of pervious concrete in the City of Shoreview.
youtube.com/user/lrrbmn