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LRRB
LOCAL ROAD RESEARCH BOARD

TECHNICAL SUMMARY

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TOTAL PROJECT COST:
$177,414

LRRB PROJECT COST:
$127,739

Permeable interlocking concrete pavers like these can be installed fairly quickly.

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Guidance on Permeable Pavements in Cold Climates

Clear guidance on where and how to install permeable pavements will increase their use on low-volume roads throughout Minnesota, which should reduce the amount of roadway pollutants running off into waterways without compromising pavement durability in cold weather.

What Was the Need?

Stormwater runoff carries pollutants from roadway surfaces to the surrounding environment and sometimes directly into waterways. Permeable pavements may be able to reduce such runoff and improve water quality. Porous asphalt, pervious concrete and permeable interlocking concrete pavers allow water to infiltrate through the pavement structure to be stored temporarily and then filtered into the underlying subgrade.

Although they are too porous to durably support high-volume, high-load roadways, porous pavements have been used successfully for parking lots and low-volume roads like neighborhood streets in some areas of the country. However, the structures are prone to clog with particulates from stormwater runoff, vehicle use and nearby vegetation, reducing their ability to absorb water over time. Most importantly for Minnesota environments, little research had been done on permeable pavement performance in cold climates.

What Was Our Goal?

The aim of this project was to create a guide for local road engineers to use in deciding where and how to install permeable pavements and how to maintain them. This study aimed to summarize the research and practice of permeable pavements in areas of North America with cold climates like those in Minnesota.

What Did We Do?

Researchers began by conducting an extensive literature search that identified and summarized 170 documents on permeable pavement use and performance. They also identified and summarized case studies, including test cells at MnROAD and in four Minnesota cities or water districts as well as in parking areas in Denver, Colorado; at the University of New Hampshire; and in Ontario, Canada.

Researchers then worked closely with a Technical Advisory Panel composed of state and local road engineers and industry representatives to develop a simple, Web-based tool for initially deciding where a permeable pavement might be feasible and a final report that would function as a guide to decision-makers.

Investigators identified knowledge gaps that would need to be filled to more fully understand permeable pavement options and develop reliable and appropriate selection, design, construction and maintenance procedures for the use of permeable pavements in viable locations.

What Did We Learn?

A surprising number of reports and case studies detail permeable pavement performance, maintenance needs and effectiveness in cold climates. Not all case studies showed positive experiences (most notably the Colorado sites, where clogging and deterioration proved problematic), but most installations have performed well in managing stormwater and water quality.

continued

"If you're considering permeable pavements, this report has the things you should know. The report is one of the best resources for permeable pavements, especially as they relate to cold weather climates."

—Mark Maloney,
Public Works Director,
City of Shoreview

"In Robbinsdale (Minnesota), permeable pavement reduced snow and ice without salt. Permeable pavement is the only way that I know of to mitigate or to reduce our salt application, aside from everyone slowing down and putting up with less salt on the roads."

—John Gulliver,
Professor, University of Minnesota Department of Civil, Environmental and Geo-Engineering

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Even with little or no road salt, a permeable pavement like this porous asphalt in Robbinsdale, Minnesota, collects little slush and snow in the winter because it warms well and remains porous enough to infiltrate surface water effectively.

Materials and Construction. Permeable pavements work best over noncompacted subgrades. Designers must consider compaction, density and permeability in porous asphalt designs, and recommended water-cement and aggregate-cement ratios as well as expedient construction practices in pervious concrete mixes. Full-depth permeable pavement shoulders can effectively infiltrate stormwater runoff from highway pavement.

Hydrologic Design and Hydraulic Performance. Properly designed and constructed pavements significantly reduce stormwater runoff volumes and peak flows. In winter, air content within permeable structures provides insulation, keeping the pavement structure warm relative to the environment and allowing infiltration to occur.

Water Quality. Concentrations of solids and particle-bound metals in effluent from permeable pavements were 50 to 60 percent lower than effluent from traditional pavements in most cases because permeable pavements trap a majority of pollutant solids. Most of the impact on water quality is positive, including the reduced need for road salt in winter.

Maintenance. Permeable pavements require regular maintenance via pressure washing and/or vacuuming to prevent clogging that decreases infiltration capacity. Sand cannot be used for winter maintenance, and road salt application can be reduced.

Knowledge Gaps. Native subgrade infiltration rates must be included in permeable pavement design considerations. Geotextile impacts are not well understood. Research will need to develop appropriate fatigue models for permeable pavements, effective concrete and asphalt mix designs, and tests to measure pervious concrete properties. Cost and effectiveness of maintenance approaches on various permeable pavement designs must be fully explored. Water quality impacts of various designs, including impact on drinking water, require further evaluation. Long-term pavement performance—10-, 20- and 30-year studies—must also be monitored and evaluated.

What's Next?

While no follow-up research projects have been planned, identified knowledge gaps can be explored further. Long-term evaluation of existing installations and of the MnROAD cells should be undertaken to monitor performance and deterioration of the pavement structures over periods of decades.

This Technical Summary pertains to the LRRB-produced Report 2015-30, "Permeable Pavements in Cold Climates: State of the Art and Cold Climate Case Studies," published June 2015. The full report can be accessed at mndot.gov/research/TS/2015/201530.pdf.