



## RESEARCH SERVICES

OFFICE OF POLICY ANALYSIS,  
RESEARCH & INNOVATION

## TECHNICAL SUMMARY

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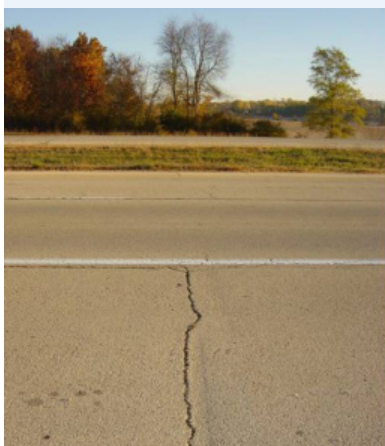
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### Principal Investigator:

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### PROJECT COST:

\$20,000



The use of a performance test in material specifications could help prevent the most common type of pavement distress in Minnesota—cracking caused by low temperatures.

# Laboratory Tests for Predicting the Performance of Asphalt Concrete

## What Was the Need?

To ensure the quality of its asphalt mixtures, MnDOT sets requirements specifying ingredients, quantities and mixing procedures. These specifications, like those of most departments of transportation, do not require that mixtures be tested in the laboratory for mechanical properties such as stiffness and strength.

If feasible, including a laboratory performance test in MnDOT's asphalt mixture specifications would improve the longevity of asphalt pavements and reduce the risk of early cracking, rutting and other deterioration. Research was needed to identify candidate tests based on how well they predict field performance.

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## What Was Our Goal?

The goal of this project was to synthesize research and implementation efforts related to asphalt performance tests as a first step toward identifying a suitable test for material specifications.

## What Did We Do?

Researchers began by determining the current state of practice for asphalt performance tests by reviewing material specifications of various state transportation agencies. Investigators then reviewed technical literature on the relationship between laboratory tests and pavement performance to determine the current state of the art for the topic, and reviewed previous MnDOT research projects dealing with asphalt performance tests. This information was synthesized to:

- Determine the suitability of including mechanical tests in material specifications.
- Identify potential laboratory tests used by other DOTs as performance indicators, and evaluate their labor intensiveness and potential for predicting field performance. Researchers focused on tests that measure cracking, which is the most common form of asphalt pavement distress in Minnesota.
- Make recommendations for future studies that can be undertaken to evaluate the suitability of a performance test and develop implementation plans.

## What Did We Learn?

The literature review showed that several agencies have routinely made use of performance test requirements in standard material specifications, typically to evaluate the likelihood of rutting or damage caused by moisture. However, a few demonstration projects have shown that the use of performance testing-based material specifications is feasible for predicting asphalt pavement cracking.

The review of laboratory tests used by other DOTs to predict field performance indicated that few of these tests have undergone a satisfactory validation, and fewer are simple enough to be used on a routine basis. Most tests tackle one or more kinds of asphalt pavement distress, but none can be used as a global performance indicator. The availability of vetted tests that satisfy the requirements for use as a simple cracking performance test is limited.

*“By scanning the practices of other departments of transportation, researchers from this project identified a few promising performance tests that warrant further investigation.”*

—Tim Clyne,  
Senior Research Engineer,  
MnDOT Office of Materials  
and Road Research

*“Once it can specify that manufacturers produce asphalt not just with a certain constitution but with predetermined mechanical properties, MnDOT will improve the performance of its pavements.”*

—Eshan Dave,  
Assistant Professor,  
University of Minnesota  
Duluth Department of  
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One promising performance test is the indirect tensile strength test, which can be used to measure tensile strength by applying a load across the diameter of a cooled, cylindrical specimen and increasing the load until the specimen fractures.

Most research at the national level has focused on the development of an asphalt mixture performance test. The results for this test correlate well with rutting, and some studies have shown that it can successfully predict cracking with the use of mechanistic models.

Tests with the greatest potential for use in performance-based material specifications for asphalt mixtures in Minnesota include:

- The indirect tensile strength test, in which specimens are loaded to the point of failure.
- Fracture energy tests, including the disk-shaped compact tension and semi-circular bend tests, in which specimens are loaded and the resulting cracks measured.
- The Texas overlay tester, which measures the number of cycles it takes for a specimen to fail.
- The four-point bending beam fatigue test, which is used to evaluate cracking.

Fracture energy tests have shown very good correlation with cracking in the field, particularly thermal and reflective cracking, which are prominent distresses on flexible and composite pavements in Minnesota. However, fracture test procedures need to be simplified to be well-suited to routine use in performance-based specifications.

## **What's Next?**

A second phase of this study will evaluate the candidate tests identified in this project. Researchers recommend:

- Evaluating indirect tensile strength for use as a performance measure since it is already used as part of MnDOT's mix design process and would require no additional implementation if used for performance-based specifications.
- Evaluating fracture energy tests for asphalt mixtures for routine use in Minnesota. This evaluation should include an analysis of required equipment, specimen preparation and data postprocessing.
- Further reviewing and synthesizing the significant amount of test and field performance data available from previous MnDOT projects to help identify candidate tests for further validation and implementation studies.
- Trial projects to evaluate the feasibility of using performance-based specifications.

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*This Technical Summary pertains to Report 2011-22, "Synthesis of Performance Testing of Asphalt Concrete," published September 2011. The full report can be accessed at <http://www.lrrb.org/PDF/201122.pdf>.*