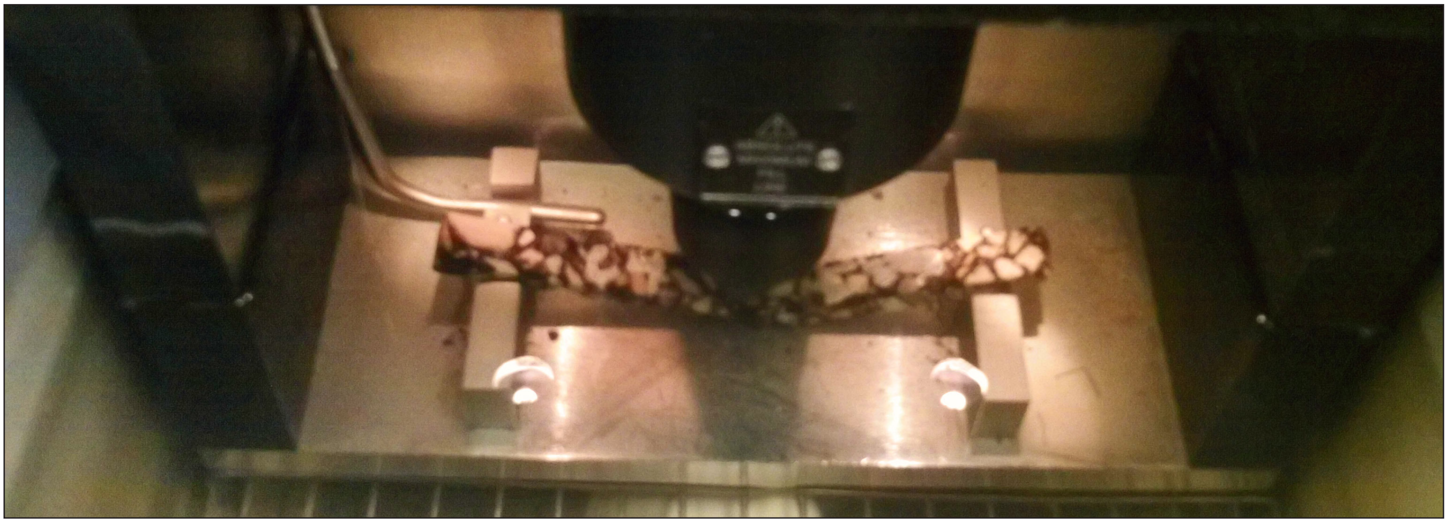
MOUNTAIN-PLAINS CONSORTIUM

PROJECT BRIEF | December 2013

Implementation of Low Temperature Tests for Asphalt Mixtures to Improve the Longevity of Road Surfaces



the ISSUE

Thermal cracking in pavements due to stresses caused by low temperatures is a major factor in roadway degradation nationwide and especially in the mountain west. Studies have shown that more than $50 million are spent every year on road maintenance resulting from thermal cracking in pavements.

the RESEARCH

This research used the bending beam rheometer (BBR) to measure low-temperature response of asphalt mixtures from both laboratory-prepared and field samples. The first part of the work demonstrated that small beam slivers measuring 12.7 mm x 6.35 mm x 127 mm could be tested by bending at low temperatures to represent the global properties of the pavement mixture. Once it was clear that this test configuration satisfied the requirements for a representative volume element (RVE), field samples were obtained from cores taken from multiple roads around the Salt Lake Valley in Utah. The cores were cut into small beam slivers and prepared for BBR testing.

The beams were tested by bending at different temperature to obtain their time-dependent, viscoelastic, properties. The response of field cores and subsequent viscoelastic analysis showed that, even though the same binder grade is used throughout the region (PG 64-28), the resulting mixtures have significant differences in creep moduli and m-values. This indicates that binder testing alone, as it is currently done, might not be enough to control the material's creep modulus and thus its resistance to thermal cracking.

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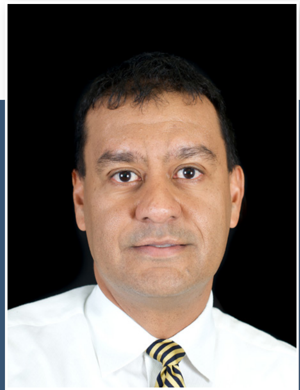

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Project Title

Implementation of Low Temperature Tests for Asphalt Mixtures to Improve the Longevity of Road Surfaces

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the FINDINGS

Results and comparison to field surveys indicate that two material properties can be used to characterize the low-temperature performance of asphalt pavements: the creep modulus determined at 60 seconds of loading and slope of the creep modulus versus time curve at the same time (called m-value). Pavements with high creep moduli and low m-values are more susceptible to low-temperature thermal distress (i.e., cracking). By plotting the test results on a Black Space Diagram it was observed that section with high modulus and low m-value were more susceptible to thermal cracking. It was determined that a thermal stress failure envelope could be developed into a low temperature pavement performance specification. The results also showed that the proposed test is practical because results could be obtained in one day. This indicates that the test is ideal for quality control or even quality acceptance of asphalt mixtures to control thermal cracking.

the IMPACT

The implication of this work is that the low temperature properties of asphalt mixtures can be measured and controlled in the laboratory during design and the field during construction, all using equipment that is already available to the asphalt industry thus reducing costs and training. Because there is currently no commonly run test for low temperature properties, this work will result in longer-lasting pavements.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=758

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7938 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.

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