

<b>UTC Project Information</b>	
Project Title	MPC-530 – Screening of South Dakota Asphalt Mixes for Moisture Damage using Conventional and Innovative Approaches
University	South Dakota State University
Principal Investigator	Rouzbeh Ghabchi, PhD
PI Contact Information	Assistant Professor Civil and Environmental Engineering South Dakota State University Brookings, SD 57007 Phone: (605) 688-6333 Email: rouzbeh.ghabchi@sdstate.edu
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Project Duration	September 30, 2013 to September 30, 2018
Brief Description of Research Project	Moisture-induced damage (also called stripping) is a major distress in asphalt pavements. The loss of strength and durability in asphalt mixes due to the reduction in bond strength between aggregate and binder in presence of moisture is called moisture-induced damage [1-5]. South Dakota Department of Transportation (SDDOT) and other DOTs in Region 8 spend millions of dollars annually to combat stripping problem. Also, with increased use of warm mix asphalt (WMA) and mixes containing reclaimed asphalt pavement (RAP), polymer-modified asphalt binders (PMA), and anti-stripping agent (ASA), evaluation of stripping potential of asphalt mixes has become particularly important. For example, there are state- and national-level concerns over the moisture-induced damage potential of WMA mixes. This is due to presence of water in mixes as a result of water injection in foamed WMA mixes and incomplete drying of aggregates at lower WMA mixing and compaction temperatures. Also, some aggregates, upon their incorporation in an asphalt pavement containing some binder sources and/or WMA additives, may lead to a higher moisture-induced damage potential. Therefore, there is an immediate need for evaluation of the effects of different additives and asphalt binder and aggregate sources on pavements' moisture-induced damage potential. As a response to this need, the

present study is proposed to evaluate the moisture-induced damage potential of asphalt mixes used in Region 8. More specifically, effects of RAP, WMA, ASA, PMA, and sources of binders and aggregates on moisture-induced damage potential of mixes commonly used by asphalt contractors in South Dakota will be evaluated. Additionally, in an effort to highlight the problematic mixes, aggregates and asphalt binders from recent projects that have shown stripping in the field will also be identified and tested in collaboration with SDDOT.

The moisture-induced damage potential of an asphalt mix is generally evaluated using the indirect tensile strength ratio (TSR), which is the ratio between conditioned and unconditioned indirect tensile strengths (ITS) or from the stripping inflection point (SIP) in the Hamburg wheel tracking (HWT) test, in accordance with the AASHTO T 283 and AASHTO T 324 test methods, respectively. Although these tests are widely used by DOTs for screening asphalt mixes, they do not address the failure mechanisms governing the stripping of asphalt pavements, which may cause some misjudgments in prediction of the moisture-induced damage potential. Also, the currently-used approaches for analyzing TSR results are empirical in nature, which do not reflect the field performance of a mix. A number of laboratory studies show that some mixes with relatively low TSR values performed well when tested using the HWT, and vice versa [6,7]. This type of observations raises questions about the reliability of TSR and HWT tests for screening moisture-induced damage potential at the mix design stage. From a mechanistic viewpoint, it is imperative to evaluate the bond strength between asphalt binder and aggregate, to assess stripping. A good adhesion bonding is essential to ensure good resistance to moisture-induced damage and fatigue [1, 3, 7-10]. In absence of a reliable and quick method for screening of mixes for moisture damage, introducing a simple and quick test and analysis method with a strong mechanistic basis becomes very critical. Therefore, proposing a simple and reliable test method based on the fracture mechanics for screening the moisture-induced damage potential of asphalt mixes was defined as another objective of the present study. The results of this study will be compiled in a database and are expected to help the DOT and asphalt industry in selection of asphalt binders and aggregates to maximize the durability of the asphalt pavements. Therefore, in addition to immediate implementation, the proposed study involves a high degree of novelty.

<p>Describe Implementation of Research Outcomes (or why not implemented)</p> <p>Place Any Photos Here</p>	<p>Specific outcomes and impacts of the proposed study are listed below:</p> <ul style="list-style-type: none"> <li>• DOTs in Region 8 spend millions of dollars to combat stripping of asphalt pavements. Accurate screening of mixes for stripping susceptibility will avoid using stripping prone mixes in construction of new pavements and maintenance of existing pavements. Using the outcomes of this study, including the asphalt binder-aggregate compatibility database along with the new proposed testing and analyzing methods for screening asphalt mixes for moisture damage will lead to a better pavement performance and service life. Therefore, economic impacts of the proposed database are expected to be significant by any measure.</li> <li>• Stripping potential of warm mix asphalt (WMA) is generally believed to be higher than hot mix asphalt (HMA), particularly when water-based foaming techniques are used in producing such mixes. Screening of WMA mixes using the newly proposed test method is expected to benefit both the asphalt industry and the DOTs because it will lead to better products and better performing pavements without any increase in production cost. In fact, water-based foaming techniques are becoming increasingly popular throughout Region 8 because they need one-time investment for plant modification and allow companies to produce mixes cheaper because of reduced fuel costs. Assuring stripping resistant WMA mixes will have a huge impact to asphalt producers in South Dakota and other states in Region 8.</li> <li>• Better screening of mixes containing RAP for stripping will increase industry confidence in using RAP in WMA, making construction more affordable (reduced cost due to RAP) and environment friendly – an important element of sustainable transportation infrastructure. It is also a major MPC goal (Economic Competitiveness).</li> <li>• Use of a number of ASA with some other additives are known to result in an asphalt mix prone to moisture-induced damage. The outcomes of this study will determine the effectiveness of using ASA in asphalt mixes and their compatibility with other components in the mix.</li> <li>• Recommendations and proposed draft standard on a new simple laboratory test method (SCB) and analysis technique (fracture energy-based) for moisture-induced damage will be an important advancement in screening of mixes in the design stage.</li> <li>• Recommendations and proposed draft standard on a new method for analyzing the ITS results (energy-based) for</li> </ul>
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	<p>moisture-induced damage will be an important outcome for this study.</p> <ul style="list-style-type: none"> <li>• The proposed study will advance the workforce development goal of the MPC through providing important experiential learning opportunity to graduate and undergraduate student research assistants (RAs), to be appointed on this project. Experience suggests that RAs are more likely to pursue career in transportation.</li> <li>• Workshops are found to be an excellent tool for technology transfer. In the proposed study, one technology transfer workshop will be conducted. We propose to conduct such workshops at SDDOT headquarter.</li> <li>• The findings of this study, will be published in peer-reviewed journals and conference proceedings. Although slow, such publications can have lasting impacts on technology awareness and acceptance. Publications involving the private sector is a plus.</li> </ul>
<p>Impacts/Benefits of Implementation (actual, not anticipated)</p>	<p>This project will provide a good learning opportunity for both graduate and undergraduate students. A graduate student (master's) will be working on this project. The results of this study will be used to provide materials for his/her thesis. Undergraduate students will also be hired on an hourly basis to work on this project. The outcomes of this study can also be used as course materials for selected lectures in the CEE 765.S01: Pavement Design course.</p>
<p>Web Links</p> <ul style="list-style-type: none"> <li>• Reports</li> <li>• Project Website</li> </ul>	<p><a href="https://www.ugpti.org/resources/reports/details.php?id=1001">https://www.ugpti.org/resources/reports/details.php?id=1001</a></p>