Project Summary

Texas Department of Transportation

0-5270: A Logical Guideline for Super-heavy Load Review Policy

Background

The Texas Department of Transportation (TxDOT) has become increasingly aware of the fresh seal coat peel-off damage caused from super-heavy load (SHL) moves. The field monitoring conducted by department personnel over recent periods has led to a tentative recommendation that fresh seal coats less than 5 weeks old should be avoided for super-heavy load routing. However, case studies revealed that the seal coat damage is also associated with temperature, slope, materials, and wheel loads. The main goals of this research project were to:

- propose a mechanistic approach to assess seal coat damage potential taking into account the factors above, and
- prepare a guideline for use of this approach to regulate SHL moves on seal coated routes.

What the Researchers Did

The research team proposed a mechanistic approach to evaluate seal coat damage accounting for pavement surface temperature, curing period, pavement slope, seal coat material properties, and wheel load. Laboratory tests characterized seal coat binders and aggregates in terms of surface energy, temperature-viscosity relationship, gradation, and volumetric properties. The tests provided inputs for estimating tensile strength of seal coat mixtures. Laboratory tests successfully characterized typical seal coat binders and aggregates that are used in Texas in order to compute tensile strength of various mixture combinations.

The research team conducted field tests to validate the proposed mechanistic model on roadways in the TxDOT Bryan and San Antonio districts. This field testing was accomplished by using test trucks equipped with wheel force transducer systems and operating those trucks on roadways at various temperatures, curing periods, slopes, and material types. A sand patch test was used to examine the relationship between surface texture condition and seal coat damage extent, as shown in Figure 1.

What They Found

The mechanistic approach conceptualized interaction between wheel loads and seal coats. It requires two main force terms. One term is the "fracture pressure" that acts as an applied force; the other term is "tensile strength" within the seal coat that is regarded as a resistance force. When the fracture pressure exceeds tensile strength, seal coat damage tends to occur.

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Recognizing the difficulty in conducting tests to obtain the tensile strength of seal coat mixtures, the research team instead employed a formula based on fracture mechanics capable of estimating tensile strength in terms of surface energy and relaxation modulus properties. In addition, a global aging model that was incorporated into the mechanistic approach was used to simulate variation of tensile strength with respect to time and temperature changes. Field tests conducted in the Bryan and San Antonio districts revealed that seal coat damage is most highly associated with pavement surface temperature. Curing period, slope, and material types also influenced seal coat behavior in response to test truck loading. The sand patch testing results indicated that lower texture depth appears to result in improved performance.

Field tests provided an opportunity to calibrate the mechanistic approach. The calibrated mechanistic approach was used to analyze several case studies conducted by TxDOT, and the model captured seal coat failure damage potential reasonably well. The research team developed a database integrating routing inspection sheets that have been collected by TxDOT in the past 5 years for pavement evaluation in routing SHLs. Statistical analyses on the database indicated that establishing a logical guideline for SHL on seal coats should be encouraged, since the portion of routes including seal coat and travel distances less than 50 miles were close to half of the considered routes.

What This Means

A simple program using Microsoft Excel® entitled "Mechanistic-Empirical Seal Coat Damage Evaluation Program" (M-E SDEP) and corresponding guidelines are now available, which will be especially useful for districts frequently receiving SHL moves such as the Bryan, Houston, Yoakum, and San Antonio Districts.

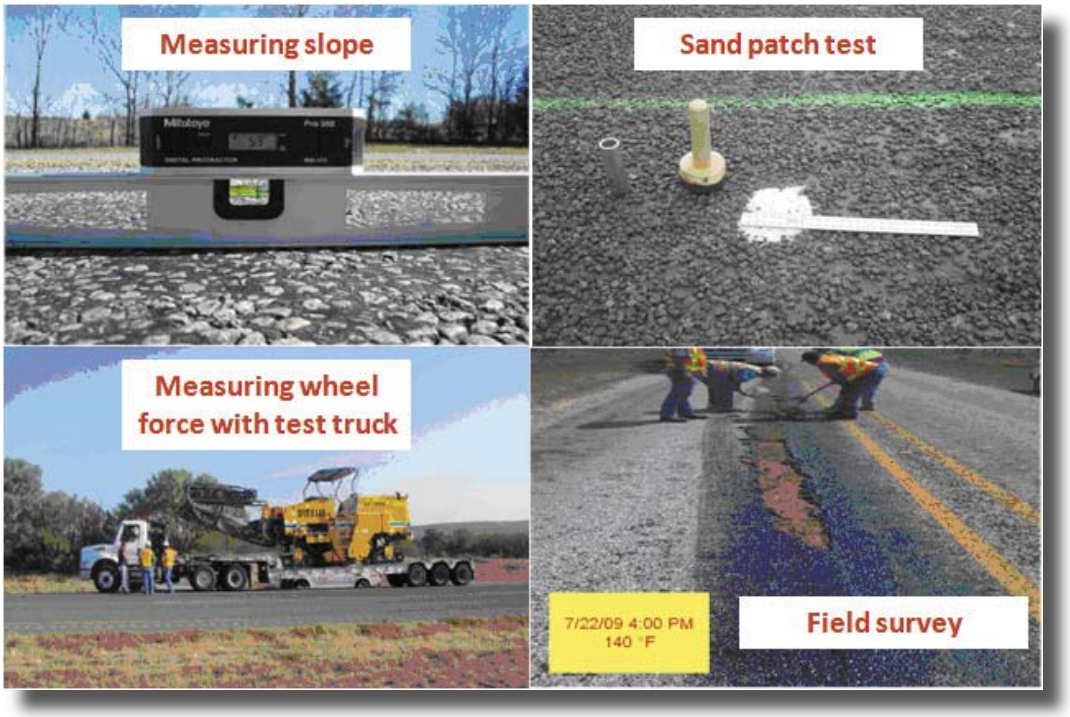

Figure 1. Illustration of Field Test Activities.

For More Information:
0-5270-1 Seal Coat Damage Evaluation Due to Superheavy Load Moves Based on a Mechanistic-empirical Approach

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