SOUTHERN PLAINS TRANSPORTATION CENTER

SPTC Brief

Highlighting Developments at Southern Plains Transportation Center
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EVALUATING RUTTING/STRIPPING POTENTIALS OF ASPHALT MIXES USING HAMBURG WHEEL TRACKING DEVICE

OVERVIEW: Rutting (permanent deformation) is a major concern in asphalt pavements due to the unrecoverable cumulative deformation that occurs in the wheel path under high temperatures as a result of repeated traffic loading. The depression is mostly due to compaction while the lateral movement happens as a result of the shear failure (Figure 1a).

Moisture damage also causes distress in asphalt pavements. It is the progressive deterioration of asphalt mixes caused by loss of adhesion between asphalt binder and aggregate surface and/or loss of cohesion within the binder primarily due to the action of water (Figure 1b).

(a) (b)

Figure 1: Rutting as a result of Shear Failure and Moisture Damage

The objective of this research project is to measure and minimize the impact of rutting and stripping on asphalt concrete pavements. The work builds on the collaboration between researchers at the University of New Mexico (UNM) and the New Mexico Department of Transportation (NMDOT), which involves testing and interpretation of laboratory data to assess the effectiveness of the Hamburg Wheel Tracking Device (HWTD) testing criteria and develop specifications needed for proper testing and implementation of HWTD in New Mexico.

To understand the rutting susceptibility as well as the moisture susceptibility, the current study investigates performances of asphalt cement (AC) mixes using the Hamburg Wheel Tracking Device, shown in Figure 2. This machine measures the combined effects of rutting and moisture damage by rolling a steel wheel across the surface of an AC specimen that is immersed in hot water. Traditionally the tests have been performed underwater at 50°C and each set of samples are loaded for 20,000 passes or until 20 mm of deformation occurs, whichever comes first.

Figure 2: UNM Hamburg Wheel Tracking Device

There are no defined standards for HWTD testing. Several transportation agencies have adapted their own specifications for HWTD testing, which differ in testing temperature, conditioning time and frequency of loading. Varying test conditions result in variability of HWTD test results among state agencies. Furthermore, due to climate and material variability used in pavement construction between different regions, a separate specification is needed to determine the suitability of HWTD in New Mexico.

FOUNDATIONAL RESEARCH: Extensive HWTD tests were conducted on Hot Mix Asphalt (HMA) and Warm Mix Asphalt (WMA) mixes collected from asphalt plants or paving sites located in various regions of New Mexico. The laboratory test results provided important insights into the susceptibility to permanent deformations to mix temperature, aggregate type and binder

type. A total of 14 mixes, varying in composition of aggregate type, gradation, binder type, anti-stripping agents, Reclaimed Asphalt Pavement (RAP) content, and WMA additives or agents were tested and the generalized results are shown in Figure 3.

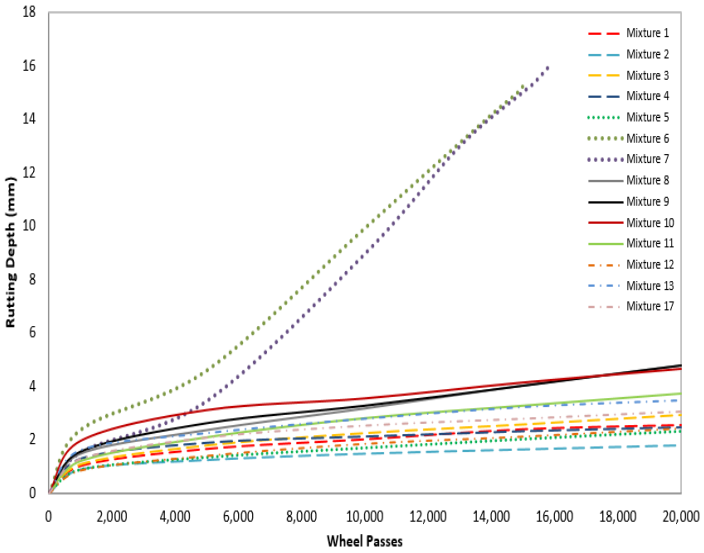

Figure 3. Generalized HTWD Results

Among the 14 mixes, only Mix 6 and Mix 7 reached the stripping phase and were not able to finish the 20,000 passes. Both mixes were in presence of unique aggregates of shale and dacite, respectively. In addition, these mixes were finer mixes due to finer gradation.

On the other hand, mixes which consisted of a coarser gradation and harder aggregate types, such as basalt and quartzite, tended to perform better against rutting and showed no signs of stripping susceptibility.

Mix 8 to and Mix 12 have the same properties in terms of aggregate type, gradation, binder PG-grade, etc. These mixes only differ in the type of HMA/WMA technology. Among the tested mixes, Mix 12 with WMA agent of Cecabase RT and polymer modified binder (PMB) showed a significant decrease in the rutting susceptibility.

CURRENT RESEARCH: While many important lessons were learned from previous research done by testing and data interpretation of the tested mixes, it is necessary to extend the results to better understand the rutting and stripping susceptibility of AC mixes due to material variability and testing conditions.

Aggregate has become an important contributor to the performance of asphalt mixes since it is a primary component of the mix. Aggregate mineralogy and durability properties are key in determining the influence of aggregates in HWTD testing. Aggregate type is closely related to permanent deformation (rutting) since its composition influences the behavior of this distress. The interplay between aggregate type, binder type and temperature have a direct influence on a mix's susceptibility to rutting and stripping.

UNM researchers with the support of SPTC are investigating the effects of aggregate, binder PG grade, gradation, WMA agents and PMB's in HWTD. The results of this extensive analysis of the mentioned factors will be beneficial for future mix designs by NMDOT.

About the Researchers

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