Project Summary

Texas Department of Transportation

0-5627: Aggregate Resistance to Polishing and its Relationship to Skid Resistance

Background

In 1999, the Texas Department of Transportation (TxDOT) implemented a statewide Wet Weather Accident Reduction Program (WWARP) to reduce skid-related accidents in Texas. The Surface Aggregate Classification (SAC) system, one of the WWARP's outcomes, is used for the selection for aggregates in the pavement surface based on their frictional characteristics. In order to improve the SAC, TxDOT funded a research project with the Texas Transportation Institute to develop a model for predicting the pavement skid resistance based on measurable aggregate and mixture properties. This model would help in the selection of aggregate type and mixture design that are needed to meet the required asphalt pavement skid resistance, and consequently, construct safe roads with minimal cost of maintenance and rehabilitation.

What the Researchers Did

The researchers conducted a comprehensive literature review to establish the present state of knowledge in the area of skid resistance models, techniques for measuring skid resistance, and methods for measuring aggregate frictional characteristics. The following tasks were performed to aid in the development of a model for predicting the skid resistance of asphalt pavements:

1. Design and execute laboratory experiments in order to measure the friction and texture of the surface of slabs prepared using asphalt mixtures with different aggregate characteristics, measure aggregate characteristics, and develop a model to predict the International Friction Index (IFI), which is related to Skid Number (SN), of these mixtures.
2. Acquire and analyze SN values measured by TxDOT over several years.
3. Measure the friction and texture of asphalt pavements using the Dynamic Friction Tester (DFT) and Circular Texture Meter (CTMeter).
4. Develop models for IFI and SN of asphalt pavements as functions of traffic level, aggregate characteristics, and aggregate gradation.

Laboratory Experiments

Five different aggregate sources from Texas that exhibit different performance in terms of contribution to skid resistance were used in this study. Conventional test methods such as petrographic examination, acid insolubility test, magnesium sulfate soundness test, Micro-Deval test, and British Polish value were used to evaluate aggregate chemical and physical characteristics. The Aggregate Imaging System (AIMS) was used to measure aggregate texture before and after different polishing intervals in the Micro-Deval.

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A total of 13 mixes from three asphalt mixture types currently used by TxDOT, namely Type C, Type D, and PFC were prepared and compacted using 5 ft long by 2 ft wide molds. These slabs were subjected to polishing action, to simulate polishing due to traffic, using the National Center for Asphalt Technology polishing machine. The slabs' texture and friction were measured using the CTMeter and DFT, respectively, after different polishing intervals. Using the DFT and CTMeter results, IFI was calculated as a function of polishing cycles.

Field Experiments

The review and analysis of comprehensive measurements of skid resistance data led to the selection of 65 roads including 1527 Pavement Management Information System (PMIS) sections. The skid numbers for these PMIS sections were analyzed and the effects of different factors such as traffic, mix design, and aggregate type on measured skid number were evaluated. The pavement sections included different mixtures (surface treatments Grade 3 & Grade 4, PFC, Type C, Type D, CMHB-C, CMHB-F, Novochip, and SMA) and 21 aggregates. The DFT and CTMeter were used to measure the friction and texture, respectively, of 65 sections. A complete record of the construction history and skid measurement was also acquired for the test sections from TxDOT databases.

What They Found

The following are the major findings from this study:

- A model was developed to predict the skid resistance of asphalt pavements based on inputs describing aggregate texture before and after polishing, gradation of asphalt mixture, and traffic.
- The surface treatments had a very high variability in skid number.
- PFC mixes exhibited better skid resistance and lowest variation than other mix types.
- There was high interaction between aggregate characteristics, mixture types, and traffic levels (polishing due to traffic). In general, it is hard to classify aggregates without specifying mixture type and traffic levels. Skid resistance depends on micro-texture, macro-texture, and polishing susceptibility of the aggregates. This is why some aggregate types performed poorly in certain mixtures, while their performance was acceptable in other mixtures.

What This Means

The researchers developed a promising method and program to predict the pavement skid resistance over the service life of the pavement. Utilizing this program the design engineer can select appropriate aggregate source(s) and mix design in order to ensure the adequate skid resistance during its service life. Alternately, a pavement can be classified based on the threshold skid numbers and predicted skid numbers at the end of its service life. Some additional validation will be needed to apply this system to chip seals.

For More Information:

0-5627-1 Predicting Asphalt Mixture Skid Resistance Based on Aggregate Characteristics

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