Project Summary

Texas Department of Transportation

0-5262: Optimizing the Design of Permeable Friction Courses (PFC)

Background

Porous or permeable friction courses (PFC) as defined in Item 342 of the 2004 TxDOT Standard Specifications book are hot mix asphalt (HMA) mixtures placed at the surface of an asphalt pavement structure in a thin layer to reduce the risk of hydroplaning and wet skidding; decrease splash and spray, fuel consumption, tire wear, and pavement noise; improve ride quality and visibility of pavement markings at night and in wet weather; and produce cleaner runoff when compared to dense-graded HMA. To obtain these benefits, a mix design system that produces both a functional and durable PFC mixture is required.

TxDOT test method Tex-204-F, Part V, describes the current PFC mix design procedure used to determine the optimum asphalt content (OAC) at 78-82 % laboratory density. Specimens at the OAC are then evaluated for draindown using Tex-235-F, moisture susceptibility using Tex-530-C, and durability using Tex-245-F. The main objectives of this research project were:

1) to develop and recommend an improved PFC mix design method, and
2) to develop guidelines for construction and maintenance of PFC.

What the Researchers Did

The project started with an information search documented in report 0-5262-1 that summarizes information from a worldwide literature review and TxDOT district interviews focused on performance, maintenance, and construction of PFC. The information gathered was used to define an experimental design directed to evaluate four main aspects of PFC mix design: volumetrics, functionality (or drainability), durability, and aging. These aspects were evaluated for both performance grade (PG) and asphalt rubber (AR) asphalt systems in laboratory mixed-laboratory compacted (LMLC), field mixed-laboratory compacted (FMLC or plant mixes), and field mixed-field compacted (FMFC or road cores) specimens and corresponding extracted binders. An extensive laboratory and field testing program included 11 projects from eight TxDOT districts and determination of the following:

- total and accessible air void (AV) contents based on bulk specific gravity (G_{mb}) by dimensional analysis or a vacuum method, and measured or calculated maximum theoretical specific gravity (G_{mm}) based on measured values at lower asphalt contents (AC),
- interconnected AV based on X-ray CT and image analysis,
- cantabro loss (Tex-245-F) in dry, wet, cold, and aged conditions,
- cracking life (expressed as number of cycles to failure) in the Overlay Test (Tex-248-F),
- rutting resistance in the Hamburg Wheel-Tracking Test (Tex-242-F),
- laboratory permeability,

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- field water flow value (WFV) (Tex-246-F),
- work of adhesion in dry and wet conditions based on measured surface energy components,
- dynamic shear rheometer and ductility testing of neat and extracted binders in unaged and aged conditions,
- current draindown and durability tests and tensile strength ratio on a limited number of specimens, and
- preliminary evaluation of different compaction conditions and a fine aggregate gradation.

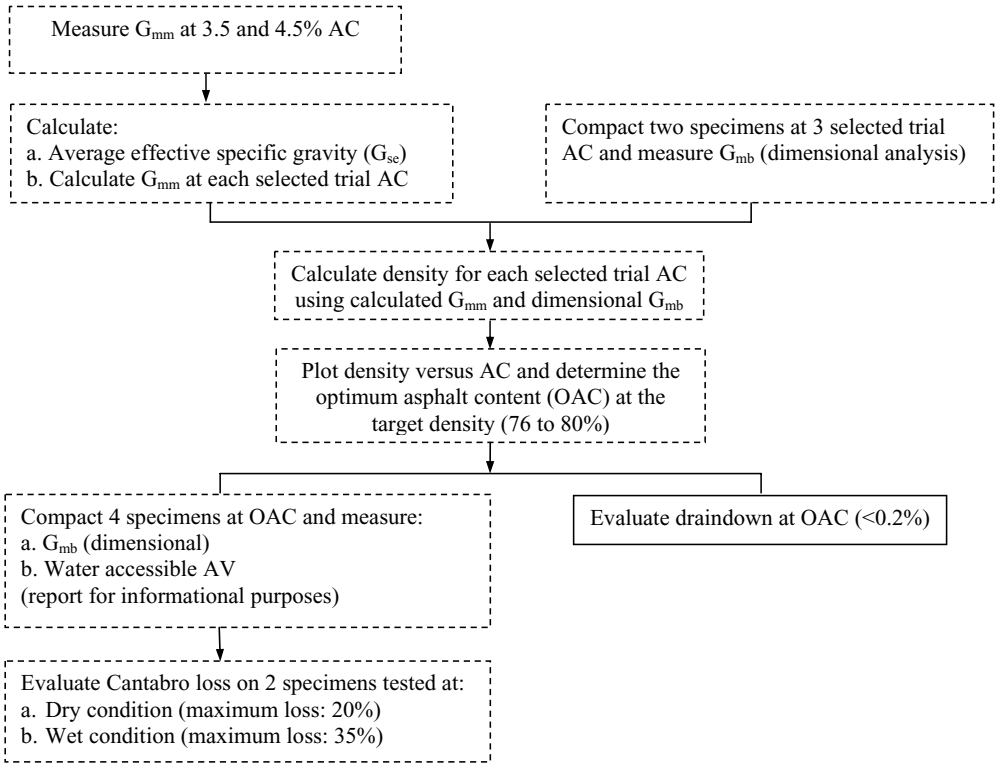
Report 0-5262-2 constitutes the second interim report and documents construction and maintenance guidelines for PFC. Report 0-5262-3 provides comprehensive documentation of the project.

What They Found

G_{mb} determined by dimensional analysis and calculated G_{mm} (based on measured G_{mm} at 3.5 and 4.5 %) were recommended for evaluating total AV content. Determination of water accessible AV content (using dimensional analysis) was suggested for future design and performance evaluations. To ensure adequate functionality, the laboratory density specification was modified to 76-80 % and the current maximum field WFV of 20 seconds was preliminarily validated. For durability, the current draindown test and Cantabro loss tests (both dry and wet conditions with maximum values of 20 and 35 %, respectively) were recommended. In addition, density requirements for field compaction were suggested to improve the control of functionality and durability.

What This Means

This figure illustrates the recommended improved PFC mix design method. Researchers suggest implementation of this method and future research in terms of tracking PFC performance toward selecting a laboratory functionality parameter for use in mix design and evaluating and validating the durability parameters.



Improved PFC Mix Design Method for Volumetric and Durability Evaluation.

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