Project Summary

Texas Department of Transportation

0-4822: Monitor Field Performance of Full-Depth Asphalt Pavements to Validate Design Procedures

Background

Since 2001, the State of Texas has been designing and constructing full-depth asphalt pavements (also known as perpetual pavements) on some of its heavily truck-trafficked highways. To mitigate rutting and fatigue cracking, the perpetual pavement (PP) design concept limits the tensile and compressive strains at the bottom of the lowest asphalt layer and on top of the subgrade to 70 and 200με, respectively.

To date, there are 10 in-service PP sections, typically consisting of about 22 inches total of hot-mix asphalt (HMA) 8-inch thick bases (lime- or cement-treated) that rest on compacted in-situ subgrade soil material. Superpave and coarse-graded stone-filled HMA (SFHMA) mixes were utilized as the main structural load-bearing layers.

This research study was initiated to monitor the construction and performance of the Texas PP sections with objectives to:

- identify any construction deficiencies with the new Superpave and SFHMA mixes,
- collect construction, performance, and material testing data and store results in an accessible database,
- conduct structural evaluations to validate the Texas PP design concept,
- evaluate and recommend software for design of Texas PP structures, and
- make recommendations for future Texas PP designs, construction, and performance evaluations.

What the Researchers Did

To achieve the study objectives, researchers completed the following tasks:

- construction monitoring and compaction quality measurements,
- laboratory and field testing including periodic performance evaluations,
- comparative evaluations of dense-graded Type B and coarse-graded SFHMA mixes,
- traffic and response measurements for structural evaluations,
- computational modeling and software evaluations, and
- database development.

Research Performed by:

Texas Transportation Institute (TTI),
The Texas A&M University System

Research Supervisor:
Tom Scullion, TTI

Researchers:
Lubinda F. Walubita, TTI

Project Completed: 8-31-09

What They Found

From the study, the researchers found the following:

- Performance of all the Texas PP sections is satisfactory with no structural distresses, except for a few construction-related defects such as poor construction joints and associated longitudinal cracks.
- Compared to the dense-graded Type B/C mixes, the coarse-graded stone-filled HMA mixes were associated with numerous construction problems (such as density variations, segregation, debonding, and permeability issues) primarily due to their lean mix design of low binder content and coarse aggregate gradation.
- The Texas PP design concept was found to be conservative, with the potential for further optimizing to about 14 inches total of HMA thickness. Results indicated that the PP structures were sufficiently stiff with higher HMA moduli values on the order of 700 to 1500 ksi versus the 500 ksi of initial designs.

What This Means

Based on the study findings, researchers recommend the following:

- Transition to a more optimal PP structural design with about 14 inches total HMA thickness. Use the FPS 21W and MEPDG software for PP structural thickness design and performance predictions, respectively.
- Use the more constructable dense-graded mixes such as the Type B mix for the main structural load-bearing layers.
- Revise the design moduli value to a range of 700 to 1200 ksi for the load bearing layers and a minimum strength of 35 ksi for the foundation. This will optimize the PP designs.
- Improve and enforce construction quality specs such as joint staggering, joint compaction, layer bonding (tack coat), etc.
- Monitor pavements over the long term. The majority of the existing PP sections have been in service for barely over 5 years at the time of this summary report.

Findings from the project indicate that:

- A structural thickness reduction from 22 to about 14 inches total HMA thickness translates into 8 inches of HMA cost savings. This difference saves millions of dollars while yielding satisfactory performance with minimal rehab activities.
- Use of dense-graded mixes such as Type B (as opposed to SFHMA mixes) will lead to better construction quality with minimal subsurface defects.
- The rich bottom layer (RBL) is generally not necessary to meet structural requirements, but may be necessary to ensure density of lower HMA layers or as a moisture barrier in certain environments.
- The developed Texas PP database will serve as an ongoing reference data source for Texas Department of Transportation engineers as well as other transportation professionals.

For More Information:

0-4822-1 Perpetual Pavements in Texas: State of the Practice
0-4822-2 Perpetual Pavements in Texas: The Fort Worth Sh 114 Project in Wise County

Research Engineer - German Claros, TxDOT, 512-465-7403
Project Director - Joe Leidy, TxDOT, 512-506-5848
Research Supervisor - Tom Scullion, TTI, 979-845-9913

www.txdot.gov
keyword: research

Texas Department of Transportation
Research and Technology Implementation Office
P.O. Box 5080
Austin, Texas 78763-5080
512-465-7403