0-6742: Evaluation of Design and Construction Issues of Thin HMA Overlays

Background

Thin hot-mix asphalt (HMA) overlays, placed between 1.25 to 0.5 inches, have quickly become a go-to maintenance treatment in Texas. While implementation around the state is proving successful, a few issues needed to be addressed:

1. The unavailability of surface aggregate class (SAC) A aggregate is pressuring districts to blend in lower-quality SAC B materials. **The question:** How much and which types of SAC B aggregate should be allowed in blending to still have acceptable skid resistance?

2. Because these mixes are so thin, they are subject to higher stresses than traditional overlays, especially if the bond is poor. **The question:** How do we test bond strength, and what are the best materials and methods to achieve a good bond?

3. Achieving adequate compaction is a critical step to ensure long-term overlay performance. Measuring density on thin overlays, however, is not possible with traditional methods. **The question:** What test methods will best monitor thin lift density?

What the Researchers Did

SAC B Blending and Friction

Laboratory friction testing considered samples with two gradation types, four aggregates types, and five levels of aggregate blending. Samples were polished with simulated traffic in the lab and tested with the dynamic friction tester and circular track meter.

Bond Strength and Tack Materials

Shear and tensile strength tests were developed to measure interlayer bond strength. Computer modeling was done to predict the maximum shear stress at a thin overlay bonded interface. To identify critical parameters for bonding, bond strength tests were performed on laboratory samples using combinations of two base mix types, two thin overlay types, five tack types (including non-tracking tacks), three tack rates, simulated milling, and moisture conditioning. A tack tracking test was also developed to discern different curing times of non-tracking tack.

Thin Lift Density Tests

Four compaction quality assurance test methods were used on three thin overlay projects. Properties measured were flow time with the existing Texas Department of Transportation permeability test, surface dielectric with high-frequency ground-penetrating radar (GPR), mean profile depth (MPD) with the circular-track meter, and bulk density from field cores. Results were correlated with non-linear regression analysis.

Research Performed by:
Texas A&M Transportation Institute

Research Supervisor:
Tom Scullion, TTI

Researchers:
Bryan Wilson, TTI
Lubinda Walubita, TTI
Stephen Sebesta, TTI
Abu Faruk, TTI

Project Completed:
8-31-2014

What They Found

SAC B Blending and Friction
Friction results show the terminal polish value for all designs with 100 percent SAC B replacement failed, as did designs with 50 and 75 percent blending of one SAC B+ and one marginal SAC B aggregate. Twenty-five percent replacement was acceptable for all SAC B aggregates, and 50 and 75 percent blending was acceptable for the other SAC B+ and marginal SAC B aggregate.

Bond Strength and Tack Materials
Bond strength was most dependent on the mix types and compaction effort, and less on tack type and tack rate. In the tensile strength tests and half the shear tests, non-tracking tacks had higher strengths than samples using CSS-1H or no tack. No single non-tracking tack was found to have better performance than others. Variable tack rates of CSS-1H were only significant on dense-graded mixes. Low and moderate levels of tack provided the best bond. Using no tack produced the lowest bond. Milled samples had higher strengths than unmilled samples in shear. Moisture conditioning did not significantly affect the results.

Thin Lift Density Tests
Correlations of density tests were strong on a project-by-project basis. The permeability test had the strongest correlations (flow time–MPD and flow time–core voids). The GPR-based rolling density meter also had good correlations with core voids. Lower and upper limits for flow time were determined.

What This Means

Laboratory and field results were considered in the refinement of the thin surface mixtures specification, Item 347. In addition, two bond strength test specifications and a micromilling specification are recommended for adoption. A ready-to-use document, *Thin Overlay Guidelines: Project Selection, Design, and Construction,* was created for district engineers and contractors.

SAC B Blending and Friction
Thin overlay mixes (TOMs) are recommended for high-speed sections, while ultra-thin (UT) mixes should only be used for lower-speed, non-critical sections. Aggregate blending with even marginal SAC B aggregates is acceptable up to 25 percent. Recommendations above 25 percent require specialized testing.

Bond Strength and Tack Materials
Though non-tracking tack can produce a stronger bond, the bond from both types of materials is acceptable. Both the shear and tensile strength bond tests are recommended for use by the engineer on any questionable construction. Tentative shear and tensile strength requirements are 100 psi and 40 psi, respectively.

Thin Lift Density Tests
The current water flow test is an effective quality assurance tool for thin-lift density. The minimum and maximum flow time for TOM is 150 seconds and 6 minutes, respectively. Greater than 6 minutes may result in inadequate texture and thus lower the skid resistance. The minimum flow time for UT mixes is 300 seconds, with no upper limit specified. The GPR-based rolling density meter is an effective emerging technology that can be used for rapid full-coverage density testing.

For More Information

Project Manager:
Wade Odell, TxDOT, (512) 416-4737

Research Supervisor:
Tom Scullion, TTI, (979) 845-9910

Technical reports when published are available at **http://library.ctr.utexas.edu.**

Research and Technology Implementation Office
Texas Department of Transportation
125 E. 11th Street
Austin, TX 78701-2483

www.txdot.gov
Keyword: Research