# No bones about it

## Hard to argue effectiveness of new thin asphalt mixes

**By David Dennis**
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As maintenance budgets are stretched to their limits, perhaps thin-asphalt overlays can fatten those thin budgets a bit.

Texas A&M Transportation Institute (TTI) researchers have spent years developing high-performance thin-asphalt overlay mixes that bridge the gap between high traffic loads and limited maintenance budgets. Additionally, the new fine-graded surface layers reduce tire-pavement noise, which can be important when used in populated areas.

Tom Scullion, manager for TTI's Flexible Pavements Program, and Cindy Estakhri, manager for TTI's Recyclable Materials Program, are working with the Texas Department of Transportation (TxDOT) to design and promote the use of three new thin-asphalt mixes: a fine-graded dense-graded mix (DGM), fine-graded stone-matrix asphalt (SMA) and a fine-graded permeable friction course (PFC). These mixes should be placed in lifts of 1 in. or less and often result in a 30% cost savings over traditional mixes.

### Only the best

The key is finding the best application for each of these thin overlays. The fine PFC can be used to cover bleeding chip seals and address concerns about wet-weather accidents or reduce pavement-surface noise. The fine SMA and DGM solutions are good mixes to use where the existing surface is cracked and/or rutted, with the SMA being particularly effective in high-speed applications.

In addition the DGM, which can be used to restore texture and friction, can be placed in even thinner lifts. In one recent application near Austin, the mix was placed at a thickness of 0.5 in. With these ultrathin layers, the mix is very cost competitive with other thin surfacing solutions, such as chip seals or microsurfacings.

Researchers developed these fine-graded mixes using polymer-modified binders and high-quality aggregates. The mixes themselves must pass both rutting and reflection

cracking tests at the design phase. The research results indicate that using good, quality, polish-resistant aggregates (with 100% passing the 3/8-in. sieve) was key to making the thinner alternative work effectively.

"To place it thin, you need a smaller rock. Fine aggregate is in abundant supply and is almost a waste product at some quarries. We determined we could obtain the required aggregate at a reasonable cost," Estakhri noted.

Researchers wanted mixes that were easy for maintenance personnel to work with: very thin and easy to compact. To ensure the quality of these mixes, all three of them passed the rutting (Hamburg Wheel Tracking Test Tex Method 242F) and reflection cracking (Texas Overlay Tester, Tex Method 248F) performance tests. In Texas, for example, the specification mandates the use of PG 76-22. (The PG, or performance graded, system classifies binder materials by matching the correct binder with the needs of a given pavement environment's climatic conditions and considerations related to binder performance over time.) A recent extremely hot summer in Texas revealed bleeding and rutting problems when PG 70-22 was used.

Warm mix is recommended when the project involves long-haul distances. Personnel should apply these mixes during warm weather, since placement is cooler and windy weather is problematic due to the rapid cool down of the thin mats.

Because thin lifts are susceptible to rapid cooling, proper compaction is a concern. During one project, researchers used an instrumented roller to record mat-surface temperatures during compaction. In this instance, personnel made two passes down the right side of a mat, then moved the roller to the left side. Researchers found that the temperature dropped 50°F between the two sides, even during a summer project. Data also showed the benefit of using tandem breakdown rollers instead of a single roller.

The fine-graded PFC drains well and, as a result, has good friction characteristics. An added plus is substantially reducing road noise compared with seal coats. As Estakhri stated, "Sometimes people complain about the noise associated with seal coats. This fine PFC makes for a quieter surface."

An additional benefit is in the maintenance area, where the fine PFC (which contains 24% air voids) can be used to effectively cover bleeding chip seals (described in more detail below).

## Thin work out

Sarah Horner, assistant area engineer with TxDOT's Brownwood District, oversaw the recent application of the fine-graded PFC on U.S. Highway 183 in Stephens County. The PFC was laid ¾ in. thick in both travel lanes. TxDOT is trying to combat a bleeding issue that compromised the existing surface.

"We're hoping that the open PFC will allow the bleeding asphalt from the chip seal to go up into the PFC and keep it away from traffic. We're also hoping for a smoother, quieter ride," Horner said. TxDOT expects at least five years with little or no maintenance needed for the new PFC surface.

The fine-graded SMA has an excellent surface texture, resists rutting and is useful on roadways with high volume and numerous intersections. Darlene Goehl, materials engineer for TxDOT's Bryan District, chose SMA for a recent resurfacing project on the access roads for State Highway 6. Goehl noted, "We can have problems with seal coats and turning movements. Example: Seal coats often shove in an intersection. We were looking for a rut-resistant, crack-resistant thin mix that we could place in urban areas. We're expecting 10-12 years of service life from the SMA surface."

A major thin overlay project is proposed for a high-volume section of U.S. 59 in Houston, where TxDOT is rehabilitating the concrete-surfaced roadway with a 1-in. bottom layer of crack-resistant DGM (with a final surface of 1-in. fine SMA). This combination of a crack-resistant level-up layer and a thin high-performance surface layer is a very popular combination in Texas. It has the potential for use in many locations, especially in urban areas as an overlay for concrete. The bottom lift seals the concrete and minimizes reflection cracks while

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providing an impermeable layer under the wearing surface. The total thickness is 2 in., which also minimizes problems with guardrail heights.

Because proper compaction of the SMA is challenging, one option in the Texas specification calls for the use of dual-steel-wheel rollers working in tandem, keeping them as close as possible to the paver. Pneumatic rollers are not allowed because they tend to pick up these rich mixes when they stop.

Since proper compaction of these and other mixtures is so vital, TTI researchers have spent 10 years addressing the problem. To measure the temperature of the mat at laydown, researchers came up with Pave-IR. Pave-IR is an array of sensors mounted on the back of a laydown machine that allows contractors to detect temperature problems in real-time and make adjustments. Pave-IR has been adopted in Texas and numerous other states.

To augment Pave-IR, TTI is studying the use of a work-hardened and simple ground-penetrating radar system for real-time continuous-density measurements.

"What we're busy putting together right now is a three-antenna system that can be mounted on the back of a pickup truck after the guys have rolled a section of overlay. These are very small antennas, about the size of a cigar box. You'll drive over the section immediately after it's been rolled, and the system will tell you in real-time if you have any low-density areas," Scullion stated. Field testing of this system is scheduled to begin this year.

## Doing it better, cooler, and sometimes cheaper

TTI created all three of the mixes as alternatives to chip seals or multiple inches of hot-mix asphalt.

"It's not as cheap as a chip seal, but it will be cheaper than 2 in. of regular hot mix," said Estakhri. "Currently those are the alternatives. These mixes are in between those options. Even though they are much thinner, we think that these overlay mixes will perform better than 2 in. of hot-mix asphalt."

Is this just the beginning for implementing exciting new technologies in road building? Tom Scullion thinks so. "Some technologies don't work; others work very well. Hopefully, with continued support from TxDOT, we can keep on coming up with products like this," he said.

Estakhri noted that TxDOT has incorporated the fine PFC and SMA into their new specifications, found at www.dot.state.tx.us/business/specifications.htm, to be implemented across the Lone Star State in 2013.

"Texas has such a huge network of roads to maintain, some in remote areas. TxDOT has to be more creative in terms of extending their dollars to cover more area," she noted.

For more information, contact Cindy Estakhri at 979.845.9551 or c-estakhri@tamu.edu or Tom Scullion at 979.845.9913 or t-scullion@tamu.edu. See the video summary report on developing very thin overlay systems at www.youtube.com/watch?v=p3ZcFDs7JHc. **AT**

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