Texas A&M Transportation Institute

PROJECT SUMMARY

Texas Department of Transportation

0-6908: Comparative Analysis of Tack Coats, Trackless Tack Coats, Spray Paver Membranes, and Underseals

Background

The bond quality between pavement layers significantly impacts pavement life. Several treatments are available to prepare a surface for a new asphalt overlay, including:

- Traditional tack coats.
- Trackless tack coats.
- Spray paver membranes.
- Underseals.

However, there is confusion about which treatment would provide the best long-term performance for the lowest possible cost in a given overlay scenario. This project evaluated treatments for bond strength, resistance to reflection cracking, and permeability; estimated the life-cycle cost for each treatment; and provided a reference guide for selecting the appropriate treatment.

What the Researchers Did

The performance of each treatment was measured in the laboratory with the shear bond strength test, a modified Texas overlay test, the compact tension test, and the Florida falling-head permeability test. To assist in sample fabrication, a laboratory tack spray system was developed.

Bond strength and cracking resistance were evaluated in the field on 42 unique test sections on five overlay projects. The test sections considered different treatment types, tack/binder types, surface types, and application rates. On some projects, samples were collected both at the time of construction and after several months in service.

Using computer modeling, the effect of bond condition on the long-term performance of an overlay on transversely cracked pavement was evaluated. The overlay life-cycle cost when using different bonding and sealing treatments was then estimated.

What They Found

Bond strength, cracking resistance, and permeability were sensitive to treatment type. Hot-applied trackless tack had the highest bond strength and spray paver membranes, and underseals were the weakest, though all treatments showed acceptable performance. Bond strength varied significantly among the projects, even for the same treatment. Bonding was very sensitive to sample age, with an average 80 percent strength increase after 12 months. Most of the bond strength likely develops within the first month. For cracking resistance, the compact tension test distinguished among samples better than the modified Texas overlay test. High-residual treatments (underseal, spray paver membrane, and hot-applied trackless tack) had the highest fracture energy and thus high resistance to cracking. In permeability testing, the high-residual treatments had the lowest permeability.

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In the models, performance was sensitive to the interface shear modulus or bond condition. A stronger bond increased the resistance to fatigue cracking and rutting. For reflection cracking, a partial bond resulted in longer service life. This may be explained by the lower-stiffness interface providing relief from thermally induced stress. The spray paver membrane and underseal treatments had the longest service life, and the spray paver membrane had the lowest life-cycle cost. Compared to a traditional tack coat, this treatment would save 15 percent for the agency and users over 25 years. For other scenarios, constrained by rutting or fatigue, a different treatment is likely to prove more cost-effective.

What This Means

The Texas Department of Transportation (TxDOT) should continue to promote trackless tack as having the best bond strength, though other treatment types can also have high bond strength especially after short-term strength gain. TxDOT should decrease the emphasis of spray paver membranes and underseals for bonding, and promote their ability to seal against moisture infiltration and to relieve reflection cracking stress. A bonding and sealing treatment guide was developed with scenario recommendations for applying each treatment (Table 1).

District engineers should understand that the existing surface, overlay mixture type, and compaction temperature will influence bond strength. Therefore, a strong bond may be achieved by a treatment for one project and have much lower bond strength for another. Strength gain over time is very significant, especially over the first month in service, so a project with initially low bond strength may be fine with time.

Table 1. Recommended Bonding and Sealing Treatment Applications.

Construction Scenario		Recommended Bonding and Sealing Treatments and Residual Asphalt Rates, gal/sy				
		Traditional Tack Coat	Trackless Tack Coat		Spray Paver Membrane	Traditional Underseal
			Emulsion	Hot Applied		
Surface Type	New hot-mix asphalt (HMA)	0.02–0.03	0.02–0.03	—	—	—
	Aged HMA, good condition	0.03–0.05	0.03–0.07	0.10–0.20	0.10–0.15	—
	Aged HMA, moderate to severe cracking	—	—	—	0.12–0.18	0.25–0.40
	Aged HMA, bleeding	0.02–0.05	0.02–0.07	—	—	—
	Aged HMA, severe polishing	—	0.03–0.07	0.10–0.20	—	—
	Milled HMA	—	0.04–0.07	0.10–0.20	0.10–0.15	—
	Aged concrete	—	—	0.10–0.20	0.12–0.15	0.25–0.40
Overlay Type	Thin overlay	—	0.02–0.07	0.10–0.20	0.10–0.15	0.25–0.40
	Permeable friction course	—	0.04–0.07	0.10–0.20	0.10–0.15	
	Seal coat	None				
	Slurry seal/microsurfacing	None				

For More Information

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