Texas A&M Transportation Institute

PROJECT SUMMARY

Texas Department of Transportation

0-5836: Performance of Permeable Friction Course (PFC) Pavements over Time

Background

Recent Texas Department of Transportation (TxDOT) Projects 0-5262, 0-5185, and 0-4834 addressed important design, construction, and maintenance issues associated with permeable friction courses (PFCs) that have been increasingly utilized by TxDOT as a surface pavement layer based on safety and environmental benefits. These benefits that include reduced risk of hydroplaning and splash and spray and improved noise reduction effectiveness as compared to dense-graded hot-mix asphalt (HMA) are derived from high, interconnected air void (AV) contents in PFCs that may contribute to durability issues. To complete the evaluation of PFCs in terms of functionality and safety benefits and durability concerns, performance was tracked over time and compared against that of HMA in this project.

What the Researchers Did

The performance of two types of PFCs allowed in TxDOT Item 342 (asphalt rubber PFC [AR-PFC] and performance-graded PFC [PG-PFC]) was evaluated over a four-year period and compared to dense-graded HMA. Twenty pavement sections were monitored over a four-year period. Nondestructive on-site measurements included noise by onboard sound intensity (OBSI), drainability by Tex-246-F Field Water Flow Test, texture by circular texture meter (CTMeter), friction by dynamic friction tester (DFT), and skid by TxDOT skid trailer. The change of these variables with time, as well as the influence of traffic, binder/mixture type, aggregate classification, and climatic region, was evaluated. Accident data were also gathered and analyzed on a more comprehensive number of pavement sections across Texas. All this information was compiled in database format. In addition, when performance issues were identified through monitoring of additional sections, field cores were acquired for forensic evaluation. Results from the multi-year performance data analysis and previous research were used to produce guidelines and recommendations to improve the design, construction, and maintenance of PFCs. A preliminary benefit-cost (B/C) analysis and framework was also generated.

What They Found

Overall performance of PFCs over time was adequate. PFCs had lower overall noise levels when compared to dense-graded HMA, and AR-PFCs were quieter than PG-PFCs. With regard to drainability, the water flow values had a tendency to increase early in the life of the pavement and remain relatively constant afterward. PG-PFCs showed better drainability as compared to AR-PFCs. The amount of rainfall helped assure the continued drainability of PFCs, especially in warm climates. Texture for PFCs remained practically unchanged over time. Both AR-PFCs and PG-PFCs had superior texture and skid versus dense-graded HMA. With regard to friction and skid, sections with aggregates classified as SAC-B per the TxDOT Surface Aggregate Classification (SAC) System had statistically significantly lower values as compared to those sections with either SAC-A or a combination of the two aggregate classifications (SAC-A/B). The accident data indicated that PFCs reduce the number of accidents, injuries, and fatalities on roads in Texas.

Table 1 provides a summary of the performance of PFC sections evaluated in this project with different colors to indicate overall performance (with green indicating good performance, yellow indicating marginal performance, and red indicating poor performance). The sections in Table 1 are separated by binder type (AR or PG) with the PG binders further subdivided by the type of modifier (tire rubber or polymer). This separation shows the superior performance of the PG-PFCs with tire rubber monitored in this project and the adequate performance of the majority of the other PFCs with performance lives of 6–10 years as expected based on the literature.

Research Performed by:
Texas A&M Transportation Institute

Research Supervisor:
Amy Epps Martin, TTI

Researchers:
Edith Arambula, TTI
Cindy Estakhri, TTI
Jorge Prozzi, CTR
Andre Smit, CTR
Manuel Trevino, CTR

Project Completed:
8-31-2012

What This Means

The continued use of PFCs in Texas is encouraged. PFC provides a safe, quiet surface pavement layer that provides sufficient durability over a 6- to 10-year pavement life. While PFC is more expensive per ton than conventional dense-graded HMA, the high AV content and subsequent benefits in terms of safety and functionality offset this cost. Continued performance monitoring until maintenance or rehabilitation is performed will provide a refined B/C model.

Table 1. Performance of PFCs.

AR-PFC								
District	Route	Binder Content	Aggregates				Pavement Age (yr)	Performance
			% Passing		Blend	Type		
			3/8"	N4				
Lubbock	LP 289FR	8.6	68.2	3.6	SAC-A/B	Gravel/Limestone	2	Raveling right after construction
Austin	US 290	8.3	75.7	7.9	SAC-A	Sandstone	5	Clogged @ 2yrs
Houston	SH 288	8.0	54.9	4.0	SAC-A/B	Granite/Limestone	6	
San Antonio	US 281	8.1	54.6	5.0	SAC-A/B	Sandstone/Limestone	6	Poor drainability @ 5yrs low noise level
San Antonio	US 281	8.2			SAC-A	Traprock	7	Clogged @ 4yrs, low skid, low noise level
Pharr	US 281	9.1	42.4	8.0	SAC-A	Gravel	8	Areas raveling @ 6yrs
Corpus Christi	IH 37	8.7	60.7	0.9	SAC-B	Limestone	8	Clogged @ 6yrs and low texture due to fog seal
Houston	US 90	8.3	52.5	10.3	SAC-A	Sandstone	8	Clogged & raveling @ 6 yrs
PG-PFC with Tire Rubber								
District	Route	Binder Content	Aggregates				Pavement Age (yr)	Performance
			% Passing		Blend	Type		
			3/8"	N4				
Tyler	IH 20	6.0	58.4	15.7	SAC-A	Sandstone	3	High noise level
Tyler	IH 20	6.7	48.1	12.2	SAC-A	-	4	
Houston	SH 6	6.0	55.9	15.8	SAC-A	-	7	
Abilene	IH 20	6.5	59.4	18.6	SAC-B	Limestone	7	Low friction and skid due to SAC-B
Waco	IH 35	6.0	56.5	10.6	SAC-A	Rhyolite	9	
PG-PFC with Polymers								
District	Route	Binder Content	Aggregates				Pavement Age (yr)	Performance
			% Passing		Blend	Type		
			3/8"	N4				
Bryan	SH 6	6.2	45.4	11.3	SAC-A/B	Sandstone/Limestone	3	
Yoakum	US 59	6.0	52.8	6.6	SAC-B	Limestone	5	Low Friction due to SAC-B
Paris	IH 30	6.5	43.0	15.5	SAC-A	Sandstone	6	
Abilene	US 83	6.4	50.9	3.2	SAC-B	Limestone	7	Poor drainability @ 4 yrs, low friction and skid due to SAC-B
Houston	SH6	5.6	55.6	15.4	SAC-A	Quartzite	7	
Waco	SH 6	6.0	67.5	21.4	SAC-B	Limestone	7	Severe raveling @ 6yrs, high texture due to raveling, low friction and skid due to SAC-B
Corpus Christi	IH 37	7.0	56.1	6.7	SAC-A/B	Limestone/Gravel	8	Severe raveling @ 6yrs, high texture and noise level due to raveling

For More Information

Project Manager:
German Claros, TxDOT, (512) 416-4730

Research Supervisor:
Amy Epps Martin, TTI, (979) 862-1750

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