Assessment of Asphalt Interlayer Designed on Jointed Concrete

tech transfer summary

Based on the substantial reduction in reflective cracking and only marginal cost increases from using the interlayer on this research project, it is recommended that future hot mix asphalt (HMA) overlay projects in Iowa consider using the crack-relief interlayer to delay reflective cracking.

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RESEARCH PROJECT TITLE
Assessment of Asphalt Interlayer Designed on Jointed Concrete

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Background

Reflective cracking in hot mix asphalt (HMA) overlays has been a common cause of poor pavement performance in Iowa for many years. Reflective cracks commonly occur in HMA overlays when deteriorated Portland cement concrete (PCC) is paved over with HMA.

To delay the formation of cracks in HMA overlays, the Iowa Department of Transportation (DOT) has begun to implement a crack-relief interlayer mix design specification. The crack-relief interlayer is an asphalt-rich, highly flexible HMA that can resist cracking in high strain loading conditions. It is designed to have a high volume of asphalt with a low percentage of air voids and to contain a polymer-modified binder with a wide temperature performance grade range.

Problem Statement

The differential movement of concrete slabs at PCC joints create microcracks at the bottom of the HMA layer that grow and propagate to the surface. Since the rehabilitation strategy for many distressed PCC pavements in Iowa is to overlay them with HMA, the prevalent reflective cracking distresses has resulted in poor ride quality and increased transportation maintenance costs.

Goal and Objectives

To assess how effective the interlayer is at delaying reflective cracks, the field performance of an HMA overlay using a one-inch interlayer was compared to a conventional HMA overlay without the interlayer.

Reflective cracks in non-interlayer overlay on US 169 in April 2014

Research Description

Pavement test sections of the two overlay designs were constructed on US 169 just north of the city limits of Adel, Iowa and evaluated for reflective cracking. The laboratory performance of the interlayer mix design was also assessed for resistance to cracking from repeated strains by using the four-point bending beam apparatus.

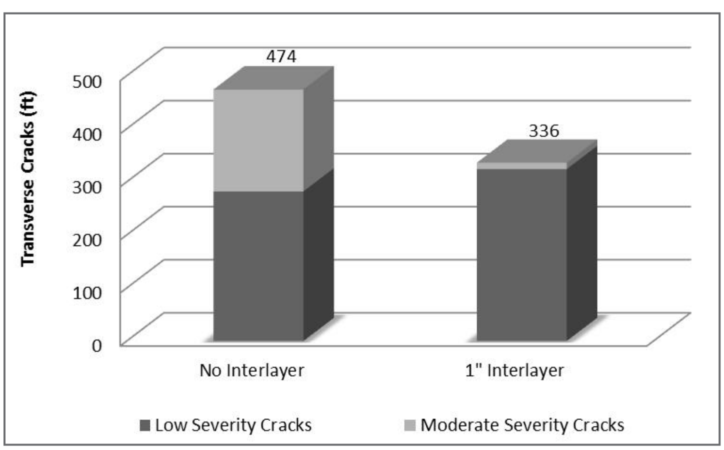
Key Findings

The laboratory performance test results of the initially designed interlayer failed the minimum 100,000 load cycle criteria in the four-point bending beam but eventually passed the criteria after the polymer modified binder used for the mix design was re-engineered. Rather than using the minimum amount of poly(styrene-butadiene-styrene), or SBS polymer, to formulate the required PG 64-34 binder, a highly polymer modified binder was designed for the interlayer mix.

The polymer used was D0243, an SBS polymer design by Kraton, Inc., which can be added to asphalt at higher polymer concentrations without reducing workability. Seven and a half percent of the D0243 was selected to be blended in a base PG 52-34 binder. Once the new highly polymer modified binder was used for the mix design, the average number of load cycles achieved in the bending beam apparatus increased from 18,235 to 201,390, thereby exceeding the 100,000 load cycle criteria.

For the US 169 project, the performance of the interlayer overlay exceeded the performance of the conventional overlay. After one winter season, 29 percent less reflective cracking was measured in the pavement with the interlayer than the pavement without the interlayer. The level of cracking severity was also reduced by using the interlayer.

In the non-interlayer section, 41 percent of the total transverse crack lengths measured contained moderate severity cracks. In the interlayer section, 4 percent of the total crack lengths measured contained moderate severity cracks. Thus, the crack-relief interlayer successfully delayed reflective cracking in the HMA overlay.



Total transverse cracking in traffic lanes

Furthermore, pavement performance improved by using the interlayer in spite of the interlayer not meeting the volumetric and laboratory performance testing requirements, which was the result of a low asphalt content during production. Had the volumetrics of the interlayer been closer to the mix design targets, the overlay would have likely exhibited less cracking.

One winter season after construction, cores were obtained along transverse cracks in the non-interlayer and interlayer pavement sections. Core samples from the non-interlayer pavement section contained full depth cracks while some core samples from the interlayer pavement section contained cracks that were only in the surface course. Thus, in some areas, the interlayer was effective in delaying cracking from becoming full depth.

Implementation Readiness and Benefits

Since the cost of using an interlayer only increased the overlay construction costs by 10.6 percent, this project demonstrates the economic benefit of using an interlayer for HMA overlays. Based on the substantial reduction in reflective cracking and only marginal cost increases from using the interlayer on US 169, it is recommended that future HMA overlay projects in Iowa consider using the crack-relief interlayer to delay reflective cracking.

The provisional crack-relief interlayer specification drafted by the Iowa DOT proved to be effective in reducing reflective cracking in the HMA overlay. Therefore, no change in the specification is recommended at this time. However, since the field produced interlayer did not meet the four-point bending beam performance criteria, this project demonstrates the importance of verifying the laboratory fatigue performance of the field produced interlayer.

For future interlayer mixes that do not initially meet the minimum 100,000 load cycle criteria in the four-point bending beam, the number of load cycles the mix design can achieve in the performance test can be increased by improving the elastic and fatigue resistant properties of the binder. Based on the laboratory test results for this project, that can be accomplished by using a high percentage of Kraton D0243 SBS to create a highly polymer modified binder.

The Iowa DOT provided Reflective Crack Delay System Special Provisions (Effective Date May 15, 2012) for the Asphalt Interlayer/I-35 Open House in Cerro Gordo County in August 2012. As of October 2014, the HMA Interlayer Design Criteria and Performance Requirements are included in Materials IM 510 Appendix A.