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New Jersey Department of Transportation
Bureau of Research

Technical Brief

HVS Evaluation of Flexible Overlays on Composite Pavement

Background

The use of asphalt overlays on rigid pavements as a preservation and rehabilitation technique has become common among many state transportation agencies. This is because the application of asphalt overlays is relatively quick and inexpensive compared to other surface treatments for rigid pavements. The addition of asphalt overlays on rigid pavements provide several advantages which include: extending the service life of the pavement, reducing surface permeability, maintaining grade and slope geometry of the pavement improving the ride quality of the pavement surface, and minimizing noise at the tire-pavement interface. Several hot mix asphalt mixes (HMA), which have performed successfully in the laboratory and field, have been used to construct asphalt overlays. These HMA mixes include: dense graded Superpave mixes, stone matrix asphalt (SMA) mixes, ultra-thin bonded wearing courses (UTBWC), and open graded friction courses (OGFC). Many of the studies conducted on the aforementioned HMA mixes focused on evaluating the laboratory performance of these mixes and very few studies evaluated the HMA mixes under conditions that are representative of those that exist in New Jersey. Therefore there was need to evaluate the field performance of various asphalt overlay treatments before New Jersey Department of Transportation could fully implement these treatments on its roadways.

To address this concern, a research study was initiated to evaluate the field performance and life expectancy of various asphalt overlay treatments commonly used in New Jersey through full-scale accelerated testing. To accomplish these goals, six 30-ft. long and 12-ft. wide full-scale, composite field sections were evaluated in this study. All six field sections contained a similar substructure (i.e. 8-in. thick Portland cement concrete (PCC) base, 16-in thick New Jersey I-3 (A-1-a) granular subbase, and 12-in. thick compacted natural soil subgrade). The overlay on the test sections consisted of the following mixes a 3-in. thick 9.5ME Superpave mix for Section 1, a 3-in thick Stone Matrix Asphalt (SMA) mix for Section 2, and a 2-in. thick New Jersey High Performance Thin Overlay (NJHPTO) for Section 3. The overlays on sections 3 through 6, consisted of a combination of 1-in. thick layer of BRIC and a 2-in. layer of 9.5 ME Superpave, SMA, and NJHPTO, respectively. All sections were instrumented with two asphalt strain gauges, linear variable differential transformers, soil compression gauges, and one pressure cell. The test sections were subjected to accelerated pavement testing at the Rowan University Accelerated Pavement Testing Facility (RU-APTF) using a Heavy Vehicle Simulator (HVS). The accelerated pavement testing involved the application of 60-kN, dual-tire, single axle load configuration for 200,000 repetitions. The test sections were also evaluated through heavy weight deflectometer testing and transverse pavement profile assessment. A ranking system was developed to determine which asphalt overlay had the best overall field performance.

Research Objectives and Approach

The primary research goal of this study was to identify and predict the expected life of thin asphalt overlay treatments used for rehabilitating and preserving PCC pavements. The secondary goal was to compare the relative field performance of the asphalt overlays considered to determine the most suitable asphalt overlay treatment for deteriorated rigid pavement in New Jersey.

Conclusions

Based on the test data collected from the embedded sensors and the subsequent data analyses performed, the following conclusions were drawn:

- The strain data processing and analysis approach presented in the study was successfully used to rank all sections based on their relative fatigue performance. This is the case because the computed analysis parameters, asphalt layer modulus (E_{APT}) and cumulative damage index (DI), were able to distinguish between the sections. Based on the rate of reduction in E_{APT}, Section 5 (SMA and BRIC) was ranked as the most susceptible to fatigue cracking, followed by Sections 6 (NJHPTO) Section 4 (9.5ME and BRIC), Section 3 (NJ HPTO) and

Section 2 (SMA). Using the cumulative DI parameter, Section 2 (SMA) was the best at resisting fatigue cracking followed by Section 3 (NJHPTO), Section 5 (SMA and BRIC), Section 6 (NJHPTO and BRIC) and Section 4 (9.5ME and BRIC), respectively. The cumulative DI parameter demonstrated a more consistent fatigue performance ranking and was able to distinguish between overlays that contained a layer of BRIC and those which did not.

- The transverse pavement profile evaluation was able to assess the extent of permanent deformation on the surface of the sections due to applied HVS loading. Based on the results of the transverse profile evaluation, Section 2 (SMA) had the lowest surface permanent deformation after 200,000 HVS passes followed by Section 1 (9.5 ME), Section 4 (9.5 ME and BRIC), Section 3 (NJHPTO and BRIC), Section 5 (SMA and BRIC), and Section 6 (NJHPTO & BRIC) respectively.
- Section 2 (SMA) had the best overall performance with an average ranking score of 4.5 followed by Section 1 (9.5 ME) and Section 3 (NJHPTO) with an average ranking score of 3.
- Section 5 (SMA and BRIC) and Section 6 (NJHPTO and BRIC) had the worst overall performance with an average ranking score of 2 followed by Section 5 (SMA and BRIC) with an average ranking score of 2.5.
- The overall performance ranking indicated that the addition of a 1-in. layer of BRIC did not improve the field performance of the overlay. The performance criterion ranking scores indicated that the addition of the 1-in. BRIC layer slightly worsened the performance of the test sections with regard to reflective cracking susceptibility and surface permanent deformation.

Recommendations

The following are the recommendations from the study:

- Further field evaluation is required to estimate the life expectancy of the overlays considered in the study.
  - The research presented provides tools to successfully measure and rank the field performance of the six asphalt overlays considered in this study.
  - Estimation of the expected life of the six overlays evaluated in this study would provide verification for the parameters developed to characterize the asphalt overlays' reflective cracking susceptibility in this study.

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A final report is available online at: http://www.state.nj.us/transportation/refdata/research/.
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