National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Bond Strength Between Asphalt Pavement Layers

RESEARCH SYNOPSIS 05-08

Problem Statement

Poor bond between two layers of hot-mix asphalt (HMA) is the cause of many pavement problems. A commonly observed problem related to poor bond between layers is slippage failure, seen in Figure 1, which may occur at locations where traffic accelerates, decelerates or turns.

In order to improve bond between HMA layers, tack coats are used. However, existing guidelines for the selection of tack coat materials and application rates are not clear. To improve tack coat guidelines, a test method and criteria were needed for measuring bond strengths between HMA layers.

Figure 1 Example of a slippage failure due to poor bond strength.

Objective

The primary objective of this study was to develop a test for evaluating the bond strength between HMA layers. A secondary goal of this study was to provide helpful information for the selection of the best type(s) of tack coat materials and optimum application rate(s).

Description of Study

This study included two phases. The first phase was a laboratory experiment to develop and refine a bond strength test device, as shown in Figure 2, and evaluate the effects of various factors, including tack coat materials, application rates, temperature, and normal pressure, on the bond strength between HMA layers using laboratory-fabricated samples. Based on the results of the laboratory phase, a draft method for measuring bond strength was written.

The second phase was a field validation of the draft bond strength test method. This phase involved setting up tack coat test sections on seven paving projects in Alabama and obtaining cores for testing the bond strength of each section. The results of the field work were used to establish preliminary criteria for bond strengths between pavement layers.

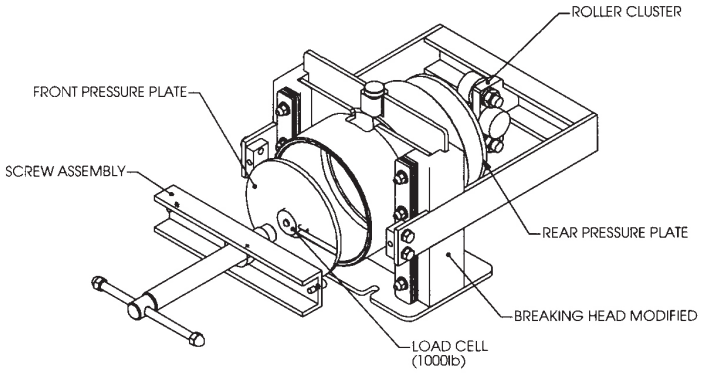

Figure 2 Illustration of NCAT bond strength device.

Key Findings

The recommended bond strength test can be conducted at a temperature of 77°F without applying a normal stress. A preliminary minimum bond strength using this bond strength procedure is 100 psi.

- If the test is run at a higher temperature, a normal pressure of 20 psi should be applied to avoid premature failure of the testing specimens. However, the preliminary bond criterion cannot be used because of the difference in testing temperatures.
- Application rates for emulsified asphalt tack coats should be specified in terms of residual asphalt.
- For tack coats on a new HMA layer, the optimum application rate is 0.054 gal/yd2 for asphalt emulsion and ranged from 0.020 to 0.063 gal/yd2 for paving grade asphalt. For milled HMA surfaces, the optimum application rate is from 0.014 to 0.060 gal/yd2 for asphalt emulsions and 0.028 gal/ yd2 for paving grade asphalt.

- ASTM D 2995, Standard Practice for Estimating Application Rate of Bituminous Distributors, is an effective method for checking the application rate of residual asphalt on projects.
- Bond strengths measured for a pavement section placed with a Novachip spreader were significantly higher than similar sections placed with conventional paving equipment.
- Milled HMA surfaces appear to significantly enhance the bond strength with the next HMA pavement layer.

Recommendations for Implementation

1. Training on the importance and proper application of tack coats should be provided as part of Asphalt Roadway Technician Certification courses.
2. Specifications for application rates of emulsified tack coats should be based on residual asphalt and should be checked using ASTM D 2995.
3. The bond strength procedure provided in the appendix of the full report is simple to run and relatively inexpensive. The bond strength fixture can be purchased for approximately $5,000. The load is applied and recorded with a Marshall press.

Implementation Benefits

Implementation of the study results will help improve the bond strength between HMA layers, which could reduce many pavement problems, such as slippage failures.

Acknowledgements and Disclaimer

This study was sponsored by the Alabama Department of Transportation. This research synopsis provides a brief summary of the study's final publication. This document is for general guidance and reference purposes only. NCAT, Auburn University, and the listed sponsoring agencies assume no liability for the contents or their use.