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New Jersey Department of Transportation
Bureau of Research

Technical Brief

HMA Pay Adjustment

This project is to evaluate multiple quality characteristics of hot-mix asphalt (HMA) for pay adjustment in quality assurance (QA). Life-cycle cost analysis (LCCA) was used to develop performance-related pay adjustment for in-place air voids. Laboratory tests were conducted to determine the upper limits of air voids at the longitudinal joint. Pavement structural analysis and shear strength test were conducted to identify the minimum bonding strength requirement to prevent premature pavement failure.

Background

In the current New Jersey Department of Transportation (NJDOT) specifications, hot-mix asphalt (HMA) pavement is tested and price adjusted for in-place air voids, total thickness, and ride quality compliances. The current pay factors in the specifications are based on empirical field data and engineering experience. The logical and defensible method to develop pay adjustments should be based on the difference between the life-cycle-cost value of the as-constructed pavement and that of the as-designed pavement.

A number of states have begun to implement longitudinal joint specifications, and most are based on determinations of density. However, distress at the joint is caused by the ability of air and water to enter the pavement structure, which is also related to permeability. This study will recommend the specification limits for air voids at the longitudinal joint based on density and permeability testing results and perform risk analysis for the proposed pay equations.

The requirement on interface bonding strength has not been specified in the construction specification before. The interface bonding between asphalt layers are affected by many factors, such as tack coat type and rate, surface roughness, and testing conditions. Therefore, analysis is needed to determine the minimum requirement of interface bonding strength to withstand the interface stress caused by vehicular loading.

Research Objectives and Approach

The objectives of this research are to

1) Develop a performance-related pay adjustment methodology for in-place air void;
2) Develop a specification for longitudinal joint density; and
3) Determine the minimum requirement on interface bonding strength between asphalt layers.

Findings

The following conclusions can be concluded from this study.

1. The performance-related pay adjustment was developed considering two quality characteristics (air voids of surface layer and intermediate/base layer). The life-cycle cost analysis (LCCA) results show that as the percent defectives (PDs) of air voids for both surface and intermediate/base layers are around the acceptable quality level (AQL), the bonus pay adjustments derived from LCCA match the ones from the current specification. On the other hand, the current specification appears to assign the greater penalties to contractors as the air void of intermediate/base layer is of poor quality but to assign the fewer penalties to contractors as the air void of surface layer is of poor quality, compared to pay factors derived from the LCCA.
2. The upper limits for air voids at the longitudinal joint are recommended to be 9 percent for stone-matrix asphalt (SMA) and 10 percent for dense-graded hot-mix asphalt (HMA) based on the permeability criterion for the air voids measured with the saturated surface dry method. The air voids at the joint are 1.5-2.0 percent greater than the air voids at the mats adjacent to the joint. Individual testing of the theoretical maximum density for the cores taken at the joint is recommended due to existence of joint adhesive.
3. A draft specification is developed for longitudinal joint density, including quality characteristics, sampling method, testing methods, acceptance limits, and pay equations. Alternative pay equations were proposed with different triggers for retest and rejectable quality level. Risk analysis was conducted to confirm that the effective acceptable quality level (AQL) coincides with the stated AQL and the acceptance procedures properly award 100 percent payment at the stated AQL.
4. The current tack coat rate specified in the specification (0.05-0.15 gal/yd^2) are within the range of typical tack coat application rates used by other state DOTs, although it is slightly toward the high end. Theoretical analysis of interface shear stress caused by vehicular loading show that the minimum bond strength should be around 70psi if direct shear test is conducted without confining pressure at room temperature. This requirement can be easily achieved in field projects based on the testing results of interface shear strength from a number of previous studies and this study.

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A final report is available online at: http://www.state.nj.us/transportation/refdata/research/. If you would like a copy of the full report, send an e-mail to: Research.Bureau@dot.state.nj.us.

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