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Testing and Analysis of LWT and SCB Properties of Asphaltic Concrete Mixtures

INTRODUCTION

For pavement to perform well in the field, a balance of both rut and crack resistance in response to the traffic loads and environment conditions is required. Controlling volumetric properties of a hot mix asphalt (HMA) mixture is not enough to ensure good pavement performance because pavements often do not perform as they are designed. DOTD specifications were designed to target rutting as the major distress impacting Louisiana roadways. However, an adverse effect of that specification was the production of "dry" mixtures. The reduced asphalt content in the mixtures resulted in questionable durability of the roadway. A possible solution would be the development of laboratory test procedures to evaluate the as-built pavement-qualities to predict the pavement performance and life. In so doing, numerous agencies around the United States are incorporating mechanical tests to evaluate the rutting potential, cracking potential, and moisture susceptibility of HMA mixtures. Recent DOTD specification changes were implemented and evaluated using semi-circular bending (SCB) and loaded wheel tracking (LWT) tests. The results of these specifications were used to implement balanced mixture design practices. This study evaluated the use of the LWT and SCB tests as end result parameters to indicate the stability and durability of HMA mixtures. As part of this study, an attempt was made to develop a simplified and reasonable SCB test procedure so that the commonly used Marshall Load frame device would be adapted for plant and district laboratory testing.

OBJECTIVE

The objective of this research was to evaluate the LWT and a simplified SCB test as an end result parameter for testing asphaltic concrete mixtures. In addition, a balanced mixture design concept was evaluated using field project from across the state.

METHODOLOGY

The mixtures evaluated in this study were prepared using two design practices. Conventional SuperPAVE design methodologies were utilized for mixtures evaluated from historic data from the LTRC database and general contractor provided specimens. A proposed balanced mixture design (BDM) approach was evaluated for 11 of the mixtures in the factorial.

DOTD Volumetric Mixture Design

The mixtures evaluated in this study were designed according to AASHTO TP 28 "Standard Practice for Designing Superpave HMA" and Section 502 of the 2006 Louisiana Standard Specifications for Roads and Bridges.

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BMD

A balance of both rut and crack resistance in response to the traffic loads and environment conditions is required by the pavement to perform well in the field. Controlling volumetric properties of asphalt mixture is not enough to ensure good pavement performance as often pavements do not perform as designed. Balanced Mixture Design evaluates the mixtures volumetric properties, as well as, the mixture's laboratory rutting and cracking resistance.

CONCLUSIONS

Based on the results of the analysis, the following findings and conclusions may be drawn:

With respect to LWT testing:

- 46 of the 51 mixtures evaluated (90%) passed the criteria specified for acceptable rutting resistance.
- Additionally, the 11 mixtures produced using the DOTD proposed BDM specifications exhibited improved or similar performance to mixtures produced using the 2006 DOTD specification.
- Mixtures containing polymer modified binders resulted in improved rutting performance when compared to unmodified binders.

With respect to SCB testing:

- Research has shown the commonly accepted criterion for acceptable cracking resistance is a J_c of 0.5 kJ/m2 (17). The percent of mixtures passing this criterion for mixtures containing PG 64-22, PG 70-22M, PG 76-22M and PG 82-22CRM is 38, 68, 91, and 20, respectively.
- 64% (7 out of 11) of the mixtures designed according to the DOTD proposed balanced mixture design specifications met or exceeded the cracking criteria. It is noted, two mixtures of the mixtures which failed to meet this criterion were prepared with PG 64-22 and PG 82-22CRM binder.
- Mixtures containing PG 76-22M modified binder outperformed the mixtures containing other binders.
- In general, mixtures containing no reclaimed asphalt pavement (RAP) exhibited improved J_c.

The comparison of field and laboratory specimen types shows there may be an effect of specimen type on the computed J_c. This relationship would need to be further investigated before using field cores for quality assurance practices.

RECOMMENDATIONS

Based on the findings of this research, it is recommended that DOTD implement the LWT and SCB test procedures as part of the mixture design and acceptance. Primarily, the following specifications should be required:

- For LWT testing, 6 mm at 20,000 passes for mixtures containing elastomeric polymer and crumb rudder modified binder and 10 mm at 20,000 passes for mixtures containing unmodified binder.
- For SCB testing, J_c = 0.6 kJ/mm2 min for mixtures containing binder with a high temperature PG grade greater than 76. This is determined based on the majority of mixtures contained PG 76-22M resulting in Jc greater the 0.55 kJ/mm2. A minimum J_c=0.5 kJ/mm2 is recommended for mixtures containing binder with a high temperature PG grade less than 76 (i.e., PG 70-22M and PG 64-22).

Figure 1
Marshall Load frame device