

New Jersey Department of Transportation  
Bureau of Research

## Technical Brief



### Performance Testing for HMA Quality Assurance

*This project evaluated the potential implementation of performance-based specifications (PBS) for the design and quality control of hot mix asphalt mixtures. Database of performance testing was generated to evaluate typical mixture performance and comparisons were drawn to general field performance to help establish criteria and recommendations. A new design method, Balanced Mix Design, was evaluated using NJDOT approved mixes and results indicated NJDOT mixtures are under-asphalted to meet the fatigue cracking performance. The use of Effective Asphalt Content by Volume (EACV) was recommended as a design and control parameter to help improve the durability of asphalt mixtures. Finally, installation and training for the NJDOT took place regarding the use of the recommended performance tests.*

### Background

The Superpave asphalt mixture design system is based on evaluating the performance of each constituent of the asphalt mixture; asphalt binder, aggregate/sand, and the mixture as a whole. In its development and initial release, a suite of performance tests were developed to accompany the new volumetric design system to verify asphalt mixtures would not prematurely rut or crack. Unfortunately, the cost of the test equipment, as well as the time it took to test the mixture design specimens, was impractical. This resulted in the Superpave design system to simply be a volumetric based asphalt mixture design system with only moisture damage being evaluated using AASHTO T283, *Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage*.

During its early implementation with the New Jersey Department of Transportation (NJDOT), the initial Superpave mixtures were found to be coarser, had less asphalt binder, and harder to place and compact than the previous Marshall asphalt mixtures designed for the identical traffic level. What resulted were asphalt mixtures that were prone to poor longitudinal joint construction and asphalt pavements failing quicker due to fatigue cracking related distress.

Adding to the already fatigue prone asphalt mixtures observed in New Jersey, the asphalt industry in New Jersey has been pressuring the NJDOT to utilize more recycled asphalt pavement (RAP) in their mixtures. Historically, due to the oxidized and stiff asphalt binder associated with RAP, higher percentages of RAP have been associated with an increase in fatigue and low temperature cracking potential when compared to virgin or low RAP content asphalt mixtures.

## Research Objectives and Approach

The objectives of this research are to

- 1) Develop a database of performance properties for HMA, SMA, and OGFC asphalt mixtures;
- 2) Evaluate a new asphalt mixture design procedure that balances rutting and fatigue cracking performance; and
- 3) Provide training and implementation of required test equipment to enforce the proposed performance-based specifications.

## Findings

The following conclusions can be concluded from this study.

1. Utilizing laboratory data conducted on New Jersey specific asphalt mixtures, as well as conversations with TxDOT regarding their implementation of performance-based asphalt mixture designs, Rutgers University and the NJDOT developed a set of performance criteria for use in “Conventional” asphalt mixtures. “Conventional” asphalt mixtures includes dense-grade mixes, SMA mixes and OGFC mixes. The criteria are sensitive to both traffic level and location in the pavement (i.e. – surface, intermediate, or base). Traffic level is incorporated through the specification of asphalt binder grade. For high volume traffic, a PG76-22 is selected. Meanwhile, lower volume traffic requires a PG64-22. At the moment, the NJDOT differentiates High and Low volume traffic at a level of 10 million ESAL’s (MESAL’s) – greater than 10 MESAL’s requires a PG76-22 and less than 10 MESAL’s requires a PG64-22. The criteria also attempts to maintain consistency across other NJDOT performance-based specifications, such as the NJDOT HRAP specification.

2. The Balanced Mix Design approach seems to have potential with respect to determining an appropriate asphalt content that would meet both the rutting and fatigue cracking requirement on NJDOT’s typical surface course mixtures. Also the test methodology may be more time consuming, the laboratory exercise noted that an increase in the current design VMA may help in the achieving greater fatigue resistance in dense-graded asphalt mixtures. Based on the data generated in this study, a 1 percent increase is recommended for both 9.5 and 12.5 mm nominal maximum aggregate size mixtures. The 1 percent increase resulted in only a slight increase in rutting potential, while greatly improving the fatigue resistance of the asphalt mixtures.

3. The asphalt mixture performance generated during the Balanced Mix Design phase showed that the Effective Binder Content by Volume parameter may be more appropriate, and easier, to specify. The VMA parameter directly changes with changes in air voids, making it a difficult parameter to specify during production. However, Effective Binder Content by Volume remains constant, during mix design and production, as it is the difference between the measured VMA and compacted air voids. This provides a stable value that can be used during volumetric design and plant production quality control.

4. The Robin Round exercise validated the Troxler Electronics Overlay Tester as an alternative test device to the Shedworks Overlay Tester at Rutgers University. Three different sets of test specimens were produced and tested. In the final round robin, the student t-Test indicated that the test results of four different asphalt mixtures were

statistically equal at a 95 percent confidence interval between the two pieces of equipment. After completion of the study, the Troxler Electronics device was delivered to the NJDOT and a 2-day training activity took place. The training encompassed sample preparation, gluing, testing and data analysis.

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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.nj.gov](mailto:Research.Bureau@dot.nj.gov).

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