Validation Techniques for Setting BMD Test Criteria

CAPRI
CONSORTIUM FOR ASPHALT PAVEMENT RESEARCH AND IMPLEMENTATION

Case Study: *New England Forensic Study*

Initial Validation

Objectives

The objective of this case study is to demonstrate how forensic analysis can be utilized to select appropriate Balanced Mix Design (BMD) tests by evaluating asphalt mixes with known field performance. This approach aims to identify test methods that correlate laboratory results with real-world pavement behavior, ensuring durable and cost-effective pavement designs.

Benefit

Forensic analysis enables state Departments of Transportation (DOTs) to screen and refine BMD test selection by leveraging historical performance data from in-service pavements. By replicating mixes with documented field outcomes (both good and poor), agencies can validate laboratory tests like the Hamburg Wheel Tracking Test (HWTT) and Indirect Tensile Strength (ITS) test, ensuring they predict performance metrics such as moisture resistance. This method reduces the risk of adopting unproven tests and helps enhance pavement durability.

Background

The New England DOTs sponsored research by the University of New Hampshire to assess moisture susceptibility tests, which included: Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage (aka Modified Lottman, AASHTO T 283), Moisture-induced Stress Tester (MiST, AASHTO T 423), Hamburg Wheel Tracking Test (HWTT, AASHTO T 324), and other promising procedures and modeling methods.

Methodology

The study conducted a state-of-the-practice literature review and identified current test practices in the New England states and across the United States. Identified and evaluated asphalt mixes of known performance (see Figure 1)and determined mechanisms for poor-performing mixes. Determined and assessed the impacts of remedial measures in reducing moisture damage. Recommended and conducted an evaluation framework of identified test procedures. The study addressed three key questions:

1. **Which laboratory tests best correlate with observed field performance?**
2. **How can forensic analysis of failed and successful pavements inform threshold setting?**
3. **How can the potential effects of moisture-induced damage be quantified on pavement service life?**

Results of the Study

Results were analyzed to determine which tests can distinguish historically good and poor-performing mixes and resistance to moisture damage on a consistent and reliable basis.

Test Correlation *(Specifically related to Moisture Damage)****:***

- **ITS ratios** (Lottman and MiST) were unable to distinguish performance. **ITS values** were able to distinguish performance; however, the results may be an artifact of binder stiffness.
- The Disk-shape Compact Tension (**DCT**) test did not show a significant distinction between good and poor.
- The Semi-Circular Bend (**SCB**) test could not consistently and clearly differentiate performance.
- The Ultrasonic Pulse Velocity (**UPV**) test showed a consistent, although small, difference between good and poor mixes.

- Dynamic Modulus **(E*) paired with MiST** results were promising.
- Hamburg (**HWTT**) results were very promising.

Threshold Refinement: Forensic analysis of failed pavements helped set conservative HWTT thresholds, ensuring mixtures resist premature failure. Successful pavements supported higher performance thresholds.

Quantifying Service Life: Dynamic modulus results of unconditioned and moisture-conditioned states were assessed using the AASHTO Pavement-ME. The results showed that moisture-induced damage can have a significant impact on pavement life. Out of the three distresses, rutting was the most sensitive to moisture-induced damage, where some materials could experience a reduction in life of more than 50 percent.

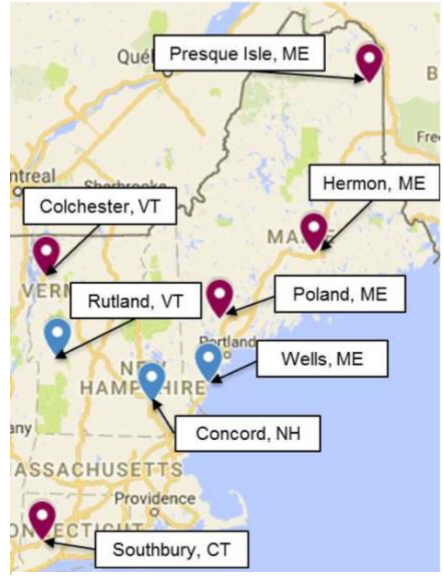

Figure 1. Study Mix Locations
Blue: Good, Red: Poor

Recommendations

- The New England agencies should not rely on AASHTO T 283.
- The HWTT is recommended for pursuit and adoption.
- Ultrasonic Pulse Velocity can be used as a low-cost, non-destructive screening tool during mix design.
- The use of MiST is also recommended on a routine basis during mix design and evaluation.

Challenges

- **Mixes:** This study conducted a survey to identify mixes of known performance. Production mixes of similar mix designs were obtained.
- **Material Replication:** Outside of this study, another approach is to obtain original aggregates and binders to replication mixes. Original materials are often not available.
- **Impact of Sampling**: All the mixes were sampled loose from production plants. Buckets were re-heated based on an established protocol (NC State). After this study, significant research has been conducted investigating the sampling, reheating, and handling. *(Resources: NAPA IS-145 and YouTube Overview)*
- **Variability:** Construction and environmental factors introduce variability, complicating direct laboratory-field correlations.
- **Time and Resources:** Forensic studies require extensive historical data and laboratory testing, increasing time and cost compared to benchmarking alone.

Level of Effort / Cost

The study required significant effort, including archival data collection from DOT pavement management systems, laboratory replication and testing (HWTT, ITS, etc.), depending on the number of mixtures and tests, and coordination with agencies for field data and material access. However, the benefit is SIGNIFICANT.

References

- Moisture Susceptibility Testing for Hot Mix Asphalt Pavements in New England (NETC-15-3 Final Report)
- NAPA BMD Resource Guide

Agencies and Research Entities

CAPRI-B-12.25.014