

Validation Techniques for Setting BMD Test Criteria



Case Study: *Texas DOT Test Track Sections*

Objective



Initial
Validation

To support the Texas Department of Transportation (TxDOT) in implementing balanced mix design (BMD) and validating proposed test criteria, TxDOT sponsored three sections at the [NCAT Test Track](#). The experiment evaluated the field performance of two asphalt mixtures designed using a BMD approach, compared with a mixture designed using the traditional volumetric mix design (VMD) approach.

Benefit

The evaluation of test sections at the NCAT Test Track demonstrated the benefit of BMD in extending the lifespan of asphalt overlays when compared to traditional volumetric design.

Background

In 2018, TxDOT sponsored two sections at the NCAT Test Track: S10 (BMD) and S11 (VMD). An additional BMD Section (N6) was added to the experiment in 2021. The combined experiment aimed to compare the field performance of asphalt mixes designed using a BMD approach (S10 and N6) with that of the traditional volumetric approach (S11). Sections were built as 2.5-inch mill-and-inlay overlays over existing asphalt pavements with approximately 15% to 20% cracked lane area to assess the surface mixes' resistance to reflective cracking.

Methodology

TxDOT developed a special provision for BMD that requires the [Hamburg Wheel Tracking Test](#) (HWTT, Tex-242-F) to evaluate rutting and moisture resistance, and uses the [Overlay Test](#) (OT) (Tex-248-F) to evaluate cracking resistance. The HWTT test temperature is 50°C, and the criterion is based on the number of passes to a 12.5mm rut depth as a function of the binder PG grade in the mix. Two OT parameters, Critical Fracture Energy (CFE) and Crack Progression Rate (CPR), are used for cracking assessment. For surface mixtures, a minimum CFE threshold of 1.0 lb-in/in² and a maximum CPR threshold of 0.45 are required. The [Indirect Tensile Asphalt Cracking Test](#) (IDEAL-CT, ASTM D8225) was also conducted for production acceptance. Two key questions TxDOT wanted to answer with the construction of the NCAT Test Track section were:

- *Will BMD mixes have a potential rutting issue?*
- *Are the current OT test criteria adequate, or should they be revised to ensure satisfactory cracking performance?*

The S10 and N6 mixes were designed by adjusting a TxDOT-approved Superpave VMD. All mixes used a PG 70-22 modified binder, RAP, the same aggregates, and had a recycled binder ratio (RBR) of approximately 20%. The main differences among the mixes were the gradation and the optimum binder content. Performance testing of the mix design samples showed that the S10 and N6 mixes passed both OT and HWTT requirements, while the S11 mix failed the cracking criterion (Figure 1a). Performance testing of the production samples showed consistent trends with the mix design samples (Figure 1b).

Results

Field performance indicated that rutting resistance for all the sections was satisfactory. Regarding cracking, section S10, constructed in 2018, had 11.0% of cracked lane area after 20 million equivalent single-axle load (ESALs), while section S11 reached over 20% of cracked lane area at around 14.5 million ESALs. The cracking in S11 progressed to approximately 25.7% before it was milled off at around 16.0 million ESALs. (Figure 2) Section N6, constructed in 2021, performed well with no cracking after 10 million ESALs. Overall, the field performance data from the three test sections agreed with the BMD performance test results.

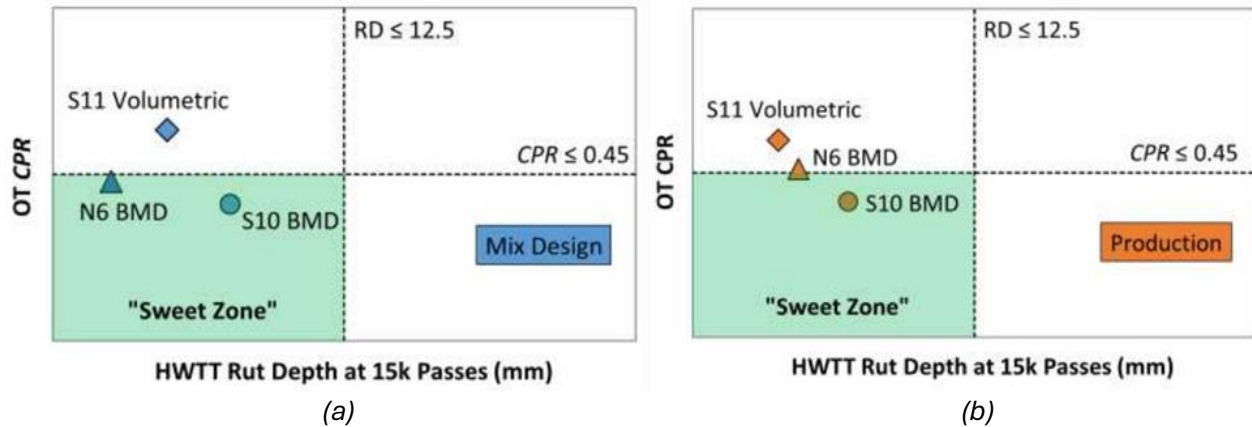


Figure 1. Performance Diagram for Mix Design and Production with OT (CPR) and HWTT (Total Rut Depth at 15,000 passes).

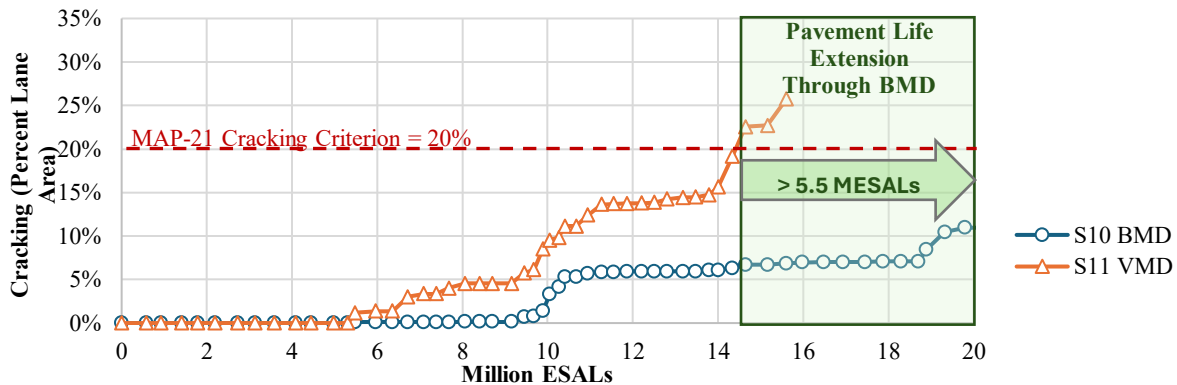


Figure 2. Field Cracking Data of Test Sections after 20-Million ESALs.

Conclusions and Recommendations

- Results of the evaluation demonstrate that BMD allows performance enhancement of asphalt mixtures over the traditional volumetric mix design. The incorporation of mixture performance test requirements can effectively identify and reject asphalt mixtures that meet the volumetric requirements but lack performance properties.
- Mixture performance test results from mix design and production testing agree with the field performance of the test sections, indicating that HWTT, OT, and IDEAL-CT are effective tests for use in BMD for mix design approval and production acceptance.
- The cracking performance of the sections demonstrates the benefit of BMD in extending the lifespan of asphalt overlays despite having a challenging underlying pavement condition. Figure 2 shows an over 38% increase in cracking resistance from section S11 (VMD) to S10 (BMD).

Level of Effort / Cost

The study required significant effort, including construction and continuous monitoring of the test sections.

References

- [Phase VIII \(2021-2024\) NCAT Test Track Findings, NCAT rep24-01, May 2024](#)
- [NAPA BMD Resource Guide](#)

Agency and Research Entity

