

Validation Techniques for Setting BMD Test Criteria



Case Study: *Oklahoma DOT* Test Track

Objective



Initial
Validation

To support the Oklahoma Department of Transportation (ODOT) in implementing balanced mix design (BMD) and validating proposed test criteria, ODOT sponsored three sections at the [NCAT Test Track](#). The experiment evaluated BMD performance tests while exploring the responsible use of RAP.

Benefit

The evaluation of test sections at the NCAT Test Track provided valuable insight into the expected long-term field performance of BMD mixtures, particularly those incorporating high RAP contents.

Background

ODOT sponsored two BMD sections on the NCAT Test Track: S1 in the 2018 research cycle and N8 in the 2021 research cycle. S1 was a 5.0-inch mill-and-inlay section using a BMD surface mix with 12% reclaimed asphalt pavement (RAP). N8 was a 5.5-inch mill-and-inlay section using a BMD surface mix with 30% RAP and a bio-based recycling agent (RA). Both sections were constructed over an existing pavement structure from previous research cycles.

Methodology

Since 2017, ODOT has been implementing BMD with draft special provisions requiring BMD tests to evaluate rutting and cracking resistance. Their first draft provisional BMD specification required using the [Hamburg Wheel Tracking Test](#) (HWTT, AASHTO T 324) and [Illinois Flexibility Index Test](#) (I-FIT, AASHTO T 393) to evaluate rutting and cracking resistance, respectively. ODOT's current special provision uses the Volumetric Design with Performance Optimization approach per AASHTO R 132-25 to design asphalt mixtures that meet performance requirements using the HWTT and replacing the I-FIT with the [Indirect Tensile Asphalt Cracking Test](#) (IDEAL-CT, ASTM D8225). The HWTT criteria are based on the number of passes required to reach 12.5 mm of rut depth at 50°C, with a minimum number of passes varying with the binder PG grade of the mix. The IDEAL-CT criteria require a minimum CT_{Index} of 100 for surface mixes and 60 for non-surface mixes.

Section S1 surface mix used a PG 70-28 SBS-modified binder, a blend of Oklahoma local aggregates, and 12% RAP. The S1 base mix used a PG 64-28 SBS modified binder, a blend of Oklahoma local aggregates, 30% RAP, and a recycling agent. Both mixes were designed using the *Performance Modified Volumetric Design* approach as described in AASHTO R 132-25. BMD testing of the mix design samples showed that both mixes passed the HWTT and I-FIT criteria. The reheated specimens from production had similar HWTT but lower I-FIT results than the mix design samples and failed the I-FIT criterion (Figure 1).

Section N8 surface mix was designed to match the volumetrics of the S1 surface mix, but with a 30% RAP content and a recycling agent. The N8 base mix uses the same mix design as the base mix of Section S1. Quality control testing of the N8 surface mix showed 1.3% more dust and 0.1% less asphalt binder at production compared to the JMF. As a result, the production mix had lower air voids (0.8%) and VMA (13.1%). Nonetheless, BMD performance testing showed that both the hot-compacted and reheated specimens passed ODOT's HWTT and IDEAL-CT criteria (Figure 2).

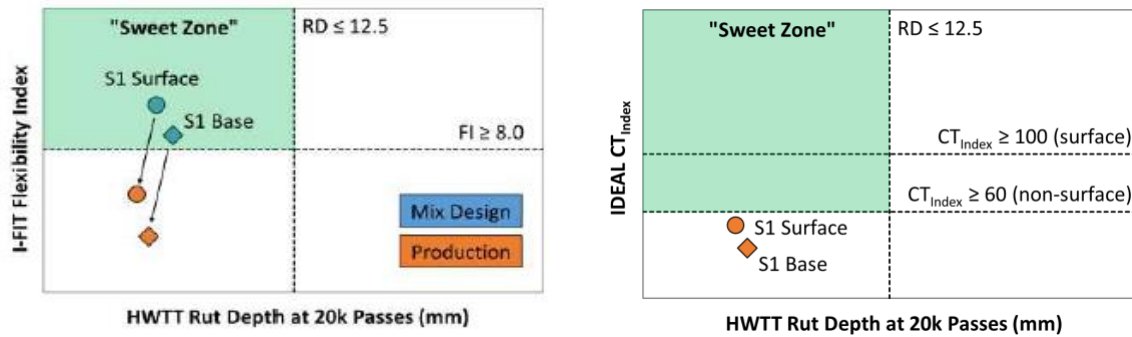


Figure 1. HWTT-Versus (a) I-FIT and (b) IDEAL-CT of S1 Surface and Base Mixes from Mix Design and Production

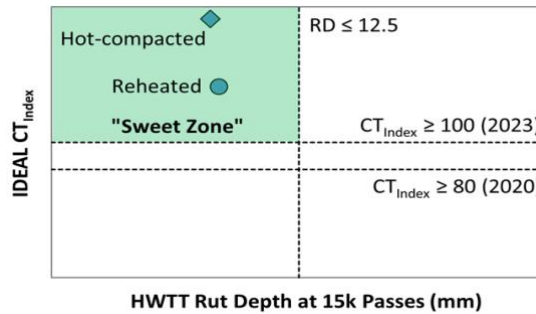


Figure 2. HWTT-Versus IDEAL-CT of N8 Surface Mix from Production

Results

Field performance of section S1 after 20 million ESALs shows excellent performance with minimal rutting and no surface cracking. Similarly, Section N8 performed well after 10 million ESALs, with minimal rutting and no surface cracking.

Conclusions

For Section S1, surface and base mixes, the production mix had similar rutting resistance but reduced cracking resistance compared to the mix design. The production mixes met the HWTT criterion but failed ODOT’s previous I-FIT and current IDEAL-CT criteria. However, the section performed well with no surface cracking after 20 million ESALs. The inconsistency between the I-FIT/IDEAL-CT results and field cracking performance suggests that ODOT’s BMD cracking criteria may be over-conservative for asphalt pavements with a strong underlying condition. For Section N8, despite lower air voids and VMA on the production, the surface mix showed balanced rutting and cracking resistance in the BMD performance tests.

Recommendations

The field performance of the sections suggests that it is feasible to design good-performing surface mixes with RAP using BMD. In addition, based on the performance of the sections, ODOT’s current IDEAL-CT criteria appear conservative for asphalt pavements with a robust underlying condition. The evaluation also indicates that to achieve the full innovation benefits of BMD, volumetric requirements should be relaxed when designing high RAP mixes, provided the performance test requirements are met.

Level of Effort / Cost

The study required significant effort, including the development of mix designs, the construction of the test sections with local Oklahoma materials, and continued monitoring for long-term performance assessment.

References

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

Agency and Research Entity

