Validation Techniques for Setting BMD Test Criteria

CAPRI
CONSORTIUM FOR ASPHALT PAVEMENT RESEARCH AND IMPLEMENTATION

Case Study: *WisDOT* Open-Road Test Sections

BMD-1 Initial Validation

Objectives & Benefit

To validate Balanced Mix Design (BMD) performance tests and preliminary criteria for asphalt mix design approval and quality assurance (QA) for the Wisconsin Department of Transportation (WisDOT), and to assess production variability of BMD test results using six open-road test sections supplemented by ten statewide shadow projects.

Benefit

The study provides WisDOT with validated BMD test criteria and production targets to enhance asphalt pavement durability and performance. Quantifying production variability enables contractors to optimize mix production for consistent quality, reducing premature failures and supporting cost-effective, sustainable pavement designs.

Background

WisDOT is advancing BMD to improve asphalt performance beyond traditional volumetric designs. Supported by the National Center for Asphalt Technology (NCAT), this study focused on validating the Hamburg Wheel Tracking Test (HWTT, AASHTO T 324) for rutting and moisture damage and the Indirect Tensile Asphalt Cracking Test (IDEAL-CT, ASTM D8225) for cracking resistance, while assessing production variability to refine WisDOT's draft BMD specifications.

Methodology

The study applied two complementary BMD validation strategies:

1. ***Open-Road Test Sections:*** Six open-road test sections designed with mix designs with a range of anticipated performance (good to poor), constructed on STH69 (Figure 1). Mixes were sampled and tested using HWTT and IDEAL-CT by WisDOT, the Contractor, and NCAT. Falling Weight Deflectometer (FWD) data were used to assess pavement structure uniformity. Lab-to-lab comparisons evaluated tests for consistency.
2. ***Production Variability Assessment (Shadow Projects)****:* Mixes were sampled from WisDOT projects statewide (Figure 2). Tests (HWTT, IDEAL-CT, and High-Temperature Indirect Tensile Test [HT-IDT]) quantified variability in BMD parameters. Statistical analysis established potential production targets for WisDOT's preliminary BMD acceptance criteria.

Results *(to-date)*

- ***Open-Road Test Sections****:* Variability in granular base materials and FWD data raised concerns about pavement structure uniformity, potentially affecting lab-to-field validation. Lab-to-lab differences in HWTT and IDEAL-CT results highlighted procedural inconsistencies (reheating, splitting, and conditioning).
- ***Production Variability****:* Across the shadow projects, HWTT Corrected Rut Depth at 20,000 passes (CRD_{20k}) exhibited a pooled within-lot standard deviation (*s*) of 1.60 mm (COV = 10.9%). IDEAL-CT (CT_{Index}) pooled within-lot *s* was 10.9 (COV = 13.3%). The HT-IDT strength pooled within-lot *s* was 2.29 psi (COV = 13.5%). Table 1 presents preliminary BMD criteria and recommended production targets. HT-IDT demonstrated potential as a faster rutting-related quality control test, with a moderate correlation (R^2 of 0.44) to HWTT CRD_{20k}, with the residual standard error (RSE of 2.0) of the linear regression was low.

Table 1. WisDOT Preliminary BMD Criteria and Recommended Production Targets from Shadow Projects.

Mix Type	HWTT (CRD_{20k}) (s=1.60mm)		HWTT Stripping Number (LC_{SN}) (s = 1436)		IDEAL-CT CT_{Index} (s = 10.9)	
	Criteria	Target	Criteria	Target	Criteria	Target
Low Traffic	≤ 12.0 mm	≤ 9.9 mm	≥ 3,000	≥ 4,440	≥ 30	≥ 44
Medium Traffic	≤ 7.5 mm	≤ 5.4 mm				
High Traffic	≤ 5.0 mm	≤ 2.9 mm				
SMA	≤ 4.0 mm	n.a.				

n.a. (not available) SMA was not included in the shadow projects; therefore, the standard deviations for this mix type are unknown.

Quality Control: HT-IDT showed potential as a faster rutting test with a moderate correlation to HWTT CRD_{20K}.

Recommendations

- Monitor open-road test sections field performance.
- Investigate lab-to-lab test result differences by standardizing mix reheating, splitting, and conditioning procedures, followed by a round-robin experiment.
- Retest test section mixtures in a single lab to establish baseline values for future correlations.
- Develop a formal technician training program for IDEAL-CT, HWTT, and HT-IDT to ensure consistency.
- Conduct additional shadow projects with contractor BMD tests to refine production variability data.
- Share Lessons Learned in the construction of the open-road test sections.

Challenges

- Non-uniform granular base materials in open-road test sections of the reconstruction project complicated field performance analysis.
- Lab-to-lab variability in HWTT and IDEAL-CT results indicated a need for standardized procedures.

Level of Effort / Cost

The study required significant effort, including experimental design, construction of six open-road test sections, statewide sampling for ten shadow projects, and extensive laboratory testing. The approach is replicable for DOTs with access to test facilities and industry partnerships.

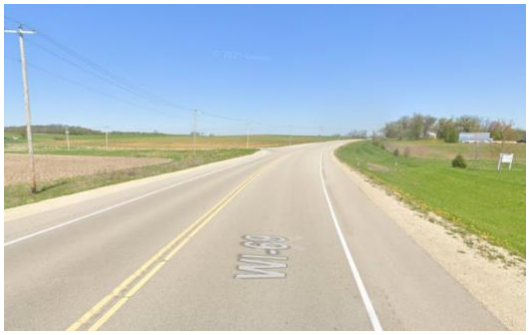

Figure 1. Open-Road Test Sections on STH 69 Post Reconstruction (May 2025)

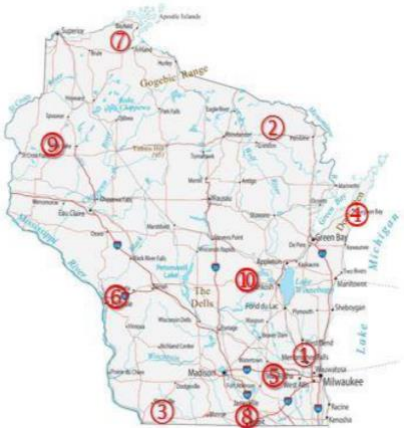

Figure 2. Shadow Project Locations

References

- WisDOT WHRP 0092-22-04 Balanced Mixture Design Pilot and Field Sections
- NAPA BMD Resource Guide

Agencies and Research Entity

Wisconsin Department of Transportation

U.S. Department of Transportation Federal Highway Administration

National Center for Asphalt Technology NCAT at Auburn University

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