Balanced Mix Design: Rutting Performance Tests

Research Team: University of Nevada, Reno; Rutgers University; Texas A&M Transportation Institute; RDM International; Duval Engineering
Sponsored by: AAPTP, in partnership with FAA and NAPA


Source: NAPA

Rutting is one of the most critical and visible forms of distress in airfield asphalt pavements. Under concentrated aircraft loading, even minor rutting can cause surface deformation that affects safety, drainage, and long-term performance. Balanced Mix Design (BMD) helps prevent these issues through performance-related testing that verifies an asphalt mixture's resistance to deformation before it is used in the field.

In this Airport Asphalt Pavement Technology Program (AAPTP) project, researchers evaluated multiple rutting performance tests to determine which tests were the most reliable, repeatable, practical, and accurate at predicting field performance. The study identified four test methods that, together, give agencies and contractors flexibility in both mix design and quality assurance.

Benefits

- Establishes a consistent set of rutting performance tests tailored to airfield asphalt mixtures.
- Enables engineers to verify mixture performance during design and production.
- Advances the Federal Aviation Administration (FAA) goal of implementing performance-based specifications through AAPTP research.
- Reduces premature rutting and the related costs of maintenance and reconstruction.
- Improves confidence in pavement durability and long-term service life.

Approach

The research team compared several established and emerging rutting performance tests using asphalt mixtures collected from active airfield projects across several regions. Each test was evaluated for repeatability and sensitivity to mixture changes, as well as practical factors such as equipment cost and testing time. Testing was performed at two air void levels (5 percent and 7 percent) to represent different field densities. Results were analyzed to evaluate how reliably each method ranked mixtures and identified performance differences tied to binder content, aggregate structure, and air voids. Statistical analyses identified which tests showed the strongest correlation with expected field performance and which could be efficiently implemented in agency laboratories.

Results

The study recommends four rutting performance tests as suitable options for incorporation into a BMD framework for airfield asphalt pavements, depending on available resources and project needs:

Asphalt Pavement Analyzer (APA) – Provides controlled wheel tracking under dry conditions. Recommended at two pressure settings (100 psi/100 lb and 250 psi/250 lb) to represent the range of load severities typical of airfield pavements.


Source: FHWA

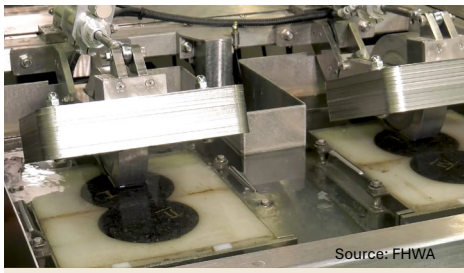
Asphalt Pavement Analyzer

Hamburg Wheel-Tracking Test (HWTT) – Evaluates rutting and moisture susceptibility under submerged conditions. Recommended for its long history of use, strong correlation with field performance, and ability to simulate repeated aircraft loading.

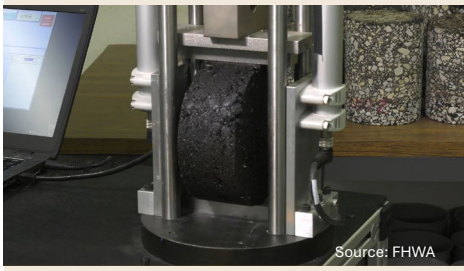
High-Temperature Indirect Tensile Test (HT-IDT) – Measures mixture resistance to deformation at elevated temperatures. Recommended for its simplicity, low equipment cost, and strong relationship to binder stiffness and aggregate structure.

Ideal Rutting Test (IDEAL-RT) – Uses standard laboratory compaction and loading equipment to measure shear strength property of asphalt mixtures. Recommended as a practical, lower-cost option for laboratories transitioning to performance testing, with good correlation to field performance and strong relationships to binder content, binder stiffness, aggregate structure, and recycled materials.

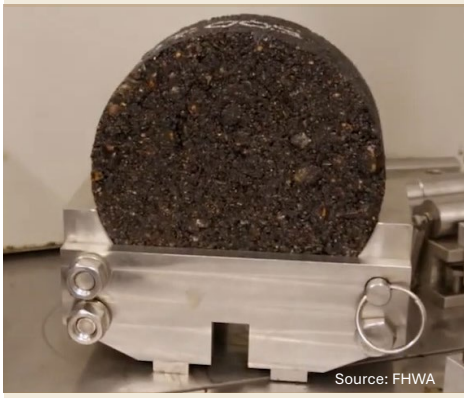
Together, these four tests provide agencies and contractors with a flexible toolkit that can be tailored to available equipment, project scale, and the performance risk level of the airfield pavement area being paved.



Hamburg Wheel-Tracking Test



High-Temperature Indirect Tensile Test



Ideal Rutting Test

Implementation

Agencies are encouraged to incorporate rutting performance testing into their mix design and verification processes as part of a phased transition to BMD. Initially, APA or HWTT are used for mix design, coupled with HT-IDT or IDEAL-RT for verification and acceptance testing.

As agencies gain experience, additional reliance on HT-IDT and IDEAL-RT can be introduced to support higher testing frequency during production. Project results also indicate that testing at 7 percent air voids and using approximately 5,000 HWTT passes are appropriate parameters for evaluating airfield mixtures.

By adopting this four-test framework, agencies and contractors can identify underperforming mixtures before construction, minimize rutting-related maintenance, and improve long-term reliability of asphalt airfield pavements.

Download the project's test results report at: bit.ly/BMDRuttingTestResults

Additional Resources

View the final report at: bit.ly/BMDRuttingTests.

Watch the AAPTP training video on BMD: bit.ly/BMDAirfieldVideo.

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About AAPTP

The Airport Asphalt Pavement Technology Program (AAPTP) is a cooperative agreement effort between the National Asphalt Pavement Association (NAPA) and the Federal Aviation Administration (FAA) to advance asphalt pavements and pavement materials. The AAPTP advances solutions for asphalt pavement design, construction, and materials deemed important to airfield reliability, efficiency, and safety. The program leverages NAPA's unique technology implementation capabilities with assistance from the FAA and industry to advance deployment and adoption of innovative asphalt material technologies.

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