Balanced Mix Design for Airfields

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Sponsored by: AAPTP, in partnership with FAA and NAPA

Source: ARA, Inc.

A rainy day accentuates rutting on the runway at Dover Air Force Base, Delaware.

For decades, asphalt mix designs for airfields have been based on volumetric criteria such as binder content, air voids, and aggregate structure. While these measures are useful, they are indirect and may not exactly predict how pavements will respond to heavy aircraft loads, high tire pressures, and elevated temperatures common in airfield environments. Many in the asphalt industry are turning to Balanced Mix Design (BMD), which goes beyond traditional design criteria to focus on how the mixture performs under real-world conditions.

This Airport Asphalt Pavement Technology Program (AAPTP) project evaluated rutting performance tests that can be integrated into a BMD framework for airfield pavements. The objective was to identify reliable and repeatable methods that agencies and contractors can use to verify mixture performance and incorporate them into specifications and acceptance procedures.

Benefits

- Improves rutting performance prediction under airfield loading conditions.
- Reduces maintenance needs and minimizes early deformation in critical pavement areas.
- Provides a clear path from recipe-based design to performance-related specifications.
- Enhances consistency between laboratory predictions and field results.
- Supports mix design strategies that mitigate rutting without increasing cracking potential.
- Enables gradual implementation of performance testing while maintaining existing volumetric controls.

Approach

The research team conducted a multi-step program combining a national practice review, material sampling, laboratory testing, and statistical analysis. First, they documented existing BMD and rutting test practices across state highway agencies to identify methods suitable for airfields. Representative asphalt mixtures were then collected from active airfield projects in multiple states, capturing a range of aggregate structures, binder grades, and production conditions to reflect real construction practices rather than idealized laboratory blends.

The mixtures were evaluated using four rutting test methods: the Asphalt Pavement Analyzer at 100 and 250 psi, the Hamburg wheel-tracking test (HWTT) test, the high-temperature indirect tensile test (HT-IDT), and the ideal rutting test (IDEAL-RT). Results were analyzed for sensitivity, repeatability, and practical implementation, with an interlaboratory study assessing consistency across laboratories. Finally, labora-tory results were compared with observed or expected field rutting under heavy aircraft loads, providing a strong technical basis for selecting test methods and threshold values.

Results

- The rutting performance tests exhibited good sensitivity to asphalt mixture properties, clearly distinguishing mixtures with higher and lower rutting resistance, and correlating well with field performance.
- Depending on available resources and laboratory capabilities, any of the rutting performance tests can be used for asphalt mix design.
- Targeting 7±0.5 percent air voids for test specimens produced consistent results across laboratories and better represented in-place density conditions, including the critical lower-density at joint areas.
- The HWTT rut depth at 5,000 passes showed stronger correlations with field rutting performance and with the other rutting test methods than the measurements at 20,000 passes, minimizing the influence of stripping.
- Performance testing identified mixtures that met volumetric requirements but were still prone to rutting in service, reinforcing the value of incorporating rutting test criteria into mix design and acceptance.
- Rutting performance test criteria were developed to account for environmental conditions, aircraft loading, and specific pavement facility type (e.g., runway, taxiway, apron).
- The strong correlations among rutting performance tests support the use of tests like HT-IDT and IDEAL-RT during production, as they provide faster test results.
- The findings support future updates to Federal Aviation Administration (FAA) P-401 and P-403 specifications to incorporate rutting performance tests for asphalt mix design and acceptance.

Implementation

The project provides practical guidance for agencies and airfield owners to incorporate rutting performance tests into mix design, verification, and acceptance. It outlines feasible test methods, performance thresholds, and a phased rollout focused on critical airfield areas. This approach builds confidence in testing before full specification adoption and advances the readiness of BMD to support FAA and AAPTP goals for safer, more reliable, and cost-efficient airfield pavements.

Download the ***Balance Mix Design: Rutting Performance Tests*** report at: bit.ly/BMDRuttingTests.

Additional Resources

For more details, visit: airportasphalt.com

Watch the AAPTP BMD video: 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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