

0-6674-03: Automated IDEAL Cracking and Rutting Tests

Background

The Texas Departments of Transportation (TxDOT) faces many challenges in the areas of asphalt pavements and laboratory testing, including:

- Cracking and rutting distresses.
- Difficulties in hiring and retaining workforce.
- Laboratory safety concerns to prevent worker injury.

TxDOT has been addressing the cracking and rutting problems by implementing a balanced mix design method to design durable mixes. However, the lack of workforce and workforce skills hinders such efforts. Additionally, the primary safety concern in the laboratory is preventing worker injury often associated with hot asphalt, large masonry saws, high-force testing machines, and toxic chemicals typically found in an asphalt material-testing laboratory. Automation of certain processes is critical to alleviate some of these challenges.

What the Researchers Did

The researchers developed the Asphalt Mixture Automated Testing System with Zero Intervention (AMAZE), shown in Figure 1. The AMAZE includes five units:

- An air voids measurement unit.
- A specimen storage unit.
- Two temperature conditioning units, one for room temperature and the other for high temperature (e.g., 50 °C).
- A material testing loading unit with automated dumping component.
- A robot arm.

The researchers designed and tested each of the five units to ensure that they worked as planned. Furthermore, the researchers evaluated the AMAZE with multiple asphalt mixture specimens in terms of air voids, cracking resistance, rutting resistance, and indirect tensile (IDT) strength.



Figure 1. AMAZE Device.

What They Found

The AMAZE proved to be able to automatically perform four asphalt mixture tests:

- Bulk specific gravity test.
- Ideal cracking test.
- Ideal rutting test.
- IDT strength test.

Accordingly, the AMAZE can automatically measure four essential asphalt mixture properties:

- Air voids.
- Cracking tolerance index (CT_{index}).
- Rutting tolerance index (RT_{index}).
- IDT strength.

The AMAZE has test results for these four essential asphalt mixture properties very similar to results produced by laboratory technicians. For example,

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Figure 2 shows the air voids measurement comparison between the AMAZE and a laboratory technician. The AMAZE with a robot arm has much better repeatability and consistency than laboratory technicians. As Figure 3 shows, the air voids of the seven specimens are almost identical between the two measurements from the AMAZE. In contrast, larger differences are seen between two experienced laboratory technicians for Specimens 1 and 5, shown in Figure 4.

What This Means

The AMAZE can complement laboratory technicians to increase productivity so that it is possible to test material engineering properties during asphalt mixture production at asphalt plants. Consequently, asphalt mixtures with poor engineering properties could be screened out, resulting in better quality and long-lasting pavements in the field.

The repeatability and consistency of the AMAZE-measured air voids highlight the objectivity of the AMAZE operation. The AMAZE-measured test results are objective without human errors and could be used for reference. In such a way, any potential test result disputes between contractors and TxDOT could be minimized.

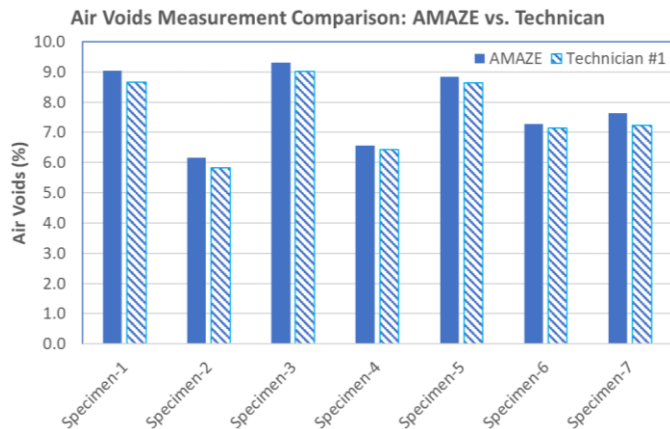


Figure 2. Air Voids Comparison between the AMAZE and a Laboratory Technician.

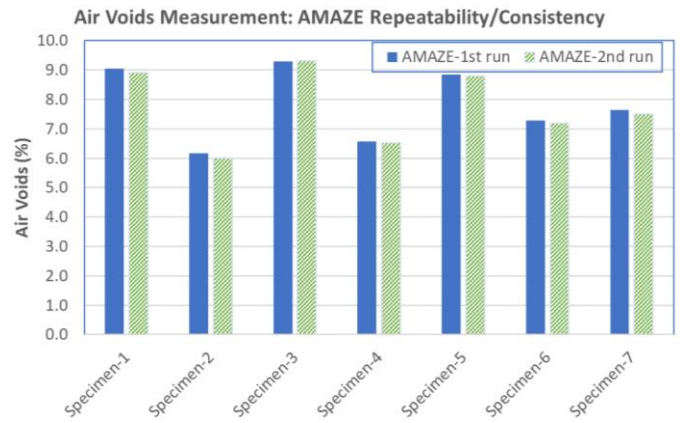


Figure 3. Consistency of AMAZE-Measured Air Voids.

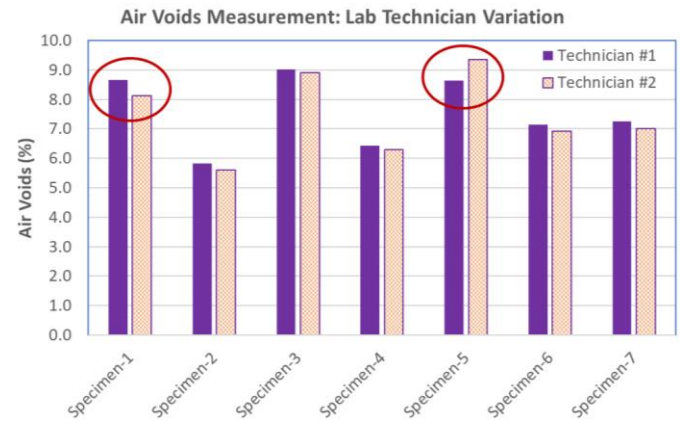


Figure 4. Repeatability of Technician-Measured Air Voids.

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