



Project Summary Report O-4774-S

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Project O-4774: New Technologies and Approaches to Controlling  
the Quality of Flexible Pavement Construction

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## New Technologies for Measuring Pavement Quality

Traditional quality control testing of new pavement layers typically consists of localized random testing of layer density. The Texas Department of Transportation (TxDOT) typically uses the nuclear density gauge to determine these density measurements. Because of regulatory concerns, along with the gap between design and construction created by the practice of designing a pavement based on stiffness and then accepting construction based on density, TxDOT desired evaluation of new test methods that could potentially verify the achievement of design parameters in the field.

In the course of this project, the Project Monitoring Committee (PMC) recommended focus on new full-coverage devices. These devices test

virtually 100 percent of the pavement area.

### What We Did...

Texas Transportation Institute (TTI) researchers began by searching for off-the-shelf technologies that could directly replace the nuclear density gauge. Next, TTI identified spot-specific tests that could potentially measure important properties such as water content, strength, or stiffness. From reviews of literature and testing performed in the field, the researchers selected the devices with the best potential for application to testing pavements. Finally, based upon input from the PMC, TTI focused on development of full-coverage test systems including:

- an instrumentation system utilizing an accelerometer attached to a vibratory roller for measuring

stiffness and uniformity, and

- an infrared temperature bar system, called Pave-IR, that mounts to a paver and measures thermal profiles in real time on asphalt paving projects.

### What We Found...

Unfortunately, no direct replacements for the nuclear density gauge currently exist that generate a density property. Of ten potential spot-test devices, two may be suitable for measuring water content in pavement subgrade and base materials. These devices are the AquaPro moisture probe and the Vertek moisture probe.

Figure 1 illustrates testing with the instrumented roller system. A key advantage of this



system is its ability to mount onto any roller. Field testing with this system revealed:

- The roller drum movements correlate to the quality of support from the foundation layer. Higher roller drum movement indicates a stiffer foundation. This is because the roller drum is not in continuous contact with the surface and essentially “bounces” higher when on a stiffer layer.
- The system can detect weak spots in the foundation layer.
- The roller drum movements did not correlate with density measurements of the upper pavement layers.
- The roller drum movements did correlate with portable falling weight deflectometer (PFWD) and dynamic cone penetrometer (DCP) measurements. [Figure 2](#) graphically illustrates how the displacement of the roller drum tracks with PFWD results along a 300-foot-long test section.

[Figure 3](#) shows the [Pave-IR](#) system installed on a paver. This device provides an effective method to collect a complete view of the thermal profile of the pavement mat and detect potential problem



Figure 1. Field-Testing the Instrumented Roller System.

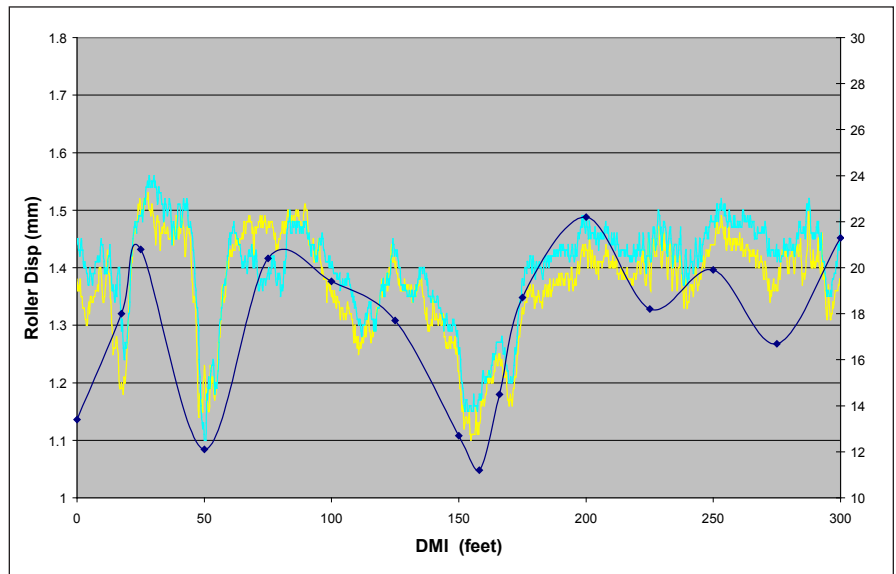


Figure 2. Comparison of Roller Displacement and PFWD Subgrade Modulus (Blue Line, Scale on Right Axis Is PFWD Subgrade Modulus [ksi]).

spots. For example, [Figure 4](#) shows a thermal profile revealing excessively hot transverse locations where the paver burners were left running while the paver was stopped and waiting for more trucks to arrive.

### The Researchers Recommend...

The greatest potential for advances in testing the quality of flexible pavement construction is in the use of the full-coverage devices. These devices are the instrumented





Figure 3. TTI's Pave-IR System Collecting Project Data.

vibratory roller and the thermal imaging system. Both systems can quantify uniformity and detect suspect locations that should be spot-checked for compliance with specifications. TxDOT already has criteria on the allowable temperature differential on paving projects. TxDOT should consider use of the infrared temperature bar as an effective means to conduct thermal profiles on paving projects.

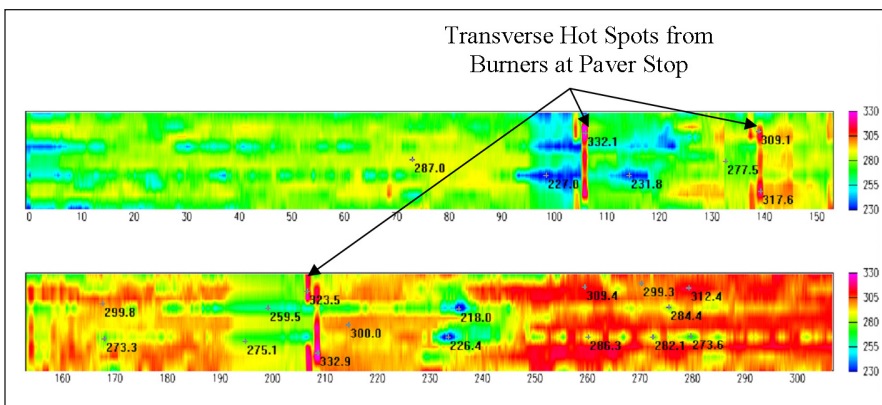


Figure 4. Example Data from Pave-IR.

With the instrumented roller, work currently is underway to identify how to formulate an acceptance specification based on the data. Figure 5 illustrates how this process could work. The section tested could be partitioned into segments of a certain length, and any segment with an average roller drum movement less than the specified limit would be checked for compliance with construction specifications.

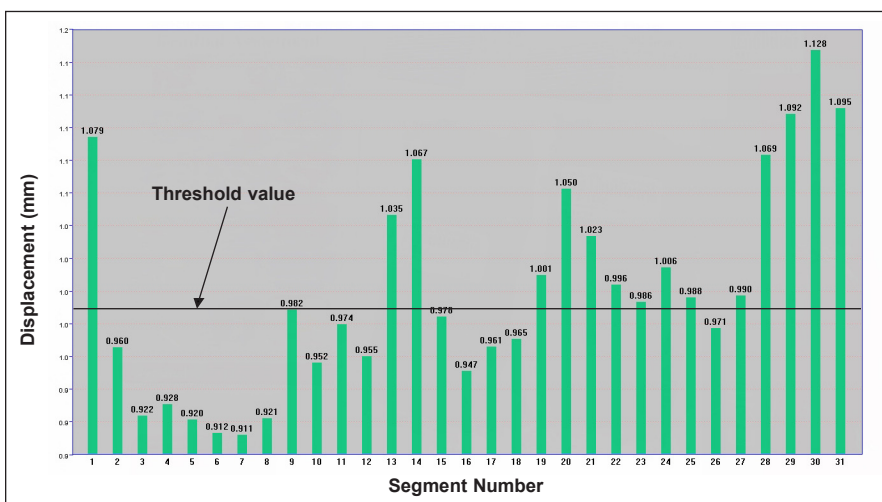


Figure 5. Average Roller Drum Movement (mm) for Each 25-Foot Segment of Test Section.



## For More Details...

Research is documented in [Report 0-4774-1, \*New Technologies for Evaluating Flexible Pavement Construction: Year 1 Report\*](#), and [Report 0-4774-2, \*Field Evaluation of New Technologies for Measuring Pavement Quality\*](#).

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