



Project Summary Report O-4495-S
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Project O-4495: Integration of FWD and GPR
for Pavement Structural Analysis

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Integrating Deflection and Ground Penetrating Radar Data for Pavement Evaluation

The Texas Department of Transportation (TxDOT) has used both falling weight deflectometers (FWD) and ground penetrating radar (GPR) technology for more than 10 years to provide structural information about its pavements. The TxDOT GPR system is shown in Figure 1.

With the current system, GPR data are processed independently of FWD analysis. GPR data are processed with the COLORMAP analysis system, and FWD data are processed with MODULUS 6.0. There is substantial synergy in combining the analysis capabilities of both systems. For example, backcalculation of the layer thickness of the pavement at the location of the deflection data must be input. These data are typically obtained from



Figure 1. TxDOT's GPR System.

either existing plans or limited coring. Inaccurate estimates account for a large source of error in the resulting layer moduli values. In addition to providing more accurate layer thickness information, GPR can identify defects in subsurface layers, such as the presence of deteriorated layers in the hot mix or areas of high base moisture contents.

Both of these defects can be used to explain changes in results from the FWD backcalculation process.

What We Did...

Texas Transportation Institute (TTI) researchers and TxDOT personnel developed a new system for integrating and processing both GPR and FWD data.



TxDOT personnel from the Equipment Branch of the Construction Division developed the integrated data acquisition system. TTI researchers developed the PAVECHECK program to integrate data processing and reporting. A key change in this new system is the adoption of digital video images to replace the standard videotapes used previously to document pavement surface condition. The new software package integrates digital video images with synchronized GPR and FWD data. PAVECHECK can also store and display photos of pavement cores. Using global positioning data, it is possible to display the location of the section under test on a digital map. The complete system provides TxDOT pavement engineers with an excellent tool for diagnosing pavement problems and for assisting in selecting the optimal pavement repair strategy.

The system is provided on a CD. The introductory screen shown in Figure 2 highlights many of the new features of PAVECHECK.

All of the critical data processing features of the current COLORMAP and MODULUS 6.0 data processing packages have been integrated into PAVECHECK. Figure 3 shows a display of the integrated data from one highway. The

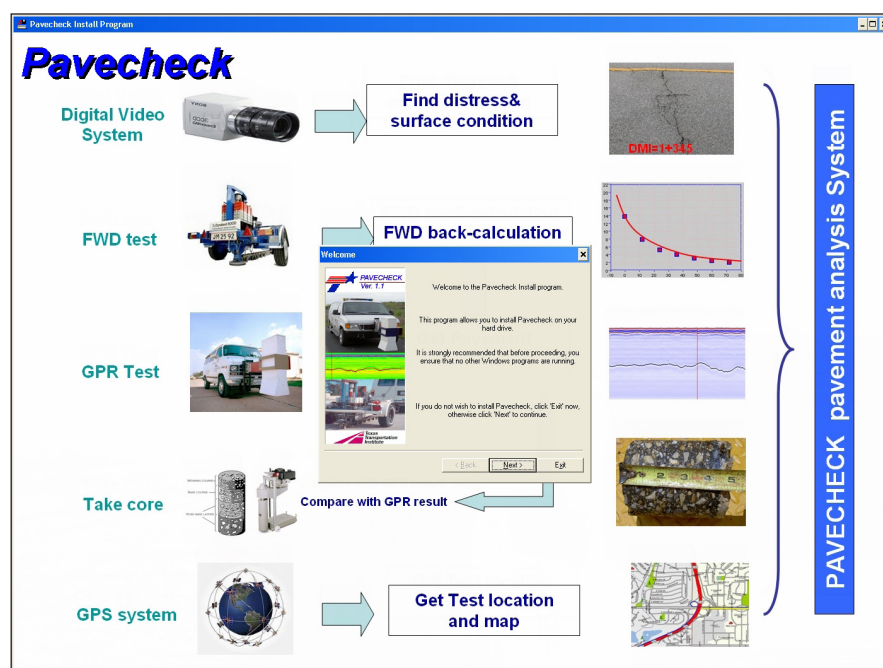


Figure 2. Introductory Screen to PAVECHECK.

lower left box of the figure shows the results of the FWD analysis, including point-specific pavement layer thicknesses and the moduli values computed with the actual thicknesses. The lower right box shows the GPR trace from the FWD test location with the computed thicknesses. The video display is from the same location, and the color display shows a GPR image for the section. The color strip shows the distance scale for the test section on the lower axis in feet, and the red vertical line is the location where the FWD deflection data were taken.

What We Found...

Field testing conducted in this project confirmed the need for an integrated system for performing backcalculation of layer moduli.

On projects tested to date, major changes in all layer thicknesses were found. It is not uncommon for total asphalt layer thickness to vary $\pm 50\%$ from assumed thickness. In some instances it is clear from the GPR data that the pavement structure changed dramatically, typically at locations where full-depth repairs have been made to the pavement.

The use of the integrated tools developed in this project will assist the pavement engineer in selecting homogeneous sections on which to perform structural evaluations.

The Researchers Recommend...

The PAVECHECK program is a powerful analysis tool that



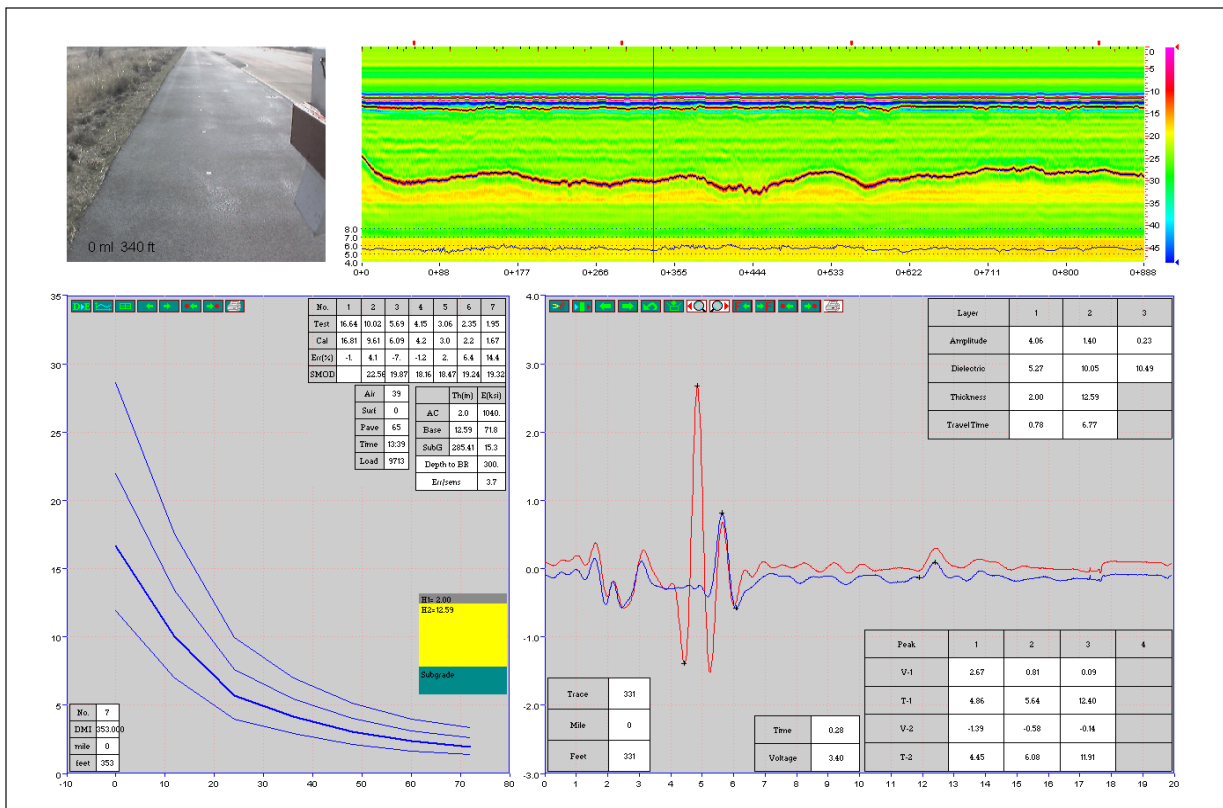


Figure 3. Integrated Display of Pavement Data and Analysis Results.

should be implemented on a statewide basis. Based on the results of the research effort, the following recommendations and implementation strategies are proposed:

- The PAVECHECK program should be thoroughly evaluated on several forensic and rehabilitation projects beyond the scope of this research effort.
- A training session for the PAVECHECK program should be developed.
- Selected TxDOT engineers should be provided training on the PAVECHECK program.
- Feedback from the trained TxDOT engineers should be used to revise and enhance the PAVECHECK program as necessary.
- TxDOT should consider adding the results from the analysis of the PAVECHECK program to its Pavement Management Information System (PMIS). If this task becomes a reality, TxDOT would have the beginning of a pavement layer database. The analysis results would also be available on demand to other engineers within TxDOT over time.



For More Details...

The research is documented in Report 0-4495-1, *PAVECHECK: Integrating Deflection and Ground Penetrating Radar Data for Pavement Evaluation*.

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