PROJECT SUMMARY

Texas Department of Transportation

0-6005: Development of the Total Pavement Acceptance Device (TPAD) and Initial Pavement Studies

Background

The predecessor of the total pavement acceptance device (TPAD) is the rolling dynamic deflectometer (RDD). The RDD was developed by the Center for Transportation Research (CTR) at the University of Texas at Austin (UT) with support from the Texas Department of Transportation's (TxDOT's) research program. The RDD has provided TxDOT with valuable pavement structural condition information for many years from continuous pavement deflection profiles.

During the past 10 years, it was found that RDD deflection profiles can be more effectively used when combined with other nondestructive testing data such as pavement layer thicknesses and subsurface conditions from ground penetrating radar (GPR), pavement right-of-way and surface conditions from a video camera, pavement surface temperatures, and precise distance measurements. It was also found that it is sometimes difficult to integrate these different data sets when they are collected with different equipment at different times.

Based on this experience, it was proposed to build a single piece of equipment that has the capabilities of the RDD, GPR, video cameras, global positioning system (GPS), a pavement surface temperature measurement, and a distance measurement instrument (DMI).

What the Researchers Did

A new, multifunction pavement testing device has been developed by a joint effort between TxDOT, CTR at the University of Texas at Austin, and the Texas A&M Transportation Institute at Texas A&M University (TTI) through TxDOT Research Project 0-6005. This device is called the total pavement acceptance device. The objective of TPAD testing is to nondestructively and nonintrusively investigate the structural conditions of the pavement.

The multi-functions include the following measurement types:

- RDD.
- GPR.
- DMI.
- High-precision differential GPS.
- Pavement surface temperature.
- Digital video of surface and right-of-way conditions.

A photograph of the TPAD is shown in Figure 1.

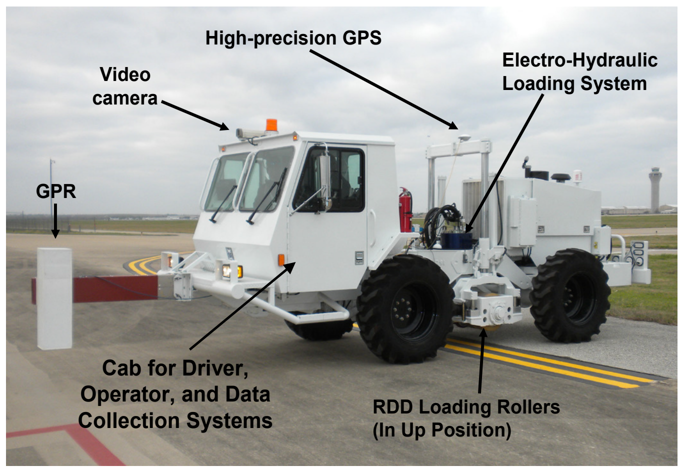

Figure 1. Photograph of the Total Pavement Acceptance Device Preparing to Evaluate a Jointed Concrete Pavement at the TxDOT Flight Services Facility.

Research Performed by:
Center for Transportation Research

Research Supervisor:
Kenneth H. Stokoe II, CTR

Researchers:
Jung-Su Lee, CTR
Boo-Hyun Nam, CTR
Richard Hayes, CTR
Tom Scullion, TTI
Wenting Liu, TTI

Project Completed:
8-31-2012

CTR was responsible for developing the mobile platform and RDD function of the TPAD. Currently, the TPAD has three RDD rolling sensors. Each rolling sensor is composed of a three-wheel cart on which a 2-Hz geophone is attached. This geophone is used to measure dynamic deflections of the pavement created by sinusoidal dynamic loads. The sensors are arranged in a linear array that is oriented along the longitudinal axis of the TPAD. A towing frame is used to position the rolling sensors and pull them along with the TPAD while the TPAD moves along the pavement. The towing frame is designed to minimize the transmission of vibrations from the dynamic loading system through the machine and to the rolling sensors. The towing frame has the potential to be modified so that additional sensors can be incorporated as the need arises.

TTI developed the other TPAD testing functions, GPR, GPS, video cameras, and pavement surface temperature sensor, and integrated all facets of the data collection and processing into one computer system.

What They Found

The performance of the TPAD was tested on three types of pavements:

- A jointed concrete pavement (JCP) at the TxDOT Flight Services Facility.
- A continuously reinforced pavement on US 287 near Wichita Falls, Texas.
- A hot-mix asphalt on US 290 near Houston, Texas.

The findings from the three case studies are as follows:

- The TPAD and data acquisition systems worked well at a testing speed of 2 mph.
- All sensors were operational at a testing speed of 2 mph, but the front rolling sensor performed somewhat poorly compared with the center and rear sensors. This difference seems to be due to chatter created by the front swiveling wheels on the towing frame.
- TPAD continuous deflection profiles provided useful data on all three pavements.
- GPR data are useful in determining the possible causes of the higher deflections and identifying locations where validation coring or additional testing would be beneficial.
- Pavement surface temperature is very important since it can have a large effect on the estimation for load transfer efficiency (LTE) of JCP.
- Uses of the center and rear rolling sensors are a more effective way of estimating the LTE for JCP.

What This Means

The multi-functions of the TPAD enable a robust evaluation of the pavement conditions in a single pass in relatively short time. With the TPAD, the pavement deflections, subsurface conditions, surface temperatures, and profiling distances are simultaneously collected and processed. Besides evaluating the pavement condition in nearly real time, the engineer can also identify additional zones that may require further testing.

For More Information

Project Manager:
Wade Odell, TxDOT, (512) 416-4737

Research Supervisor:
Kenneth H. Stokoe II, CTR, (512) 471-4929

Technical reports when published are available at **http://library.ctr.utexas.edu.**

Research and Technology Implementation Office
Texas Department of Transportation
125 E. 11th Street
Austin, TX 78701-2483

www.txdot.gov
Keyword: Research