Project Summary

Texas Department of Transportation

0-5551: Alternatives Weigh-in-Motion (WIM) Plan for Statewide Data

Background

The strategic plan for establishing a vehicle weight monitoring net across Texas prefers deploying WIM installations on 500-ft continuously reinforced concrete pavements (CRCPs). While these pavements have, from experience, provided suitable stable foundations for WIM sensors, building a short CRCP slab specifically for a WIM is expensive. This project aimed at finding less costly but equally viable alternatives for deploying WIM installations by developing guidelines for finding sections within existing asphalt concrete pavements that provide the level of smoothness, pavement support, and projected service life deemed suitable for WIM sites, particularly for installations that use piezoelectric technology.

What the Researchers Did

Researchers carried out a comprehensive work plan that covered the following tasks:

- a review of current WIM practices, including an extensive literature search and communications with state departments of transportation and equipment manufacturers,
- field and laboratory tests and data analyses to establish guidelines for identifying suitable WIM locations on asphalt concrete pavements,
- investigation of WIM applications of solar power and wireless communications, and design and installation of a wireless setup for an actual Texas Department of Transportation (TxDOT) WIM site,
- installation monitoring of an actual WIM site to document the procedures for placing quartz WIM sensors on asphalt concrete pavements, and
- roundtable discussions to identify user requirements for truck weight data within TxDOT.

What They Found

Researchers note the following findings:

- The review of WIM practices identified that most states use bending plates, load cells, piezoelectric sensors, and Kistler quartz sensors at WIM installations. With respect to the newer quartz sensors, proper installation on pavements that provide adequate support appears to be a key factor in getting good load sensor performance and service life.
- To date, the limited experience with Kistler quartz sensors in Texas has generally been good.
- The review of WIM practices did not identify any new and innovative low-cost WIM sensor that can be recommended for practical use at this time in a state WIM network.
- Tests conducted in this project showed that solar panels provide a viable alternative in the absence of land lines when properly matched with the expected WIM system power requirements. With respect to data communications, researchers concluded that current wireless cellular technology provides the most reasonable alternative to traditional wire line dialup.

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Project Completed: 8-31-08

- The WIM smoothness criteria in the provisional American Association of State Highway and Transportation Officials (AASHTO) MP-14 specification generally produced inconclusive determinations of whether a WIM installation classifies as Type I or not for the TxDOT WIM sites tested in this project.
- Researchers identified the following potential applications of the falling weight deflectometer (FWD) for maintenance of WIM sensors: 1) as a tool to check the linearity of the WIM response to applied loads, and 2) as a tool to check the consistency in the WIM readings from repeat measurements at a given drop height. However, more work is needed before any definitive conclusions can be made for using the FWD to perform checks on existing WIM systems.
- FWD deflections taken on the 500-ft perpetual pavement WIM sections south of Cotulla show the uniformity and degree of pavement support to be comparable to that provided by CRCP. Data from tests conducted with a calibration truck also showed no significant correlation between pavement temperature and measurement errors of gross vehicle weight for the quartz WIM sensors installed on the perpetual pavements at the site.
- The engineering evaluation of the proposed WIM site along US77 in Robstown showed evidence of potential pavement performance problems as reflected in the results of laboratory tests done on cores and the observed premature cracking at the site. The fact that the mix passed the Hamburg test but performed poorly on the overlay tester indicates a need for a balanced mix design based on rutting and cracking criteria.
- Using the guidelines from this project, researchers found an acceptable flexible pavement WIM site located within the limits of a recently completed rehabilitation project along I-10 west of Balmorhea. TxDOT installed a Kistler quartz WIM system on the selected site during this project.
- Based on the roundtable discussions conducted with TxDOT, researchers are of the opinion that the Statewide Traffic Analysis and Reporting System (STARS 2) provides the main opportunity to improve current internal procedures for summarizing and reporting truck weight data. This new program will cover all data procedures and is expected to provide for the traffic-related data needs of various users within TxDOT.

What This Means

Considering the above findings, researchers offer the following recommendations:

- TxDOT should implement the proposed guidelines to locate suitable asphalt concrete pavement sections for WIM installations. Based on the cost for the four-lane Kistler quartz WIM system installed in Balmorhea, four 500-ft CRCP slabs are equivalent to about eight four-lane Kistler quartz WIM systems.
- TxDOT should consider funding a contract to support implementation of the flexible pavement WIM evaluation guidelines as part of its ongoing effort to establish a state highway WIM network. TxDOT should also consider funding a follow-up research project to further investigate the potential applications of the FWD to serve WIM system maintenance and calibration needs.
- TxDOT's Transportation Planning and Programming Division (TPP) should continue its efforts to install cost-effective WIM technology that does not result in degradation of data quality. In particular, technology that performs to standard in asphalt concrete pavements should be encouraged.
- TPP should make efforts to include divisions and sections of TxDOT and other state agencies that use or desire to use WIM data in the development of STARS 2. Close coordination with these entities during development will ensure that user data requirements are addressed.

For More Information:
Deploying Weigh-in-Motion Installations on Asphalt Concrete Pavements

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