



Project Summary Report 1784-S

Project 0-1784: Evaluate Reproducibility of TxDOT FWD Fleet and Recommend Improvements to FWD Calibration Procedure

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A Comprehensive Protocol to Improve Reproducibility of TxDOT Falling Weight Deflectometer Fleet

PROJECT SUMMARY REPORT

The Falling Weight Deflectometer (FWD) device is extensively used by TxDOT to support routine pavement design, to select rehabilitation strategies, to route super-heavy loads, to load zone, and to support other pavement management activities.

The current sixteen-unit FWD fleet of TxDOT is of different vintages, and as such is manufactured from different components. If the fleet is not

reproducible, it will positively or negatively impact the reported quality of a district's pavement condition.

The primary objective of this project was to develop realistic field protocols and specifications, which in a rational manner will allow TxDOT personnel to quantify and improve the reproducibility of the existing and future FWD devices.

What We Did ...

We first established the state of the repeatability

and reproducibility of the FWD fleet. We established that the fleet was repeatable but work was needed to improve the reproducibility.

The second step of the study consisted of identifying the sources for the lack of reproducibility. We instrumented different components of three FWDs and observed their responses under different loading conditions.

Based on the above study, we developed a three-phase calibration protocol.



The new protocol has several practical advantages.

1. The FWD does not have to be disassembled for the preliminary calibration.
2. The impact of the sensor holder on the response of the sensor can be quantified.
3. The variation in calibration parameters as a function of frequency can be developed so that more comprehensive full-waveform analyses can be performed accurately.
4. The developed software provides calibration information shortly after the calibration is over.

As shown in Figure 1, the new protocol contains up to three steps. These steps include:

1. Physical Inspection and component Replacement:

This step includes a thorough check of the electrical and electronic components, replacement of mechanical components, and tune-up of the FWD to minimize excessive trailer movement and to ensure smooth and centered load application.

2. Preliminary Calibration:

In the second step, the deflections and load measured with the FWD are compared with those of well-calibrated sensors embedded in a calibration slab. If the FWD system

passes the calibration process, it would be ready for operation.

3. Comprehensive Calibration:

In this stage the sensors that failed step 2 will go through a thorough calibration to identify whether, the sensor, the sensor holder or the electronic system is contributing to the problem.

We also studied the feasibility of replacing the solid load plates with split plates. We constructed several slabs to simulate rutted and sloped pavements.

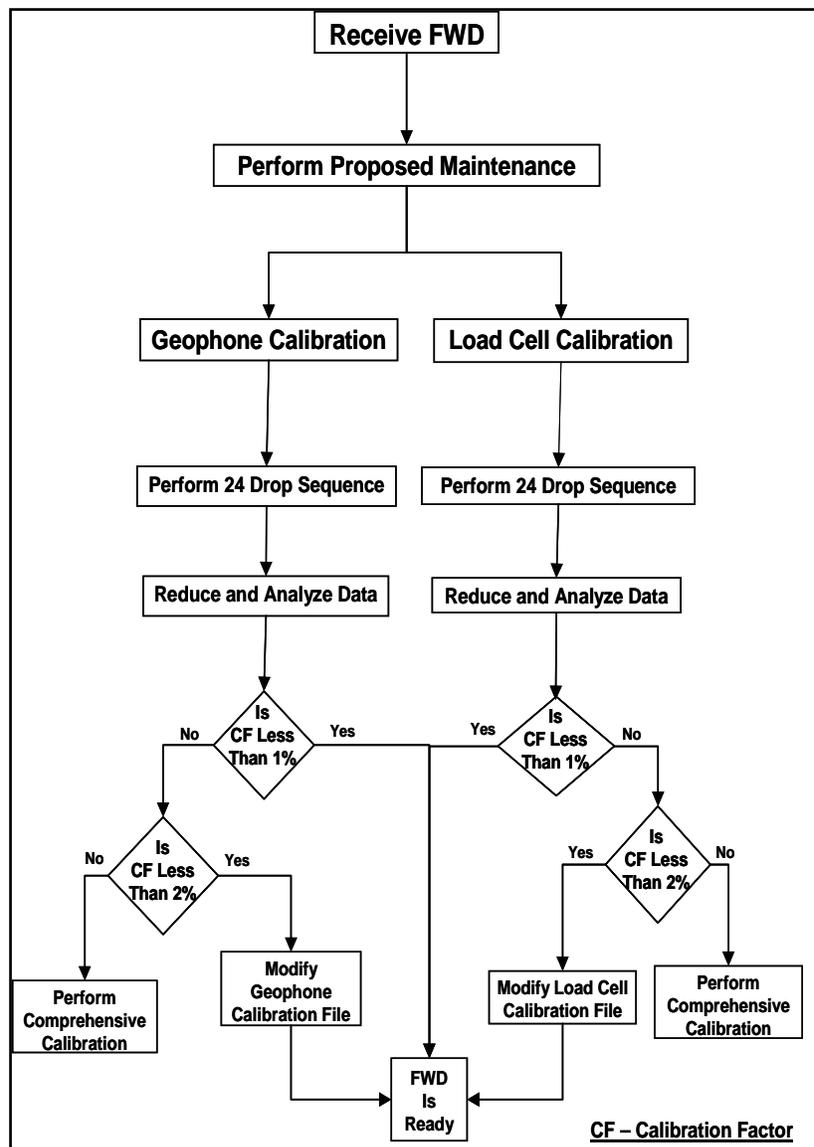


Figure 1 – Flow Chart of New Calibration Process

What We Found ...

We found that the individual FWDs owned by TxDOT are quite repeatable.

The movement of the FWD trailer during the application of the load impacts the reproducibility of the FWD fleet. This movement seems to be a function of the structural design of the trailer, the stiffness and age of the buffers as well as the condition of the components of the geophone holding assembly. The new protocol takes these parameters into consideration.

A preliminary implementation of the protocol in July 2002 using four FWDs demonstrates

that it is quite suitable for improving the reproducibility of the fleet. As shown in Figure 2, in 98% of the cases the sensors provide results that yield reproducibility of better than 5%. Under the old calibration system, only about 70% of the sensors yielded results that were better than 5% reproducible.

We also concluded that FWD devices equipped with split plates impart more uniform load to the pavement. The split plates in general improved the performance of the FWD. However, the deflections measured with the two plates are different. Should TxDOT decide to utilize split load plates, a means of adjusting the

deflections measured with the new configuration to those historically measured with the solid plate should be devised.

The Researchers Recommend ...

The initial implementation of the calibration process demonstrated that the proposed protocols are quite effective in improving the reproducibility of the fleet. We recommend that TxDOT implement the new protocol as soon as possible.

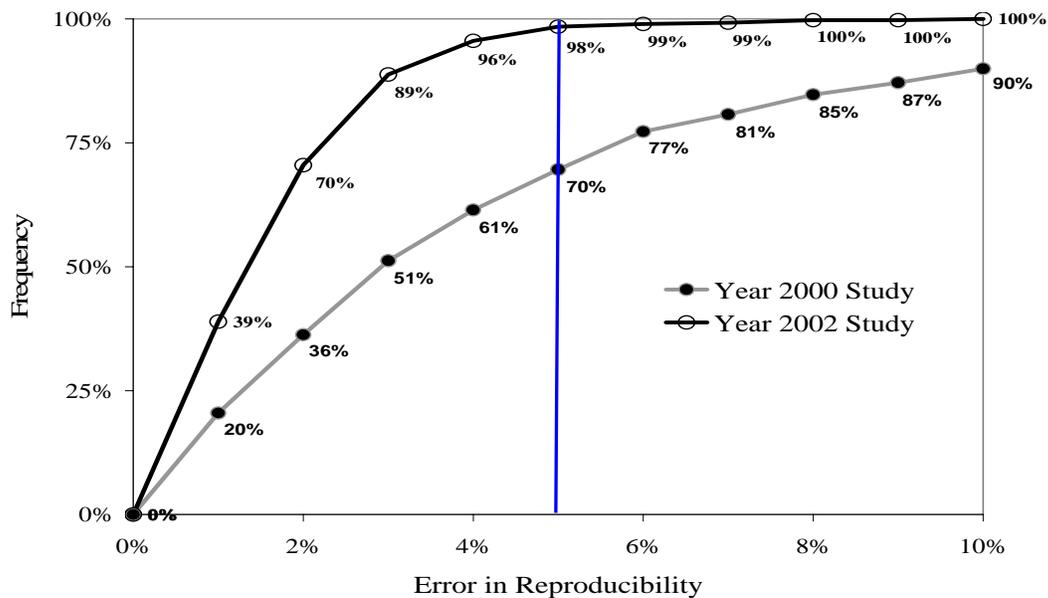


Figure 2 – Comparison of Reproducibility after Original Calibration Process and after Calibration with Proposed Process

For More Details...

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The research is documented in the following report:

- 1784-1 *Reproducibility of Texas Department of Transportation Falling Weight Deflectometer Fleet*
- 1784-2 *A Comprehensive Calibration Strategy for Texas Department of Transportation Falling Weight Deflectometer Fleet*
- 1784-3F *Impact of Load Plate on Response of Falling Weight Deflectometer*

To obtain copies of a report: Center for Transportation Infrastructure Systems
(915) 747-6925, email ctis@utep.edu.

***TxDOT Implementation Status
November 2003***

TxDOT is in the process of implementing the findings of this research project. The new calibration procedures are being implemented at two calibration centers. The first one is located at the Texas Transportation Institute (TTI) and the second is located at the University of Texas at El Paso (UTEP). Training technicians in performing the new calibration procedure is also part of the implementation effort.

For more information contact: Dr. German Claros, P.E., Research and Technology Implementation Office
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Your Involvement Is Welcome!

Disclaimer

This research was performed in cooperation with the Texas Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration. The content of this report reflects the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the FHWA or TxDOT. This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. Trade names were used solely for information and not for product endorsement. The engineer in charge of the project was Soheil Nazarian, Ph.D., P.E. (Texas No. 69263).