TN TDOT Department of Transportation

Research Summary

Evaluation of Traffic Speed Deflectometer for Collecting Network-Level Pavement Structural Data in Tennessee

Project Number:
RES2020-08

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WHAT WAS THE RESEARCH NEED?

Due to the incompleteness of construction history and the resulting inaccuracy of pavement structure value, it is necessary to adopt innovative technologies to obtain accurate network-level pavement structural data in Tennessee. Recent technological advancements have resulted in the development of continuous deflection-measuring devices including the traffic speed deflectometer (TSD). Currently, the stationary Falling Weight Deflectometer (FWD) is the most prevailing method used at the project-level to assess pavement structural conditions. Unlike static measurement devices, the TSD is capable of performing deflection surveys at traffic speeds, which provides a safe and efficient tool for collecting network-level pavement structural data. a detailed comparison of both the FWD and TSD is required to determine the underlying different mechanisms of them.

WHAT WERE THE RESEARCH OBJECTIVES?

The objectives of the research included:

- Develop TSD data collection and analysis guideline(s) for pavement structural evaluation in Tennessee.
- Obtain network-level pavement structural data in Tennessee using the TSD method.
- Develop a methodology for incorporating TSD structural data into TDOT pavement management system.

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WHAT WAS THE RESEARCH APPROACH?

This research project investigated the effect of load magnitude, test temperature, and test speed on TSD deflections, and a practical guideline for TSD data correction and analysis was provided. In addition, a new approach to determine the effective structure number (SN) with TSD measurements was developed by modifying the AASHTO method so that the improved TSD-based SN can be comparable to the existing FWD-based SN records. The viscoelasticity of the asphalt layer and the inertial damping of the structure may lead to a lag between the time when the TSD tire crosses the point and the time when the maximum response occurs. Therefore, there is a lag between the loading point and the point of maximum deflection in the basin, where the maximum deflection occurs after the loading point. The relationship between the TSD deflection lag and phase angle of the asphalt concrete layer was also investigated, and the possibility of estimating pavement conditions from TSD deflection lag was evaluated.

WHAT WERE THE FINDINGS?

The findings included:

- TSD testing is time-efficient, and it is more suitable for network-level pavement evaluation than FWD. The TSD deflection can be used to identify not only weak sections but also weak layers.
- The effects of speed (loading time) and temperature on TSD deflections are equivalent, so the speed effect on pavement responses can be evaluated by the concept of "pseudo temperature."
- There is no significant correlation between TSD deflections and pavement performance. Therefore, the value of the TSD lies in its ability to collect pavement structural information, which is not reliably or adequately captured by pavement performance indicators.

IMPLEMENTATION AT TDOT

Based on the conclusions, recommendations to TDOT include:

- Due to the limited accuracy of the TSD, it cannot accurately measure deflections when pavement deformation is negligible. Therefore, it is recommended to increase the load magnitude of the TSD or to perform TSD testing during the warm season. In addition, periodic validation of the TSD by other devices such as FWD is recommended for quality control.
- TSD deflections be corrected to the same reference level before performing any analysis. The recommended reference load magnitude, temperature, and speed are 82.2 psi, 20°C, and 40 mph, respectively.
- Collect additional and more representative TSD data to calibrate the thresholds of Deflection Bowl Parameters.

MORE INFORMATION

Find the final report here: https://www.tn.gov/content/dam/tn/tdot/long-range-planning/research/final-reports/res2020-final-reports/RES2020-08_Final_Report_Approved.pdf.

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