Transportation Consortium of South Central States

Simplified Approach for Structural Evaluation of Flexible Pavements at the Network Level

Key Points

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Tran-SET
University of Texas, Arlington
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$183,699

Brief Project Description

Currently, there is no simple procedure available to identify structurally weak pavement sections using Falling Weight Deflectometer (FWD) data at the network (e.g., city, state, county) level. The current methods are either too complex to be applied at the network level or require detailed parameters that are not usually available or commonly collected by transportation agencies. A simple method is needed to determine the structural condition of pavement sections that can be directly implemented and automated in the current pavement databases. The purpose of this research study is to develop a simple analysis method to determine the structural condition of pavements using currently available non-destructive testing (NDT) deflection measurement devices at the network level that can be directly implemented and automated in the database of a typical transportation agency (such as Texas Department of Transportation [TxDOT]). In addition, this proposed study aims to run an advanced three-dimensional (3D)-Move simulation analyses to mimic the FWD deflection bowl obtained from the field in an effort, for the first time, to reduce the need to run extensive FWD testing on the network level. The proposed project will produce a more robust, but simple and practical, methodology for the structural capacity evaluation for flexible pavements at the network level.

Problem Statement

Many state and overseas DOTs collect nondestructive (NDT) deflection testing data at the network level to identify weak pavement sections that would require further analysis at the project level. NDT equipment used include Falling Weight Deflectometer (FWD), Deflectograph, Traffic Speed Deflectometer (TSD), and others. In these devices, a load is applied on the pavement surface and the deflections at several lateral locations are recorded. Back-calculation has been used to estimate layer moduli and determine overlay thickness at the project level. However, the use of the back-calculation technique at the network level is complicated and time consuming. In addition, it requires the knowledge of layer thicknesses which are not commonly collected at the network level, making this technique not practical for the network level assessment. Currently, there is no simple procedure available to identify structurally weak sections using data obtained from the NDT deflection measurement devices at the network level. A huge

amount of NDT data available at various transportation agencies has not been utilized because of the lack of an automated method of analysis. In fact, some state Departments of Transportation (DOT), such as TxDOT, used to collect NDT data at the network level, but stopped doing so because of the lack of a simple method to analyze the data. An innovative method is needed to determine the structural condition of pavement sections at the network level that can be directly implemented and automated in the agency's database. The method needs to be simple enough to be used with a huge network deflection data for the purpose of numerically ranking pavement sections at the network level from very strong to very weak.

Objective

The proposed research study aims to achieve the following objectives:

(1) Introduce new comprehensive pavement layer deflection and deflection bowl area parameters which are based on the entire FWD deflection bowl rather than one single deflection point.
(2) Use 3D-Move pavement analysis software package to simulate field-measured FWD deflection bowl in order to limit the need to perform extensive FWD field testing on the network level
(3) Predict the number of traffic loading cycles to failure (e.g. fatigue) based on the measured strain at the bottom of the HMA layer and relate that to the predicted strain, and therefore number of cycles to failure, from 3D move analysis package
(4) Develop a scoring system to rank the strength of the pavement sections without the need to run an FWD testing.
(5) Relate the developed deflection and deflection area parameters to field measured distresses such as fatigue, rutting, and roughness.

Intended Implementation of Research

The proposed approach will not require any additional resources or testing to be implemented by various transportation agencies. The deflection data that are commonly collected by the DOTs will be utilized in this approach. Therefore, the proposed methodology has a great potential to be easily transferred to practitioners at the state level (e. g., engineers, technicians, etc.).

Anticipated Impacts/Benefits of Implementation

This simplified approach will provide a more robust methodology for the structural capacity evaluation for flexible pavements at the network level. The current methods are either too complex to be applied at the network level or require detailed parameters that are not usually available or commonly collected by transportation agencies. This idea of analysis will provide a more reliable assessment of the actual structural condition of the highway network. This will help the department of transportation officials to have clearer view of the state of the network, therefore, they can have more accurate estimation of the required funds to maintain the highway network at a certain level. Thus, better management and allocation of the resources can be made. With this approach, more informed decisions about the most suitable maintenance and rehabilitation strategies can be made.

Weblinks:

- Tran-SET's website(http://transet.lsu.edu/completed-research/)

- TRB's Research in Progress (RIP) database (https://rip.trb.org/view/1467335)