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Implementation of Rolling Wheel Deflectometer (RWD) in PMS and Pavement Preservation

INTRODUCTION

Evaluation of pavement structural capacity and integrity is an important component of the Pavement Management System (PMS) to assist in the selection of suitable maintenance and rehabilitation strategies. The falling weight deflectometer (FWD) is a non-destructive deflection testing method that is widely used at the project-level to assess the structural capacity of in-service pavements. However, issues such as expenses involved in data collection and scarcity of resources appear to present obstacles for a wide adoption of FWD for pavement testing at the network level. In addition, delays due to lane closures may compromise the safety of the traveling public and highway workers, which may not justify the worth of the collected data. The rolling wheel deflectometer (RWD), which measures deflections at highway speeds, was introduced to support existing non-destructive testing techniques by providing for a screening tool of structurally deficient pavements at the network level. RWD testing does not cause traffic disruption or decreased safety along the tested highway. This nondestructive testing (NDT) device also offers the potential of characterizing the structural capacity and integrity of the pavement network in an effective way in terms of time and cost associated with the testing process.

OBJECTIVE

The ultimate goal of this study was to conduct a detailed field evaluation of the RWD system in Louisiana. Through this evaluation, the repeatability and the effects of testing speeds on RWD measurements were quantified. In addition, the relationship between RWD and FWD deflection measurements and pavement conditions was investigated. Based on the data collected, this study developed and validated a direct and simple model for determining a pavement structural number (SN) using RWD deflection data.

While a number of states have evaluated the RWD system at highway speeds, the reported experimental program was exclusively designed to quantify deflections' repeatability and to compare data collected at different truck speeds including measurements conducted at low speeds. In addition, this study was the first program conducted using a newly installed laser deflection system that provides higher accuracy.

SCOPE

The proposed research activities were divided in two phases. In the first phase, RWD and FWD measurements were collected, and measurements were used to assess the repeatability and characteristics of RWD measurements and the effect of test speed on the measured deflection. In the first phase, a relationship between FWD deflection data and RWD measurements was also established. In the second phase, an analysis scheme was developed for using RWD measurements as a tool to identify structurally deficient pavements. Based on RWD measurements, SN- and RWD index- (RI-) based GIS maps were developed to identify structurally deficient pavements and to assess the overall condition of the pavement structure.

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PRINCIPAL INVESTIGATOR:

Mostafa A. Elseifi, Ph.D., P.E.

LTRC CONTACT:

Zhongjie "Doc" Zhang, Ph.D., P.E.
225-767-9162

Louisiana Transportation Research Center

4101 Gourrier Ave
Baton Rouge, LA 70808-4443

www.ltrc.lsu.edu

METHODOLOGY

A comprehensive field testing plan was conducted for collecting RWD and FWD measurements on selected flexible and surface treatments (i.e., chip seal) pavement test sites in District 5. Testing was coordinated through the PMS division of DOTD. Selected test sites were representative of the pavement network in Louisiana in terms of pavement classification, design, and conditions. All sections were asphalt-surfaced, since the use of the RWD on concrete pavement surfaces has not been validated. However, composite sections with a concrete layer underneath the asphalt surface were included to evaluate RWD use for such pavement types. To assess the effects of vehicle speed on the measured deflection, RWD testing was conducted on the test sections at different speeds (e.g., 20, 30, 40, 50, and 60 mph). FWD tests were conducted at the same time of RWD testing on the outer wheel path. Temperature was recorded in conjunction with each test. To assist in the analysis, pavement designs of the selected sites were obtained using cores and by reviewing construction documents. In addition, the test plan included supportive measurements, such as roughness, pavement temperature, and a distress survey for the selected sites. Based on the data collected and analysis presented in this study, a model was developed to predict the pavement structural number from RWD measurements. The objective of this model is to serve as a quick and simple screening tool at the network level to identify structurally deficient pavements.

Based on the results of the experimental program and to minimize the effects of truck vibrations on the measured deflections, an average interval 0.1 mile was used. This corresponds to the average of 10,728 individual readings for each 0.1-mile test interval. Repeatability of RWD measurements was acceptable with an average coefficient of variation (COV) at all test speeds of 15 percent. The influence of the testing speed on the measured deflections was minimal. The scattering and uniformity of FWD and RWD data appear to closely follow the conditions of the roadway. Both test methods appear to properly reflect pavement conditions and structural integrity of the road network by providing for a greater average deflection and scattering for sites in poor conditions. RWD deflection measurements were in general agreement with FWD deflections measurements; however, the mean center deflections from the RWD and the FWD were statistically different for 15 of the 16 sites. A model was developed to estimate pavement SN, based on RWD deflection data. Although the SN expression developed is independent of the pavement thickness and layer properties, it provides promising results as an indicator of structural integrity of pavement structure at the network level.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the experimental program, it was determined that the repeatability of RWD measurements was acceptable and the influence of the testing speed on the measured deflections was minimal. Based on the RWD evaluation conducted in District 5, the research team recommends extending the use of RWD to the other districts in Louisiana. The rolling wheel deflectometer index is recommended to be adopted on a provisional basis by DOTD PMS as a network structural analysis index with three categories: thin pavements less than 3 in. thick, medium pavements between 3 in. to 6 in., and thick pavements greater than 6 in. It should be incorporated into the PMS system and placed on GIS maps.

The structural number (RWD) equation should be considered valid and used as a tool to evaluate the structural condition of pavements for network purposes with similar categories as the RI. The PMS section will incorporate the SN values in their process using trigger values outlined in the report. If the PMS section considers the new index to be of significant value, then another district will be assessed with the RWD.

A follow-up study is recommended to validate and modify the developed model, if needed, based on independent data collected in the other districts. The proposed testing protocol should also be evaluated based on independent data. Once district assessment has been completed, the three categories (thin, medium, and thick) should be refined into new groups such as (< 3 in., 3 to 5 in., 5 to 7 in., etc.) based on data from other districts under a new research project. A separate assessment group should also be created for surface treated roadways.

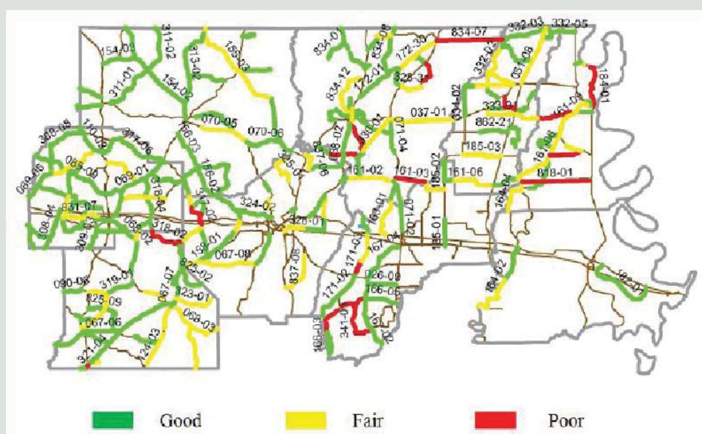

Figure 1
Road conditions in District 5 of Louisiana using SN model