Michigan Department of Transportation
RESEARCH Administration

RESEARCH SPOTLIGHT

Project Information

REPORT NAME: Testing Protocol, Data Storage, and Recalibration for Pavement-ME Design

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PROJECT COST: $224,000

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Refining data and tools to design cost-effective, sustainable pavement

Pavement design software supports engineers across the country in designing long-lasting pavement. Software models depend on information about pavement materials, construction and other variables to accurately predict pavement performance against varying traffic and climate conditions. New data, representative of Michigan-specific conditions, is now factored into the Michigan Department of Transportation (MDOT) pavement designs. Protocols and guidance for sampling and testing materials, storing and maintaining needed data, and calibrating design software models will help ensure the agency continues to design sustainable pavement.

PROBLEM

Mechanistic-empirical (ME) pavement design software from the American Association of State Highway and Transportation Officials (AASHTO) predicts the structural response of asphalt and concrete pavements to different traffic loadings, climate conditions, pavement materials, and other variables to evaluate the appropriate thickness of pavement layers. The design model, however, needs appropriate data inputs to characterize pavement performance across a range of conditions.

In addition to representative data, adequate calibration of the software's models increases the accuracy of the predictions. To ensure the design tool performs in the context of Michigan's climate and conditions, the models need to be calibrated using actual pavement performance, traffic and other data from Michigan roads. While MDOT's pavement management system (PMS) contains pavement performance data, other factors, such as construction methods, materials and climate, determine pavement response over time.

Localized data inputs and a new framework in pavement design models allow MDOT to more accurately predict pavement performance.

(continued)

"This is one of the most advanced pavement ME design research projects in the nation. The findings will help us improve the performance and cost-effectiveness of our pavements."

Justin Schenkel, P.E.
Project Manager

Current ME pavement design is based on data from older pavement segments and could provide updated performance information. MDOT wanted to identify the best available data for calibrating the pavement design model to most accurately represent Michigan roads. Selecting a representative sample of pavement segments as data sources and developing methods to store and maintain the data to track pavement performance will support robust and cost-effective pavement design.

RESEARCH

A review of local calibration efforts in other states to adequately predict different stresses of asphalt and concrete pavement illustrated the challenges related to the implementation of pavement design: the complexity of the design software, identification of and access to the most appropriate data and calibration of local conditions. Previous work on MDOT's pavement ME processes and similar studies by other state departments of transportation allowed researchers to prioritize the most helpful information affecting pavement performance to serve as data inputs for model calibration.

Choosing a sufficient number of pavement projects to supply new data included reviewing MDOT project lists, considering segments that supported the previous calibration effort and identifying a range of pavement ages. Over 300 projects were identified as representative of Michigan's pavement design, materials, construction practices, and performance. The pavement segments were also geographically diverse; varied in traffic volumes; and had adequate available data, including information on pavement cross sections.

Various statistical techniques allowed the research team to locally calibrate the models and evaluate the effect of calibration on pavement design. These results were compared to those produced with the default national calibration to assess differences and relative improvements of the models. Databases and tools that MDOT currently uses for storing and maintaining pavement materials, and construction and performance data were also evaluated.

RESULTS

The model calibrated with local, updated performance and other data produced significantly more accurate pavement distress predictions than the nationally calibrated model, particularly for bottom-up cracking, rutting and the International Roughness Index. An eight-step guide provided instruction for performing local calibration, including a summary of data inputs and sources. Data required for local calibration included MDOT's PMS data, pavement cross-section information, inputs for traffic, construction materials, and climate.

Identifying data inputs, sampling practices and testing material, and comparing field and laboratory testing led researchers to develop protocols for nondestructive in situ material sampling and testing frequency. Obtaining data during and after pavement construction is crucial to document as-constructed material properties.

New data from this effort, including traffic, hot-mix asphalt and other material properties, and climatic data, significantly expanded MDOT's pavement ME database. Researchers also added data from previous calibration efforts and guided the selection of new pavement construction projects to include in the database, ensuring a robust tool for future calibration efforts.

IMPLEMENTATION

MDOT is already sharing calibration results and exploring how the model identifies the best-engineered pavement cross sections to improve cost-effectiveness and increase sustainability. Once the agency and its pavement design and construction partners are satisfied with the model's performance, the *Michigan DOT User Guide for Mechanistic-Empirical Pavement Design* will be updated. Additional research may include a focus on standardizing a process for pavement rehabilitation.

Research Administration

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