

Fitting Traffic Data into Mechanistic-Empirical Pavement Design

Like other state transportation agencies, Michigan DOT is carefully evaluating the Mechanistic-Empirical Pavement Design Guide (MEPDG), a recently developed design tool. MEPDG combines engineering mechanics and performance data to design pavements for given materials, traffic and climate. To complement recent Michigan DOT research that looked at construction materials as input values to MEPDG, the agency needed to consider traffic as another critical design factor.

Problem

Current Michigan DOT pavement design is based on the commonly used 1993 American Association of State Highway and Transportation Officials method, which uses equivalent single axle loads (ESALs) to characterize traffic for calculating required pavement thickness. The new MEPDG methodology uses axle load distributions rather than ESALs to characterize traffic in its design calculations. Michigan DOT needed to look at a range of traffic parameters and determine their influence on asphalt and concrete pavement design using MEPDG.

Approach

For any input parameter, MEPDG can use one of three levels in its calculations: a state average (level 3), a regional average (level 2) or project-specific values (level 1). Using level 1 data is ideal, but such data can be expensive and costly to obtain if not already available. Level 3 data is the easiest to obtain, but is also least likely to represent the conditions of a specific project. The difficulty and expense of getting level 2 data are typically greater than level 3.



Michigan DOT engineers received an introduction to the mechanistic-empirical pavement design approach as well as hands-on software training.

A key part of this research was the analysis of several traffic parameters to determine their influence on the results of MEPDG design. The traffic parameters included *monthly distribution factor, hourly distribution factor, truck traffic classification, axle group per vehicle* and *axle load distribution* for different axle configurations. Whenever actual weight station (level 1) data is unavailable, parameters with significant impact on MEPDG design would require level 2 inputs, and parameters with little effect on MEPDG design would only require level 3 inputs.

Research

Researchers from Michigan State University used weight and classification data from 44 weigh-in-motion and classification stations located in the state to develop level 1, 2 and 3 inputs. The project employed extensive sensitivity analyses to determine which parameters have the most significant effect on

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Project Information

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MEPDG design outcomes. Researchers also performed a distribution analysis of the state's weigh-in-motion stations to determine if the state's network of stations will sufficiently capture required traffic data.

“Getting a handle on traffic factors provides another piece of the equation as Michigan DOT continues to assess MEPDG.”

*Michael Eacker, P.E.
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Results

The study showed that the impact of traffic input parameters to MEPDG varies both by parameter and by pavement type.

- *Truck traffic classification and tandem axle load distribution* have a significant impact on predicted pavement performance, and researchers recommend using level 2 inputs to MEPDG for these parameters when level 1 data is unavailable. On the other hand, *monthly distribution factor, axle group per vehicle and single, tridem and quad axle load distributions* have negligible impact, so level 3 inputs to MEPDG are sufficient in the absence of level 1 data.
- The influence of *hourly distribution factor* varies by pavement type. This factor significantly impacts concrete pavement performance, so level 2 is recommended, but it has negligible impact on asphalt pavement, so level 3 is appropriate.

In its study of weigh-in-motion stations, researchers determined that the distribution in the state is about right, and they recommended just a few additional weigh-in-motion sites to round out the network.

Value

Michigan DOT continues to evaluate the benefits of MEPDG: How does it compare to the state's current methodology? Can the agency afford the costs of implementation? Knowing the degree of detail required for input values for MEPDG will make a big difference for the agency as it continues its assessments.

In the meantime, Michigan DOT continues to expand its staff members' knowledge of MEPDG. Working from the results of this research project as well as the project "Evaluation of the 1-37A Design Process for New and Rehabilitated JPCP and HMA Pavements" (www.michigan.gov/documents/mdot/MDOT_Research_Spotlight_Implementing_MEPDG_298420_7.pdf), Michigan State University developed and conducted a class for pavement engineers based in Lansing and across the regions. The day-and-a-half session held in March 2010 introduced participants to the concept of mechanistic-empirical design and provided hands-on experience in using the MEPDG software. Providing this information and know-how will further help in the agency's ongoing evaluation process of this design method. ■

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