



TECHNICAL SUMMARY

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IMPLEMENTATION PROJECT COST:

\$292,385



An MEPDG software input screen for specifying asphalt layer thickness in inches.



RESEARCH
SERVICES SECTION

Putting Research into Practice: Calibrating the MEPDG for Minnesota

What Was the Need?

Traditionally, pavement design methods have been based on a limited amount of performance data acquired in the 1950s through road tests sponsored by the American Association of State Highway and Transportation Officials. As pavement materials and highway loads have changed, these methods have become less accurate for predicting the performance of a pavement over its design life.

To address this problem, AASHTO and the National Cooperative Highway Research Program developed the [Mechanistic-Empirical Pavement Design Guide](#) in 2002. This manual and accompanying software employ a design methodology grounded in engineering mechanics and validated with extensive road test performance data, providing engineers with distress models for predicting the structural and functional performance of various types of flexible and rigid pavements. By inputting traffic, climate and materials data, engineers can use these models to estimate how much damage will accumulate in a given pavement over a specified period of time. To be used accurately, however, these models must be calibrated to local conditions in every state.

What Was Our Goal?

The objective of this implementation effort was to calibrate the most current NCHRP mechanistic-empirical design procedure to conditions in Minnesota by:

- Developing guidelines for major input parameters, including traffic, material properties and subgrade characterization.
- Performing a comprehensive sensitivity analysis and identifying deficiencies in MEPDG software.
- Comparing its predictions to those of MnPAVE (Minnesota's mechanistic-empirical pavement design software) and Mn/DOT's current design standard.

What Did We Implement?

This project was an implementation of the Mechanistic-Empirical Pavement Design Guide. This undertaking was informed by recent Mn/DOT and Local Road Research Board efforts, including report [2008-23](#), "Effects of Seasonal Changes on Ride Quality at MnROAD," a project to update [MnPAVE](#) (LRRB INV 828), and other recent projects.

How Did We Do It?

For rigid pavements, investigators examined faulting, cracking and International Roughness Index models. For flexible pavements, they evaluated rutting, alligator cracking, transverse cracking and IRI models.

Investigators began by developing recommendations for the default Minnesota values of MEPDG inputs for both rigid and flexible pavements, including traffic information and material properties. These inputs were obtained using performance data from MnROAD concrete and asphalt pavement test sections, and materials test data from Mn/DOT databases.

Investigators then conducted a sensitivity analysis to evaluate how the performance predicted by distress models using these default inputs compared with expected predictions for Minnesota, as well as how dramatically the predicted performance changed in response to changes in design inputs.

Finally, investigators recalibrated MEPDG models to reduce the difference between predicted and measured performance.

continued

“We made significant progress in helping AASHTO debug its MEPDG software, which will increase the accuracy and usability of future versions.”

–Jerry Geib,
Mn/DOT Pavement
Design Engineer

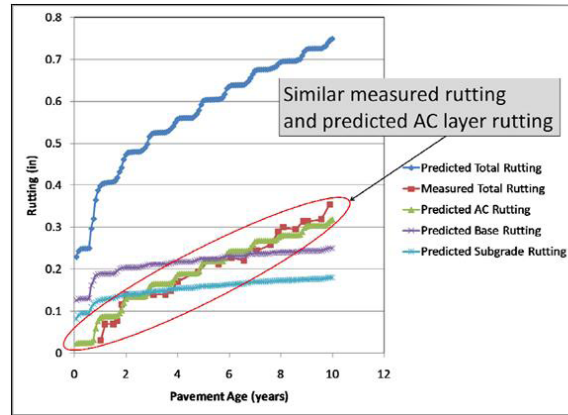
“Since the MEPDG won’t be deployable soon, Mn/DOT and LRRB are continuing to work on improved design methods and tools, especially for improved rehabilitation strategies such as overlays and reclamations.”

–Maureen Jensen,
Minnesota Road
Research Manager

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A comparison of the MEPDG models with MnROAD forensic studies showed that while these models are fairly accurate in predicting rutting in the asphalt layer, they significantly overestimate subgrade and base rutting.

What Was the Impact?

Investigators successfully recalibrated most models for Minnesota conditions, reducing the MEPDG bias and error in design predictions for both rigid and flexible pavements.

For rigid pavements, investigators found that MEPDG statistical analysis verified the trends observed in cracking and faulting charts, and recommend implementing the MEPDG for rigid pavements using the modified cracking model coefficients developed during recalibration. The most important parameters identified for control of the level of both cracking and faulting were traffic volume, slab thickness, base thickness and coefficient of thermal expansion.

Some parameters appeared to affect cracking and faulting differently. A change in the flexural strength of the concrete significantly affected the level of cracking, but did not cause a significant change in faulting. Dowel bar diameter dramatically affected the level of faulting, but did not affect the percentage of cracked slabs. Finally, the effect of supporting layer strength had an insignificant effect on both cracking and faulting.

For flexible pavements, investigators found numerous issues with MEPDG models, including inaccuracies and software problems related to MEPDG subgrade characterization, stabilized base characterization, asphalt binder characterization and climate inputs. While investigators recommend using the modified rutting model and the modified coefficients for the alligator cracking and thermal cracking models developed in this study, they do not recommend using the MEPDG longitudinal cracking and IRI predictions for flexible pavements.

What’s Next?

AASHTO is expected to sponsor a significant upgrade to the MEPDG software during the next several years; future work will be needed to validate this upgrade and recalibrate its distress models for Minnesota conditions. The current software version, with proposed model adjustments, should be used only for pilot evaluations of the MEPDG. It may be years before full implementation of the MEPDG can occur; Mn/DOT and LRRB are working to fully deploy the design tools and methods already available to local agencies.

This Technical Summary pertains to the LRRB-produced Report 2009-06, “Implementation of the MEPDG for New and Rehabilitated Pavement Structures for Design of Concrete and Asphalt Pavements in Minnesota,” published January 2009. The full report can be accessed at <http://www.lrrb.org/PDF/200906.pdf>.

The research being implemented via this project is the 2002 Mechanistic-Empirical Pavement Design Guide, available at <http://www.trb.org/mepdg/guide.htm> (see <http://ntlsearch.bts.gov/tris/record/tris/01123422.html> for the 2008 MEPDG Manual of Practice). More information about Mn/DOT’s MEPDG efforts can be found at <http://www.dot.state.mn.us/materials/pvmtdesign/mepdg.html>.