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RESEARCH PROJECT TITLE
Iowa Calibration of MEPDG Performance Prediction Models

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PRINCIPAL INVESTIGATOR
Halil Ceylan, Associate Professor
Civil, Construction, and Environmental Engineering, Iowa State University
515-294-8051
hceylan@iastate.edu

CO-PRINCIPAL INVESTIGATORS
Sunghwan Kim, Research Assistant Professor
Iowa State University

Kasthurirangan Gopalakrishnan, Research Assistant Professor
Iowa State University

FOR MORE INFORMATION
www.instrans.iastate.edu

Institute for Transportation
Iowa State University
2711 S. Loop Drive, Suite 4700
Ames, IA 50010-8664
515-294-8103

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tech transfer summary

A previously completed research study in pursuit of MEPDG implementation in Iowa indicated the need for local calibration of MEPDG performance prediction models by taking into account local materials, traffic information, and environmental conditions.

Background

The latest AASHTOWare® DARWin-ME™ (now referred to as Pavement ME Design), and the Mechanistic-Empirical Pavement Design Guide (MEPDG) (AASHTO 2008) are significantly improved methodologies for the analysis and design of pavement structures. DARWin-ME™ builds on the research-grade MEPDG software version with additional key enhancements.

The national calibration-validation process was successfully completed for MEPDG. Although this effort was comprehensive, further calibration and validation studies in accordance with local conditions were highly recommended by the MEPDG as a prudent step in implementing a new design procedure that is different from the current procedures.

Problem Statement

The performance models used in the MEPDG are nationally-calibrated using design inputs and performance data largely from the national Long-Term Pavement Performance (LTPP) database. The LTPP database used for national (global) calibration of MEPDG does not include hot-mix asphalt (HMA) pavement sections and only one type of portland cement concrete (PCC) pavement section that is used in Iowa.

In addition, a previously completed research study by the authors in pursuit of the MEPDG implementation initiatives in Iowa indicated the need for local calibration of MEPDG performance prediction models by taking into account local materials, traffic information, and environmental conditions.

Objective

The primary objective of this research is to improve the accuracy of MEPDG pavement performance predictions for Iowa pavement systems through local calibration of MEPDG performance prediction models (latest research-grade version).

Research Methodology

Based on a comprehensive literature review, the following procedure was adopted for the local calibration of the MEPDG performance predictions in consultation with Iowa Department of Transportation (DOT) engineers:

Step 1: Select typical pavement sections around the state.

Step 2: Identify available sources to gather input data and determine the desired level for obtaining each set of input data.

Step 3: Prepare an MEPDG input database from available sources including the Iowa DOT Pavement Management Information System (PMIS), material testing records, design database, and research project reports relevant to MEPDG implementation in Iowa.

Step 4: Prepare a database of performance data for the selected Iowa pavement sections from the Iowa DOT PMIS.

Step 5: Assess local bias from national calibration factors.

Step 6: Identify local calibration factors (sensitivity analysis and optimization of calibration factors).

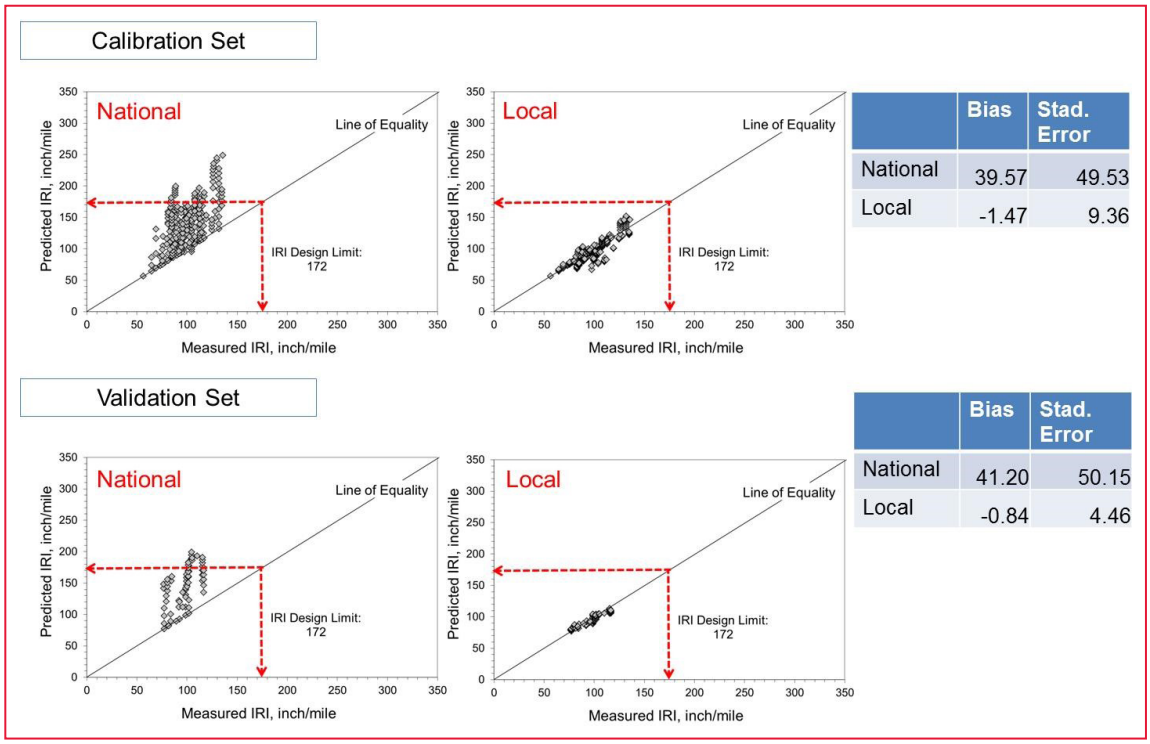
Step 7: Determine adequacy of local calibration factors.

A total of 35 representative jointed plain concrete pavement (JPCP) (rigid pavement) sections, 35 representative HMA (flexible pavement) sections, and 60 representative HMA over JPCP (composite pavement) sections were selected for this study.

The local calibration factors of MEPDG prediction models were identified by using linear and nonlinear optimization procedures to improve the accuracy of model predictions.

Key Findings

- The locally-calibrated faulting, transverse cracking, and International Roughness Index (IRI) models for Iowa JPCP provide better predictions than their nationally-calibrated counterparts.
- The identified local calibration factors increase the accuracy of rutting predictions and, to a lesser extent, longitudinal (top-down) cracking predictions for both Iowa HMA and Iowa HMA over JPCP.
- The nationally-calibrated alligator (bottom-up) cracking model provides acceptable predictions for new Iowa HMA pavement.
- Both nationally- and locally-calibrated alligator (bottom-up) cracking models provide acceptable predictions for Iowa HMA over JPCP.
- Little or no thermal cracking is predicted when using the proper binder grade for Iowa climatic conditions, but significant thermal cracking is observed in both Iowa HMA and HMA over JPCP.
- Transverse cracking records in the Iowa DOT PMIS do not differentiate thermal-cracking and reflection-cracking measurements for HMA over JPCP.
- Good agreement is observed between the IRI measures for Iowa HMA pavement and HMA over JPCP and the MEPDG predictions from the IRI model of nationally-calibrated distress inputs with nationally-calibrated coefficients and the IRI model of locally-calibrated distress inputs with nationally-calibrated coefficients.



	Bias	Stad. Error
National	39.57	49.53
Local	-1.47	9.36

	Bias	Stad. Error
National	41.20	50.15
Local	-0.84	4.46

Local calibration results for the MEPDG JPCP IRI prediction model

Recommendations

Future recommendations on the use of MEPDG/ DARWin-ME™/Pavement ME Design in Iowa pavement systems include the following:

- The locally-calibrated JPCP performance models (faulting, transverse cracking, and IRI) identified in this study are recommended for use in Iowa as alternatives to the nationally-calibrated ones.
- The locally-calibrated rutting prediction models identified in this study are recommended for use in HMA and HMA over JPCP systems as alternatives to the nationally-calibrated ones.
- The nationally-calibrated alligator (bottom-up) cracking prediction models are recommended for use in Iowa HMA and HMA over JPCP systems.
- The use of MEPDG for longitudinal-cracking, thermal-cracking, and reflection-cracking analysis in HMA and HMA overlay JPCP is recommended only for research investigations and not for routine decision making until these distress models are fully developed and implemented.
- The use of national calibration coefficient of IRI models in Iowa HMA and HMA over JPCP systems is recommended because longitudinal-cracking and thermal-cracking models as IRI design inputs are still evolving and the accuracy of the nationally-calibrated IRI model is acceptable for Iowa conditions.
- Preliminary studies comparing MEPDG (version 1.1) and DARWin-ME™ performance predictions indicated discrepancies warranting further investigation to determine if the local calibration study needs to be repeated using the latest version of DARWin-ME™/Pavement ME Design (version 1.3).

Implementation Readiness and Benefits

A systematic and thorough evaluation of the Iowa DOT's existing PMIS carried out during the course of this research identified gaps in the database with respect to the use of MEPDG and the information that may need to be collected in the future as part of the routine pavement evaluation.

The primary benefit of this research will be improved accuracy of pavement performance predictions for Iowa pavement systems through the use of the proposed local calibration factors by the Iowa DOT, city, and county engineers.

Reference

AASHTO. 2008. *Mechanistic-Empirical Pavement Design Guide*, Interim Edition: A Manual of Practice. Washington, DC.