Local Calibration of Mechanistic-Empirical Pavement Design in Tennessee *(RES2013-33)*

Purpose of the Project

The purpose of the project is to conduct a local calibration of the pavement performance (distress) models in the Mechanistic-Empirical Pavement Design Guide (MEPDG), so that the models could be better adapted to the local conditions of Tennessee. These conditions include material properties, distress types, traffic pattern, and rehabilitations.

Scope and Significance

The scope of the research project includes:

- A survey was sent to 53 transportation agencies in the US and Canada to collect information about the implementation status and the problems about using the new MEPDG design software (AASHTOWare).
- The rutting models, including asphalt mixture overlay on existing pavement, new asphalt pavement, and asphalt mixture overlay on existing portland cement concrete (PCC) pavement, were calibrated. For the new and asphalt mixture overlay on flexible pavements, two sets of local calibration coefficients were established for the rutting model by calibrating the models separately.
- The Fatigue cracking models, including the alligator and longitudinal cracking models, were validated and calibrated using data retrieved from the LTPP and Tennessee PMS. The traverse cracking model was also validated using data obtained from the Tennessee PMS database.
- The roughness models were calibrated after the calibration of the rutting and fatigue cracking models.
- The design reliability of each type of distress (including the international roughness index) was analyzed through the PMS historical distress data.

Without a local calibration, the nationally-calibrated performance (distress) models in MEPDG are not applicable to the local conditions of Tennessee. After the local calibration, the calibrated distress models showed improved design reliability than the original ones. In addition, local calibration of MEPDG can also help TDOT take advantage of the state-of-the-art pavement design methods and the latest advances in the field.

Outcomes

The following outcomes were achieved from the research project:

- In total, 39 responses out of the 53 survey forms were received. The results show that although many states have conducted studies using MEPDG, only a few have actually implemented it in their design practice. There are 52% of the responders who still use the 93 AASHTO design guide for flexible and PCC pavement design. The alligator cracking were considered the most difficult model to calibrate. Many of the responses reported difficulties in using AASHTOWare due to its complicated data preparation and overwhelmed number of inputs.
- The rutting models were calibrated for new asphalt pavements, asphalt mixture overlay on flexible pavement, and asphalt mixture overlay on PCC pavement. In addition, local

calibration coefficients of rutting model for flexible pavement (new and asphalt mixture overlay) were established for the state routes in the four regions of Tennessee.

- The alligator cracking (bottom-up) model was first validated using the data collected from the long-term pavement performance (LTPP) sections in Tennessee. The results showed that the national model generally underestimated the alligator observed in Tennessee. The local calibration coefficients of the alligator cracking model were determined using PMS data. After calibration, the bias and dispersion of the model were reduced significantly.
- The local calibration coefficients of the longitudinal cracking (top-down) model were obtained through the PMS database. The results indicated that the nationally-calibrated model greatly overestimated this type of distress observed in Tennessee.
- In order to generate more realistic predictions of alligator cracking, which was extremely low using the national model, a comprehensive characterization method for the asphalt binder treated base layer should be introduced in the MEPDG design software, the AASHTOWare.
- The roughness model was validated after all the distress models were calibrated. It was found that using the locally-calibrated distress models, the predicted international roughnesses index (IRI) was very close to the observed one. The default calibration coefficients in the MEPDG were used for the roughness model.
- The distributions of five types of distress (including IRI) were produced. Given the rehabilitation and maintenance practice in Tennessee, the design reliability of Tennessee should be adjusted to generate the most cost-effective design.
- Figures 1 through 4 compare the different distress models before and after local calibration.

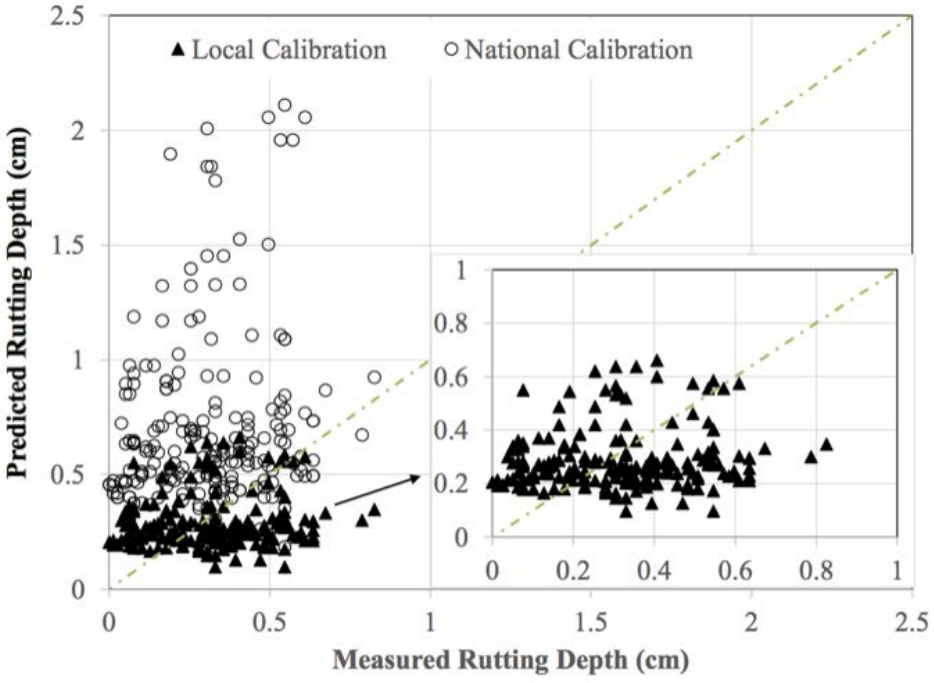

Figure 1. Calibration of the rutting model for asphalt mixture overlay on flexible pavements

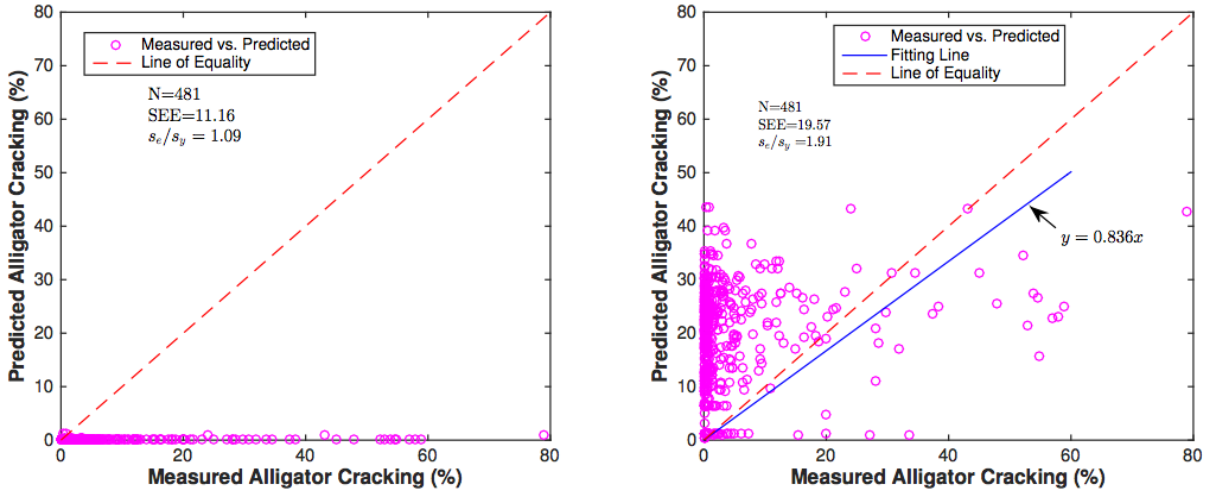

Figure 2. Calibration and validation of alligator cracking model

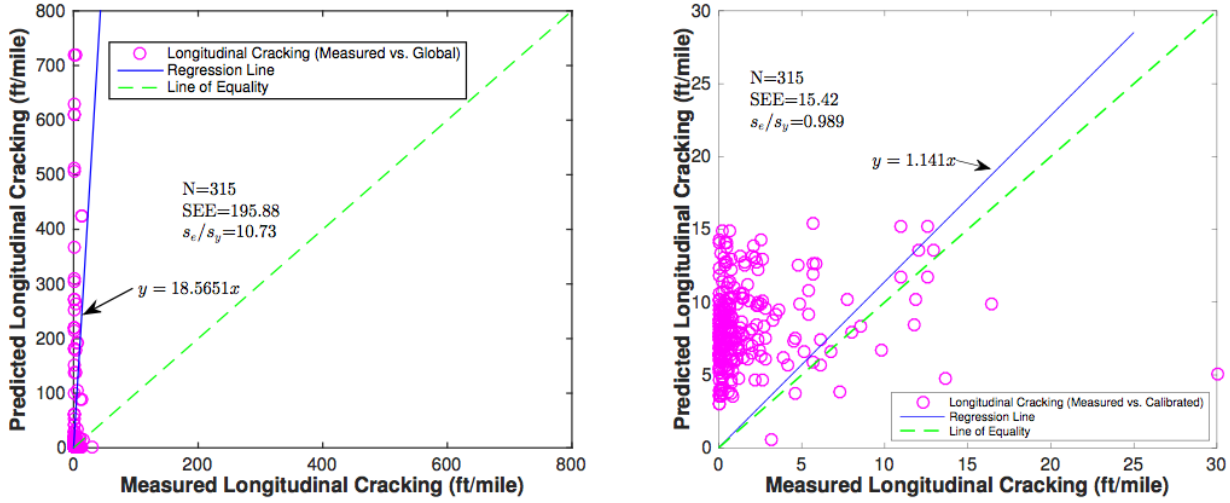

Figure 3. Calibration and validation of longitudinal cracking model

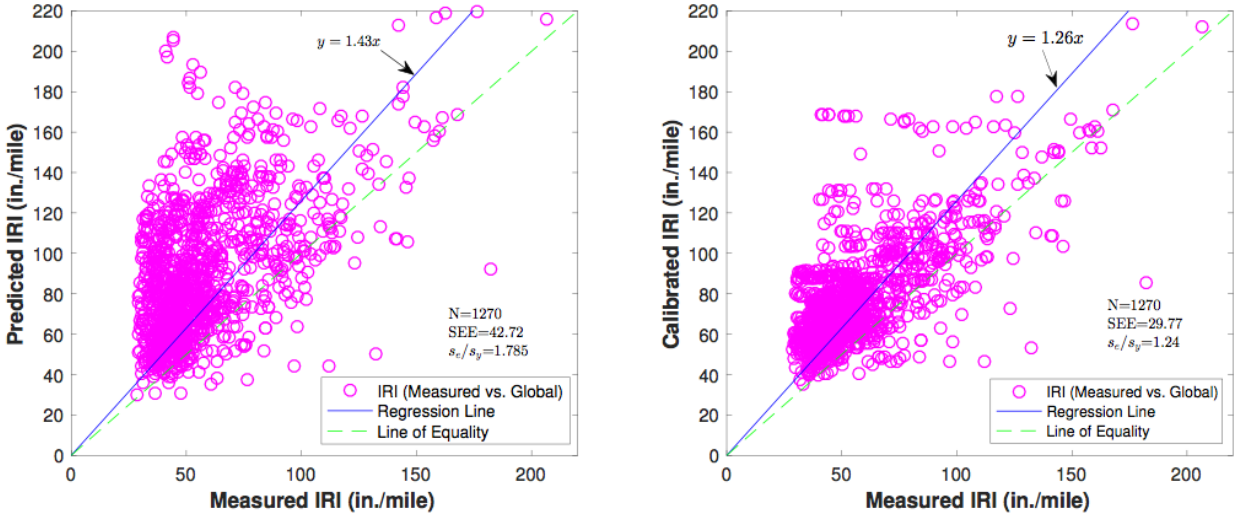

Figure 4. Validation of Roughness model

Time Periods and Status of the Project

The project started on September 1, 2013 and was scheduled to complete on August 31, 2015. The project is currently completed. The research team submitted the draft final report to TDOT and comments and feedback were received from TDOT engineers. The results and findings were also presented on the Transportation Research Board (TRB) conferences and disseminated in journal papers.

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