The Importance of Local Calibration of the MEPDG

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Primary Objectives

- Verify the applicability of the MEPDG for local conditions
- Calibrate to local conditions
- Reduce bias and standard deviation for distress prediction models
Calibration of MEPDG

(adapted from FHWA)
Concept of Model Calibration

Before Calibration

After Calibration
Bias and Error Concept

"Actual" Distress

"Predicted" Distress
National Calibration

(LTPP sections used in the national calibration for new flexible pavement)
Recommendations
(from National Calibration)

- Available data include LTPP and PMS.
- Some distress data formats may need to be converted.
- Flexible pavement longitudinal cracking and transverse cracking are questionable.
- JPCP is good for use.
- Calibration with more data is recommended.
## Across the U.S…

<table>
<thead>
<tr>
<th>Stage of Implementation</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not considering at all</td>
<td></td>
</tr>
<tr>
<td>In planning stages</td>
<td></td>
</tr>
<tr>
<td>In process</td>
<td><strong>Arkansas</strong>, California, Florida, Mississippi, New Mexico</td>
</tr>
<tr>
<td>Finished some models</td>
<td>North Carolina, Washington, Montana, Minnesota, Texas, Kentucky, Ohio</td>
</tr>
<tr>
<td>Already finished all models</td>
<td></td>
</tr>
<tr>
<td>MEPDG is in use</td>
<td>Missouri, Indiana</td>
</tr>
</tbody>
</table>

*(As of July 2010)*
Local Data Sources

• Long Term Pavement Performance (LTPP)
  – General Pavement Studies (GPS)
  – Specific Pavement Studies (SPS)

• Pavement Management System (PMS)
  – TOP25 for flexible pavements
LTPP sites in Arkansas
TOP25 from AHTD

[Map of top 25 locations with various markers and cities highlighted]
Validation and Calibration of New Flexible Pavement
Pavement Sections

38 Sections
- 18 LTPP
- 20 TOP25
## Experimental Design

### Hot-Mix Asphalt (HMA) Thickness

<table>
<thead>
<tr>
<th>Base Type</th>
<th>Thin (≤4 in.)</th>
<th>Intermediate</th>
<th>Thick (≥8 in.)</th>
<th>No. of sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTB</td>
<td>2042, 3048, 3058, 3071</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Underlined sections are randomly selected for validation; G is Good; A is Average; P is Poor
ATB: Asphalt Treated Base; CTB: Cement Treated Base.
Comparison (uncalibrated)
Comparison (calibrated)

Design Criteria

Predicted Performance

Measured Performance
Alligator Cracking

\[ y = 0.1190 \times \]
\[ R^2 = 0.09 \]

\[ y = 0.2172 \times \]
\[ R^2 = 0.22 \]

Determined in accordance with LTPP Distress Identification Manual
Alligator Cracking

Histogram of alligator cracking (Validation)

Histogram of alligator cracking (Calibrated)
Longitudinal cracking

Histogram of Longitudinal Cracking (Validation)

Predicted long. cracking, ft/mi

Measured longitudinal cracking, ft/mi

Longitudinal cracking recorded in wheelpath only
Transverse Cracking

Histogram of Transverse Cracking (Validation)

No determination made regarding ‘cause’ of cracking
Total Rutting

LTPP: dipstick or photographic
Ark: straightedge
Smoothness (IRI)

In MEPDG, IRI is a function of the other pavement distresses;

MEPDG default Initial IRI: 63 in/mile
Arkansas initial IRI (LTPP and Top 25): 70 in/mile
Results
(Calibration Coefficients)

<table>
<thead>
<tr>
<th>Calibration Factor</th>
<th>Default</th>
<th>Calibrated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alligator cracking</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>1.0</td>
<td>0.688</td>
</tr>
<tr>
<td>C2</td>
<td>1.0</td>
<td>0.294</td>
</tr>
<tr>
<td>C3</td>
<td>6000</td>
<td>6000</td>
</tr>
<tr>
<td><strong>AC rutting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>βr1</td>
<td>1.0</td>
<td>1.2</td>
</tr>
<tr>
<td>βr2</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>βr3</td>
<td>1.0</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Base rutting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>βs1</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Subgrade rutting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>βs2</td>
<td>1.0</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Validation
(Calibrated models)

• 20% of the 38 sites (8 sites)
Alligator cracking model and rutting models are improved.

<table>
<thead>
<tr>
<th></th>
<th>Alligator cracking</th>
<th>Total rutting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Measured</td>
<td>Before calibration</td>
</tr>
<tr>
<td>Average</td>
<td>2.0688</td>
<td>0.5512</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>4.9029</td>
<td>2.0661</td>
</tr>
<tr>
<td>p-value (t-test)</td>
<td>N/A</td>
<td>0.0000</td>
</tr>
<tr>
<td>p-value (F-test)</td>
<td>N/A</td>
<td>0.0000</td>
</tr>
<tr>
<td>N</td>
<td>371</td>
<td>371</td>
</tr>
</tbody>
</table>
Points to Ponder

• Start at the bottom: get “Level 3” established before $$ for Level 1.
• Although BIAS and/or ERROR are reduced, calibrated models will not be ‘perfect’.
• Calibration/Validation is an ONGOING effort.
  – Major emphasis in the Pvmt Mgmt section
  – Not all data is quality data: be intentional!
    • Understand the SENSITIVITY of the models
  – New models are out there…
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WE’RE WORKING ON IT