Rutting as a Performance Indicator

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MAP-21

- Moving Ahead for Progress in the 21st Century
- First “long-term” highway authorization since 2005 (10 extensions to SAFETEA-LU)
- $105 billion for FYs 2013 and 2014
- Performance-based management of national highway system
- Performance measures established 18 months after enactment
- Prior to enactment, FHWA undertook study, “Improving FHWA’s Ability to Assess Highway Infrastructure Health”
Project Objectives

- Define a consistent and reliable method to document infrastructure health
  - Focus on pavements and bridges
  - Initial focus on IHS, but with possible expansion to NHS
- Develop tools to provide FHWA and State DOTs ready access to key information
Project Approach

- Track #1 – Develop an approach for categorizing pavement and bridges as Good / Fair / Poor, that can be used consistently across the country.

- Track #2 – Develop an approach for assessing the Overall Health of a multi-state highway corridor.
Goals of the Pilot Study

- Validate IRI as a Tier 1 measure
- Advance potential Tier 2 and Tier 3 measures
- Key questions
  - Do different data sources tell us the same thing?
  - Do different metrics help us better understand pavement conditions?

<table>
<thead>
<tr>
<th>Goal Area</th>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
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<tbody>
<tr>
<td>Pavement Preservation</td>
<td>IRI</td>
<td>Functional condition based on Tier 1 plus HPMS distress data</td>
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### Defining Good / Fair / Poor

<table>
<thead>
<tr>
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<th>Condition</th>
<th>Typical Work Required</th>
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| **Good**       | • Free of significant defects  
• Condition does not adversely affect performance | • Activities that preserve good conditions (i.e. pavement surface treatments, deck sealing) |
| **Fair**       | • Minor deterioration on primary structural bridge elements  
• Isolated surface defects or functional deficiencies on pavements | • Minor rehabilitation  
  - Bridge crack sealing, patching of spalls, and corrosion mitigation  
  - Pavement overlays and patching |
| **Poor**       | • Advanced deterioration  
• Conditions impact structural capacity | • Structural repairs, major rehabilitation, reconstruction, or replacement |
Pilot Study Corridor

874 miles

AADT from 5,000 to 90,000

Urban and Rural

Variety of surface types
Pilot Study Data

- National Data - HPMS data in 2010+ format
- State Data
  - Documentation
  - Inventory
  - Pavement Management
- Field data
  - Collected in eastbound direction only
  - Rutting, roughness, cracking, faulting
  - Rolling wheel deflectometer
Observations from Pilot Study

- IRI is feasible for use as a Tier 1 G/F/P Ride Quality indicator
  - Reasonable correlation between sources
  - Make sure data collection/processing consistent

- IRI does not provide complete picture, other measures require additional work

- Additional work performed to investigate bias observed in rutting and identify improvements in HPMS data
Comparison of Rut Data

Outliers - Recent Work?

Line of Equality

HPMS
State

Rutting, in.

Field Data Rutting, in.
South Dakota
Outline of Data Review

- Data Collection Recommendations
- Data Processing Recommendations
- Data Quality Control
- Data Storage Recommendations
- Condition Rating
Transverse Spacing

![Graph showing Rut Depth vs Number of Points for Outside WP and Inside WP with data points and lines indicating the trend.]
Longitudinal Sampling Interval
Longitudinal Sampling Interval
Data Collection Recommendations

- AASHTO PP70-10: Width should cover at least 13 ft
- Maximum spacing between data points of 0.4 inch
- Maximum spacing between profiles of 10 ft
Profile Filtering – Moving Average

Diagram showing the relationship between Avg Rut Depth, in. and Moving Avg Distance, in. for OWP and IWP.
Reference Line
Gage Width
Data Processing Recommendations

- 2-inch moving average filter applied to transverse profile
- Use lane width wireline reference
- Gage width from 1.2 to 1.5 inches
Data Quality Control

- Initial system validation reviewing each component
- Routine checks of components, AASHTO PP70-10
- Systematic reviews of collected data
Base Length

![Graph showing the relationship between Rut Depth and Base Length. The graph includes lines for Standard Deviation, Minimum, and Maximum values. The y-axis represents Rut Depth in inches, and the x-axis represents Base Length in feet. The values range from 0 to 1 for Rut Depth and 0 to 3,000 for Base Length.](image-url)
Data Storage Recommendations

- Data Elements
  - Average, minimum, maximum, and standard deviation of rut depth
  - Cross-slope

- Base length of 0.1-mile

- Metadata stored should include the full transverse profile

- Quality control elements identifying level of review
### Condition Ratings

<table>
<thead>
<tr>
<th>Condition</th>
<th>Distress Range</th>
<th>Percentage of Corridor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Rut &lt; 0.25 inch</td>
<td>96%</td>
</tr>
<tr>
<td>Fair</td>
<td>0.25 inch ≤ Rut ≤ 0.4 inch</td>
<td>3%</td>
</tr>
<tr>
<td>Poor</td>
<td>Rut &gt; 0.4 inch</td>
<td>1%</td>
</tr>
</tbody>
</table>

- FHWA Pavement Health Track (PHT) identifies terminal rut of 0.4
- AASHTO ME identifies rut < 0.25 as adequate and rut > 0.4 as inadequate
Field Validation

- 20 segments reviewed within MN
  - 7 Good
  - 7 Fair
  - 6 Poor
- 71% agreement between condition rating
- Based on field validation, threshold values remain as preliminary until further research completed.
Acknowledgements

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- 2nd TWG – CT, KS, NC, OH, RI, FHWA, 2 Academia, 1 Consultant
- Study Team
  - AMEC Environment & Infrastructure, Inc.
  - Cambridge Systematics, Inc.
- Data Collection Vendors
  - Mandli Communications (pavement)
- Googe: FHWA Infrastructure Health Pilot Study or FHWA Asset Management Publications