“MOVING AHEAD FOR PROGRESS IN THE 21ST CENTURY ACT” OR “MAP-21”

Thomas Van
Federal Highway Administration
Washington, DC
FHWA Infrastructure Health Assessment

Study Overview

7th Symposium on Pavement Surface Characteristics
Preserving our Highway Infrastructure Assets
Focus on Implementation

September 2012

Nastaran Saadatmand, FHWA-Office of Asset Management
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
Project Structure

- Phase I – Develop methodology
- Phase II – Conduct pilot
- Phase III – Present findings at national meeting
TRACK #1
DEFINING GOOD / FAIR / POOR
Vision – consistent, reliable method that can be applied nationwide

Approach
» Develop qualitative definitions for good/fair/poor
» Develop quantitative measures for placing assets into those buckets

Benefits
» Approach is flexible and can evolve as the measures evolve
<table>
<thead>
<tr>
<th>Condition</th>
<th>Typical Work Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Good</strong></td>
<td>Activities that preserve good conditions (i.e. pavement surface treatments, deck sealing)</td>
</tr>
</tbody>
</table>
| - Free of significant defects  
- Condition does not adversely affect its performance | |
| **Fair**  | Minor rehabilitation  
- Pavement overlays and patching  
- Bridge crack sealing, patching of spalls, and corrosion mitigation |
| - Isolated surface defects or functional deficiencies on pavements  
- Minor deterioration on bridge elements | |
| **Poor**  | Structural repairs, major rehabilitation, reconstruction, or replacement |
| - Advanced deterioration  
- Conditions impact structural capacity | |
### Potential Performance Measures

*Building off Previous Work*

- Measures addressed through NCHRP 20-24(37) G

<table>
<thead>
<tr>
<th>Goal Area</th>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement Preservation</td>
<td>IRI</td>
<td>Structural adequacy based on HPMS distress data</td>
<td></td>
</tr>
<tr>
<td>Bridge Preservation</td>
<td>Structural Deficiency (SD)</td>
<td></td>
<td>Structural adequacy based on NBI ratings or element-level data</td>
</tr>
</tbody>
</table>
Potential Performance Measures
Building off Previous Work

*AASHTO Evaluation Criteria*

- Is there general consensus on the definition of the measure?
- Is there a common or centralized approach to data collection in place?
- Has the availability of consistent data across states been established through national comparative analysis or other research effort?
Potential Performance Measures

*Building off Previous Work*

- Measures addressed through FHWA Health Study

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<tr>
<td>Pavement Condition</td>
<td>IRI</td>
<td>Functional adequacy based on HPMS distress data</td>
<td>Structural adequacy based on HPMS distress data and deflection data</td>
</tr>
<tr>
<td>Bridge Condition</td>
<td>Structural Deficiency (SD)</td>
<td></td>
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</table>
PILOT STUDY RESULTS
Outline

- Pilot study approach
- Bridge pilot study
- Pavement pilot study
- Summary of Findings
Goals of the Pilot Study

**Bridge**
- Validate structurally deficiency as a Tier 1 measure
- Advance potential Tier 2 measure

**Pavement**
- Validate IRI as a Tier 1 measure
- Advance potential Tier 2 and 3 measures

**Key questions**
- Do different data sources tell us the same thing?
- Do different metrics help us better understand pavement and bridge conditions?
Pilot Approach

- Select a three-state pilot corridor

- Collect data sets
  - Federal data for pavements and bridges
  - State pavement data
  - Field collection for pavement data

- Compare data and measures resulting from data

- Identify issues and recommend improvements
Pilot Study Corridor
Corridor Statistics

- 874 centerline miles
  - SD = 411
  - MN = 275
  - WI = 188
- Wide range of pavement types
- AADT range = 5,000 – 90,000
- Urban and rural Interstate

Legend
- JCPC
- CRCP
- Asphalt
- PCC
# Bridge G/F/P Options

<table>
<thead>
<tr>
<th>Option</th>
<th>G/F/P Scale</th>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Structural deficiency</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Minimum NBI condition rating</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>3. Weighted average of NBI condition ratings</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Option</th>
<th>Basis for Weights</th>
<th>Deck</th>
<th>Super</th>
<th>Sub</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.a</td>
<td>Bridge Health Index</td>
<td>5%</td>
<td>64%</td>
<td>31%</td>
</tr>
<tr>
<td>3.b</td>
<td>Sufficiency Rating</td>
<td>4%</td>
<td>48%</td>
<td>48%</td>
</tr>
<tr>
<td>3.c</td>
<td>Equal weights</td>
<td>33%</td>
<td>33%</td>
<td>33%</td>
</tr>
<tr>
<td>3.d</td>
<td>Variable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3a unless deck rating is much worse than super or sub rating, then 3c</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Corridors Results – Percent of Bridges

- Structurally deficient – 3% of Bridge Deck Area

2. Minimum Rating

3a. Weights, based on HI

3.b Weights, based on SR

3.c Equal weights

3.d Variable weights

Good | Fair | Poor
Pavement Pilot
Data items

- Roughness
  - IRI

- Additional distress data for a functional condition index
  - Cracking
  - Faulting
  - Rutting

- Structural condition index
  - Continuous deflection - Rolling wheel Deflectometer (RWD)

- Also gathered documentation, visual ratings, and other information from state pavement management systems
Pavement Pilot
Data Gathering/Collection Summary

<table>
<thead>
<tr>
<th>National</th>
<th>State</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPMS</td>
<td>PMS</td>
<td>Condition</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RWD</td>
</tr>
<tr>
<td>MN</td>
<td>2009, 2010</td>
<td>2010</td>
</tr>
<tr>
<td>SD</td>
<td>2010</td>
<td>2010</td>
</tr>
<tr>
<td>WI</td>
<td>2009, 2010</td>
<td>2010</td>
</tr>
</tbody>
</table>

(No RWD for WI)
Comparison of HPMS, State, and Field IRI on Asphalt-Surfaced Pavements

Data collected in different years
Do HPMS, state, and field data collection methods tell us the same thing?
Faulting
## HPMS Confidence Levels

<table>
<thead>
<tr>
<th></th>
<th>Confidence in HPMS Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRI</td>
<td>High</td>
</tr>
<tr>
<td>Cracking %</td>
<td>Low/Med</td>
</tr>
<tr>
<td>Cracking Length</td>
<td>Low</td>
</tr>
<tr>
<td>Rutting</td>
<td>Med</td>
</tr>
<tr>
<td>Faulting</td>
<td>Low</td>
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## Pavement G/F/P Options

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<td>1. IRI</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Functional condition index based on HPMS data</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>3. Structural condition based on RWD</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
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</tbody>
</table>
## Pavements Evaluation Options

<table>
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<tr>
<th>Option</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Pavement roughness in terms of IRI</td>
</tr>
<tr>
<td>2</td>
<td>Pavement surface distresses in accordance with the Pavement Condition Index (PCI) procedure</td>
</tr>
<tr>
<td>3</td>
<td>Combination of pavement roughness and selected distresses (cracking, rutting and faulting)</td>
</tr>
<tr>
<td>4</td>
<td>Pavement structural capacity based on Rolling Wheel Deflection (RWD) measurements</td>
</tr>
<tr>
<td>5</td>
<td>Combination of roughness, selected distresses and RWD-based structural capacity</td>
</tr>
<tr>
<td>6</td>
<td>Pavement Remaining Service Life</td>
</tr>
</tbody>
</table>
Condition Based on FCI Computed Using HPMS and Field Data Sets

- **2009 HPMS FCI**
  - Good: 27%
  - Fair: 32%
  - Poor: 41%

- **2010 HPMS FCI**
  - Good: 47%
  - Fair: 30%
  - Poor: 23%

- **Field FCI**
  - Good: 59%
  - Fair: 27%
  - Poor: 14%
OBSERVATIONS
Observations – Data Sources

**Bridge**
- NBI is viable source for national performance measurement

**Pavement**
- HPMS section lengths may create issues
- Rutting data appear reasonable to use
- Cracking and faulting data need closer examination
- Consider developing a manual for estimating cracking, including QA/QC
- Structural condition – Need RWD calibration, data collection and processing standards
Observations – Bridge Tiers

- **Structural Deficient**
  - Widely reported Tier 1 measure
  - However, does not fit well into G/F/P approach since it is binary
  - Includes non-condition components (inventory rating and water adequacy)

- **G/F/P based on NBI condition ratings is a viable option for a Tier 2 measure**

- **Final structure of a Tier 2 measure should be based on a policy discussion**
  - Should minimum or weighted average be considered?
  - What is relative importance of deck compared to superstructure and substructure?
Observations – Pavement Tiers

- IRI is feasible for use as primary G/F/P indicator
  - Acceptable correlation between HPMS, state, and field sources

- While IRI does not provide a complete picture of condition, the Tier 2 and 3 measures require significant work

- Rutting and cracking data could be used as primary or “flag” G/F/P indicator
  - Flag for safety concern
  - Cracking flag only useful for concrete

- Faulting/cracking data can not be used for G/F/P – work needed
Health Assessment

**Objective**

- Provide FHWA with a means to examine the overall health of specific corridors and respond to requests for information

**Basic approach**

- Present data in a way that supports professional judgment
- There is no single health score or number

**Data sources**

- Draw from available data
- Identify future enhancements
- Good/fair/poor results are one input
Final Report

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