Performance Measures for Bridge Preservation

Dave Juntunen, PE
Michigan Department of Transportation
Bridge Development Engineer

2012 Midwest Bridge Preservation Partnership Meeting
Council Bluffs Iowa
MAP-21

- Sets National Goals for NHS
  - Less than 10% SD by Deck Area
- Eliminated the Federal Highway Bridge Program
  - Funding for NHS Bridges - National Highway Performance Program (NHPP)
  - Non NHS Bridges – Surface Transportation Program (STP)
- Requires Element Level Inspection on the NHS
- Requires Risk Based Asset Management
  - National Task Force Reviewing Options for Performance Measures
Levels of Performance Measures

Elements

- Steel Beams
- Reinforced Concrete Deck
- Reinforced Concrete Abutment
- Pier Columns
- Pier Cap
- Paint System
- Barrier
- Elastomeric Bearings
- Strip Seal
- Expansion Joints
- Paint System
- Barrier
- Elastomeric Bearings
- Strip Seal
- Expansion Joints

Components

- Deck
- Superstructure
- Substructure
- Culvert
Bridge Condition Ratings

Number of Bridges

Number of Bridges

NBI Rating

Serious or Critical

Poor

Fair

Good

NBI Rating

1 2 3 4 5 6 7 8 9
Performance Measure for Preservation
Bridge Cycle of Life

Bridges Cycle of Life
2004 - 2010

- **Good**: 2004 ...... 40.6%
  2010 ...... 40.9%
  32.2% Unchanged

- **Fair**: 2004 ...... 43.1%
  2010 ...... 45.7%
  32.5% Unchanged

- **Poor**: 2004 ...... 16.3%
  2010 ...... 13.4%
  7.2% Unchanged

- 16% Bridges
- 0.6%
- 9.8%
- 5.6%
- 5.0%
- 3.4%
- 14.2% Bridges
AASHTO Guide Manual for Bridge Element Inspection

• Four condition states for all elements
  – Follow – Good, Fair, Poor, Severe convention

• Deck and slab units changed to square feet.

• Wearing surfaces and protective treatments separated from structural elements
AASHTO Guide Manual for Bridge Element Inspection

- National Bridge Elements
  - Primary Load Carrying Members,
    - refinement of the deck, superstructure, substructures and culvert condition ratings
  - Also bearings and bridge rails
  - National Performance Measures
  - Additional Elements Requested By The FHWA
    - Protective Systems
      - Steel Coating
      - Concrete Coating
      - Wearing Surface
    - Deck Joints
AASHTO Guide Manual for Bridge Element Inspection

• Bridge Management Elements
  – Define secondary elements and protective systems to support advanced bridge management.
  – Flexibility allowed so states can develop need indicators to meet their BMS needs

<table>
<thead>
<tr>
<th>Condition State Definitions:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Defect</th>
<th>CS 1 - Good</th>
<th>CS 2 - Fair</th>
<th>CS 3 - Poor</th>
<th>CS 4 - Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scour</td>
<td>None</td>
<td>Arrestment or countermeasures exist, or both</td>
<td>Minor</td>
<td>The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.</td>
</tr>
<tr>
<td>Settlement</td>
<td>None</td>
<td>Arrestment or countermeasures exist, or both</td>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td>Load Capacity</td>
<td>No Reduction</td>
<td>No Reduction</td>
<td>No Reduction</td>
<td></td>
</tr>
</tbody>
</table>

Figure 24 - Recommend adding scour and settlement for applicable concrete substructure elements
What is Preservation?
Performance Measure for Preservation Monitor Bridges Dropping to Poor (Structurally Deficient)

DETERIORATION RATE STATEWIDE TRUNKLINE BRIDGES

Number Bridges Going from Good/Fair to Poor

Year

Linear Fit
Performance Measures For Preservation
Counting number of bridge projects per year and what type of projects.

- MDOT 2005 Construction Program
  - Replacement
    - 59 Projects
  - Rehabilitation
    - 133 Projects
  - Preventive Maint.
    - 206 Projects
Preventive Maintenance Projects

- Joint Replacements
- Pin & Hanger Replacements
- Complete Painting
- Zone Painting
- Epoxy Overlays
- Deck Patching
- (many more)…
Scope (Detailed Inspections) May Be Needed to Determine the Right “Fix”

- The routine (visual) bridge inspection may not be enough to determine actual bridge project needs.
- Chain drag bridge deck
- Sound concrete surfaces
- Measure section loss of corroded beams
- Compare costs of different fixes (sometimes using life cycle cost analysis)
Performance Measures and Need Indicators for Preventive Maintenance

- Expansion joints leaking
  - Measured using Pontis data.
  - MDOT categorizes seven different types of joints
Pontis Reports

- Possible projects with estimate of cost (unlimited budget)
- Future Poor Bridges (predicts what year a bridge will become poor (2012 – 2031))
Performance Measures for Preventive Maintenance

- Paint condition
  - Measured using Michigan Specific NBI rating and Pontis data.
  - Full painting
  - Zone painting
  - Spot painting

Full Painting Candidates when greater than 15% paint failure.
Develop Paint Preservation Guidance

• Lead based and zinc based paint systems handled differently
  – Only do spot and zone painting on Zinc based paint systems
• Take into account effectiveness of paint contractors and full containment requirements.
• Have had limited effectiveness because of reduced surface preparation.
Bridge Decks

• Number one overarching need Indicator
  – The condition of bridge decks most often drive bridge projects.
Performance Measures are Deck Top and Bottom Surface Condition

- **Top Surface**
  - 2 to 5% - deck patch, epoxy overlay
  - 5% to 15% - deck patch
  - > 15% - rigid overlays, HMA overlays

- **Bottom Surface**
  - < 10% - deep overlay
  - 10% to 30% shallow overlay
  - > 30% replace deck.

For more information see MDOT Bridge Deck Preservation Matrix
Need Indicator for Crack Sealing and Epoxy Overlays
Pontis Smart Flag – Deck Cracking

Epoxy Overlay

Crack Sealing
Differentiate spalls from delaminations

We often have bridge decks having rigid overlays (concrete, latex modified, or silica-fume) having very small percentage of spalls (<2%) but having large percentage of delaminations (30% plus).

Question – How long will it take delaminated area to spall?
Review Your Bridge Management Data (Bridge Management Elements) with Your Practitioners
Thank You

• Our work is not done
• We must continue to develop and enhance our performance measures for preventive maintenance