Instituting a Successful Approach to Bridge Management in Michigan

Dave Juntunen, P.E.
Michigan Department of Transportation
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Michigan DOT

- Michigan has 10,800 Bridges
  - 4400 State owned
  - 6400 Local Agency owned
- State is divided into seven regions
Why Successful?

In 1998 we were near worst in nation for bridge condition. In the last 12 years we improved bridge condition 13 percent.
Have Benchmarks
Compare Ourselves with our Neighbors

Percent Structurally Deficient Bridges
All Highway Bridges
Great Lakes States

<table>
<thead>
<tr>
<th>State</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>WISCONSIN</td>
<td>8.17%</td>
</tr>
<tr>
<td>MINNESOTA</td>
<td>8.77%</td>
</tr>
<tr>
<td>OHIO</td>
<td>9.78%</td>
</tr>
<tr>
<td>INDIANA</td>
<td>10.65%</td>
</tr>
<tr>
<td>ILLINOIS</td>
<td>8.50%</td>
</tr>
<tr>
<td>MICHIGAN</td>
<td>13.15%</td>
</tr>
</tbody>
</table>
Set Goals with Objectives and Performance Measures

STRATEGIC INVESTMENT PLAN FOR TRUNKLINE BRIDGES

- Due to the poor condition of our bridges, in 1998 a strategic plan was developed and implemented.

- Network condition goals were established:
  - Immediately address the needs of 100% of structures of critical concern.
  - 95% freeway bridges in good or fair condition by 2008.
  - 85% non-freeway bridges in good or fair condition by 2008.
Monitor Condition and Have Ability to Forecast Bridge Condition

MUST BE RESPONSIVE
Bridge Condition Forecast System

To receive an example copy of BCFS contact Dave Juntunen at juntunend@michigan.gov
Bridge Condition Forecast System

• Evaluates different mix of fixes (PM, Rehab, and Replacement)
• Compares different yearly budgets
• Uses average cost per deck area
• Deteriorates population of bridges using transition probabilities
• User sets “Preservation Path” - which bridges will be worked on and what end result is
BCFS uses Markov Chain Transition Probabilities to Deteriorate NBI Condition Ratings

<table>
<thead>
<tr>
<th>3 Year Average</th>
<th>Transition Probability Matrix</th>
<th>Percent</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
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<tr>
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<td>#DIV/0!</td>
<td>#DIV/0!</td>
</tr>
</tbody>
</table>

**Probability stay in that condition state (highlighted yellow)**

When the entire element is in one condition state, you can monitor the transition probability that the element will drop more than one condition state. Example – Above 57% bridges that were rated 9 remained 9, 35% dropped to 8, and 8% dropped to 7.
BCFS at Region Level with Programmed Projects
MDOT Call For Projects
“Establish a Mix of Fixes”

• Bridge Strategy is updated each year
  – Monitor progress towards bridge goals for each region.
• Money allocated to Regions based upon need
  – MDOT Allocates 20% Funds to preventive Maintenance, 30%
    rehabilitation, and 50% Replacement
• Bridge CFP sub team reviews region strategy and projects.
• Bridge program is coordinated with road and safety programs.

To be relevant your BMS must be integrated into your project selection process
Categorizing Bridge Condition

Number of Bridges

<table>
<thead>
<tr>
<th>NBI Rating</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serious or Critical</td>
<td>1400</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Poor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td></td>
<td></td>
<td></td>
<td>600</td>
<td>800</td>
<td>1000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>800</td>
<td>1000</td>
<td>1200</td>
</tr>
</tbody>
</table>

Legend:
- Red: Serious or Critical
- Pink: Poor
- Yellow: Fair
- Green: Good

Source: Michigan Department of Transportation
Preservation is a Very Important part of Our Overall Bridge Management System

**BRIDGE CONDITION FORECAST SYSTEM (BCFS)**

- Uses NBI (National Bridge Inspection) ratings to measure the bridge network condition.
- Uses current condition of network as a starting point.
- Uses estimated bridge network deterioration rates based on deterioration rates in recent years.
- Uses a mix of fixes based upon a strategic selection of Replacement, Rehabilitation, and Capital Preventative Maintenance projects.
- Uses average construction costs for bridge projects.

**REHABILITATION ($500 - 790 THOUSAND)**

- Graph showing distribution of rehabilitation costs based on NBI ratings.

**REPLACEMENT ($1.2 - $1.8 MILLION)**

- Graph showing distribution of replacement costs based on NBI ratings.

**PREVENTIVE MAINTENANCE ($200 - $300 THOUSAND)**

- Graph showing distribution of preventive maintenance costs based on NBI ratings.
“Big Bridges” Need Special Management and Dedication of Funds

- Complex bridges, including movable bridges, post tensioned segmental concrete bridges, and bridges with larger deck area (over 100,000 square feet) are inspected and managed by a statewide “Bridge Operations Unit” based out of Lansing.

- Goal is to always maintain these bridges in good or fair condition.
Bridges deteriorate much slower than roads, so coordinate bridge work with the road work.
As we build our preventive maintenance program, each year we work on more bridges.

- **MDOT statewide**
  - Touch each bridge every 15 years.
- **University Region**
  - Touch each bridge every 10 years

Implementing preservation is harder than developing it through your BMS
Performance Measure

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
Performance Measure for Preservation Monitor Bridges Dropping to Poor (Structurally Deficient)
Bridge Cycle of Life

Bridges Cycle of Life
2004 - 2010

16% Bridges

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

14.2% Bridges

MDOT
Michigan Department of Transportation
Is your Bridge Management System:

• Network/Strategic Level
  – NBI Bridge Condition ratings work well
  – Managing your “network” of bridges
  – Information for high level, executive, legislature, transportation commission.

• Project Level
  – Pontis elements work well
  – Prioritizing bridge projects
  – Managing bridge elements
  – Information for bridge engineers and practitioners
  – A project level BMS must have good need indicators
What is a need indicator?

- Data collected during the routine bridge inspection that identifies a specific work type activity.
- Example – Expansion joint leaking identifying repair or replacement
Preservation Projects Need Detailed Scopes to determine “fix”

- The routine (visual) bridge inspection is not enough to determine actual bridge project needs.
- Sometimes it takes a hands-on inspection to locate areas of deterioration
  - Chain drag bridge deck
  - Sound concrete surfaces
  - Measure section loss of corroded beams
- Compare costs of different fixes (sometimes using life cycle cost analysis)
Develop Guides for Projects Given Condition (Know your need indicators)

- Separate matrix provided for decks with epoxy coated rebar

![Bridge Deck Preservation Matrix – Decks with Epoxy Coated Rebar](image)
Pontis Reports

- Possible projects with estimate of cost (unlimited budget)
- Future Poor Bridges (predicts what year a bridge will become poor (2012 – 2031))
Pontis – Next Steps

• Agency rules need to be made more robust
• Would like to be able to aggregate project-level recommendations to the categories of CPM, Rehab, and Replacement.
• Need to be able to specify a mix of fixes in those same three categories and let Pontis recommend the best projects that meet the criteria set by the user.
There is always a level of risk when doing preventive maintenance and rehab.

What level of repair do you do? Repair beam ends or replace beam?

Look for hidden damage.
Coordinate your capital program with your routine maintenance program (done by maintenance crews)
Prioritize Using Risk Assessment

NCHRP Project 20-07/Task 151B

MDOT Southwest Region Scour Risk Assessment

Vulnerability

Criticality

Not Programmed □ Programmed
Bridge preservation is harder than simple replacement.

But, it is worth the effort. Thank You