VDOT’S BRIDGE PRESERVATION PROGRAM

Virginia Concrete Conference, 2012

RICHMOND, VA

March 9, 2012

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Assistant State Structure and Bridge Engineer for Bridge Maintenance
VDOT Structure and Bridge Division
The Structure and Bridge Division has the same organizational structure in the Central Office and the Districts

**Central Office**

- **State Structure and Bridge Engineer**
  - Ken Walus

  - **Preliminary Engineering**
    - David Nuckols
  - **Inspection & Load Rating**
    - Claude Napier
  - **Maintenance**
    - Adam Matteo
  - **Engineering Services**
    - Julius Völgyi

**9 District Offices**

- **District Bridge Engineer**

  - **Preliminary Engineering**
  - **Inspection & Load Rating**
  - **Maintenance**
The Challenge
There isn’t enough money to meet all the needs of Virginia’s aging Bridges and Culverts

- $1.7 Billion total maintenance need statewide
- Replacement value of the inventory is $52.4 Billion
- Approximately 60% of Virginia’s inventory is 40 years old or older
- Structures built prior to 2007 were designed for 50 year life
- Replacement value of all structures 40 years or older is $18.7 Billion
- Structures designed for 50 years may need to be kept functional for 100 years or more, perhaps even as long as 150 years
- 4719 structures with a minimum General Condition Rating of 5 (almost ¼ of the entire inventory)
- Approximately 21,000 structures in the inventory, 19,390 of which are VDOT-maintained (by comparison, Florida has 6,644 structures)
- 1,537 structures with a min. General Condition Rating of 4 or less
- Maintenance budgets are about 2/3 needs
* County Bridges added to the VDOT Inventory during this period with unknown construction dates (Assumed year built equaled year added to system)

**Structures Built – by Decade**
Average Age of Structures – by Highway System
General Condition Ratings

DEFINITIONS
9  EXCELLENT CONDITION
8  VERY GOOD CONDITION
7  GOOD CONDITION
6  SATISFACTORY CONDITION
5  FAIR CONDITION
4  POOR CONDITION
3  SERIOUS CONDITION
2  CRITICAL CONDITION
1  "IMMINENT" FAILURE CONDITION
0  FAILED CONDITION

GENERAL CONDITION RATINGS ARE PROVIDED AT EACH INSPECTION FOR:
•  DECK
•  SUPERSTRUCTURE
•  SUBSTRUCTURE
•  CULVERT

The General Condition Rating is an imperfect index, but it can provide good broad-based information about an inventory.
Approximately 200 structures per year go from “5” to “4” and become Structurally Deficient.
The Solution

Whine until we get more money?
Attacking the Problem

Spend Resources as wisely as possible to extend the life of the inventory

• Replace joints in a timely manner
• Spend money on the most cost-effective actions
  • Make data-driven decisions when selecting interventions
  • Constantly evaluate new materials and methods
• Don’t pursue a “worst first” approach
  • Emphasize preventive maintenance
  • Balance spending
• Perform high quality work
• Utilize state bridge crews
• Address highway systems with largest impact to commerce and the public
Bridge Maintenance Requires Bridge Management

- Inspection
  - Inventory
    - Work needs
    - Structure Condition
  - Bridge Management
    - Work Prioritization
    - Project Scoping
  - Project Development
    - Design
    - Permitting
    - Advertisement & Award

VDOT uses Pontis for structure inventory and modeling of needs
Bridge Longevity

New Construction
- Jointless Bridges
- Corrosion Resistant Reinforcement
- Concrete Culverts
- High Performance Concrete

Existing Structures
- Preventive Maintenance
- Painting
- Restorative Maintenance
- Rehabilitation
- Replacement
Examples of Preventive Maintenance

- Bridge Cleaning (washing and/or sweeping)
- Deck Sealing
- Sealing Joints
- Thin Deck Overlays
- Removing Large Debris in Channels
- Cleaning Culverts
- Spot and Zone Painting

VDOT has a system preservation agreement with FHWA to fund these activities

Preventive maintenance has been shown to be the most cost-effective of all bridge maintenance activities for sustaining the lives of structures
Maintenance Activities

Examples of Restorative Maintenance

- Painting (Overcoating or Re-Coating)
- Rigid Deck Overlays
- Reconstructing/Closing Joints
- Superstructure Repairs (Type B patching, etc.)
- Substructure Repairs (including shotcrete, bearings, other elements)
- Joint removal
- Fatigue Retrofitting
- Scour Repairs
- Cathodic Protection
- Electrochemical Chloride Extraction
- Replace timber decks

Much of this work is “reactive” in nature but needs to be performed to sustain our inventory
Maintenance Activities

Rehabilitation

- Generally work of a major nature
- Deck replacement
- Superstructure replacement
- Culvert lining

Replacement

- Part of the maintenance cycle
- Includes replacement of foundations
- Often coincides with a need for widening or geometric improvement
- Many projects are funded through the Dedicated Bridge Fund
Codifying “Best Practices”

Chapter 32 has recently been adopted – available online

- Acts as a primer for those not familiar with bridge maintenance
- Provides strict rules where appropriate
- Provides guidelines where appropriate
- Explains and provides guidance on funding
- Provides guidance on decision processes
- Provides a schedule for preventive maintenance activities
- Is based on both practical experience and studies
- Future revisions will include additional elements such as:
  - Standard details
  - Contract templates for maintenance work
  - Standard Special Provisions
  - Design Aids
  - Additional culvert and timber bridge guidance
What Constitutes “Best Practices”

Fundamental Principals

• Keep the roof dry and clean
  • Replace or eliminate joints
  • Timely installation of overlays
  • Timely spot or zone painting
  • Maintain drains in a functional condition
  • Sweep and wash bridges

• Perform repairs in a timely manner

• Evaluate new technologies and implement the good ones
  • Sponsor studies
  • Utilize research performed by others
  • Try new materials and methods

• Utilize appropriate materials
  • Avoid asphalt overlays
  • Use approved patching materials
Fundamental Principals, continued:

• **Utilize proven technologies**

• **Perform quality work**
  • Treat maintenance work the same as new construction
  • Test and monitor material installation, particularly for concrete
  • Provide adequate inspection
  • Utilize controls where possible

• **Distribute resources appropriately. Chapter 32 suggests:**
  • Preventive Maintenance – 15% (Program 604)
  • Painting – 10% (Program 604)
  • Restorative Maintenance – 25% (Program 604)
  • Rehabilitation/Small Structure Replacement – 50% (Program 604)

• **Maximize available resources**
  • Utilize available funding (state and federal)
  • Plan and perform work for best efficiency (multiple structure contracts)
The Importance of Preventive Maintenance - Joints
The Importance of Preventive Maintenance - Joints
The Importance of Preventive Maintenance - Decks
Preventive Maintenance

- Highest cost benefit ratio of the maintenance categories
- Most of the problems with bridge deterioration can be significantly reduced or avoided altogether with planned preventive maintenance
- FHWA agreement allows these activities to be billed as system preservation
## Preventive Maintenance Proposed Activity Cycle

<table>
<thead>
<tr>
<th>Activity</th>
<th>Preferred Cycle (years)</th>
<th>Federally Eligible?</th>
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</thead>
<tbody>
<tr>
<td>1 Bridge Deck Washing</td>
<td>1</td>
<td>Yes</td>
</tr>
<tr>
<td>2 Bridge Deck Sweeping</td>
<td>1</td>
<td>Yes</td>
</tr>
<tr>
<td>3 Seats &amp; Beam End Washing</td>
<td>2</td>
<td>Yes</td>
</tr>
<tr>
<td>4 Cutting &amp; Removing Vegetation</td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>5 Routine Maintenance of Timber Structures</td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>6 Scheduled Replacement of Compression Seal Joints</td>
<td>10</td>
<td>Yes</td>
</tr>
<tr>
<td>7 Scheduled Replacement of Pourable Joints</td>
<td>6</td>
<td>Yes</td>
</tr>
<tr>
<td>8 Cleaning &amp; Lubricating Bearing Devices</td>
<td>4</td>
<td>No</td>
</tr>
<tr>
<td>9 Scheduled Installation of Thin Epoxy Overlay</td>
<td>15</td>
<td>Yes</td>
</tr>
<tr>
<td>10 Beam Ends Painting</td>
<td>10</td>
<td>Yes</td>
</tr>
<tr>
<td>11 Removing Debris from Culverts</td>
<td>5</td>
<td>Yes</td>
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</tbody>
</table>
Total Number of Structures = 20,860

Approximately 200 structures per year go from “5” to “4” and become Structurally Deficient
Using Data to Make Better Decisions

There are Several Active Studies with the Research Council

- **Coating Study**
  - Process review of how we recoat structures
  - Review enclosure/encapsulation requirements
  - New technologies for removing
  - Other coating systems and application methods available in the market
  - Meeting with the transportation industry and surveying other industries

- **Waterproofing membrane (monitoring effort)**

- **Low permeability asphalt such as Rosphalt**

- **Asphalt Plug Joints**

- **Deterioration rates of structures (data mining)**
  - Looks at past performance of structures and the longevity of interventions
  - Developing cost/benefit ratios
  - Will help guide decision-making for maintenance activities

VDOT also participates in other studies such as the Long Term Bridge Performance Study being sponsored by FHWA
Average General Condition Ratings of Virginia’s Structures
Using Data to Make Better Decisions

Theoretical Deterioration

Extending Bridge Life

- Minimal Maintenance
- Overlay at years 10, 25 & 40
- New Construction
Evaluating Interventions

Hunter Mill Road over Difficult Run
1969-2011

Superstructure Condition Rating
Average Daily Traffic

1969 - VDOT builds new
1993 - VDOT builds new

1984 - Bridge is rated as Critical & classified as
1988 - Posted
15 Yrs

2008 - Bridge is rated as Poor & classified as Structurally Deficient
2011 - Bridge rated as Critical; Posted
15 Yrs
Evaluating Interventions – Epoxy Overlays

Evaluating Interventions – Epoxy Overlays

Effect of Overlays on Deck General Condition Rating

Average Deck General Condition Rating

Concrete decks no overlays
Bridges with Epoxy Overlays
Conc Bridges with Asphalt Overlays

Type of Deck Surface

Effect of Overlays on Deck General Condition Rating
6 year GCR Trends (2006 through 2011)

Average GCR of Bridge Decks

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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</table>

Deck General Condition Rating
### 6 Year GCR Trends (2006 through 2011)

<table>
<thead>
<tr>
<th>Year</th>
<th>Interstate</th>
<th>Primary</th>
<th>Secondary</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>6.400</td>
<td>6.375</td>
<td>6.411</td>
<td>6.408</td>
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</tbody>
</table>

Superstructure General Condition Rating
6 year GCR Trends (2006 through 2011)

<table>
<thead>
<tr>
<th>Year</th>
<th>Interstate</th>
<th>Primary</th>
<th>Secondary</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>6.147</td>
<td>6.349</td>
<td>6.386</td>
<td>6.350</td>
</tr>
<tr>
<td>2011</td>
<td>5.974</td>
<td>6.258</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Evaluating the Performance of Culverts

Average Culvert GCR by Decade and Material

Culverts have outperformed bridges and concrete culverts have outperformed steel culverts
Evaluating the Performance of Culverts

Culverts have outperformed bridges and concrete culverts have outperformed steel culverts
Importance of Quality Control

Governmental procurement rules require many steps before any work can be done in the field.
Importance of Quality Control

Installation

All previous efforts are wasted if the final step isn’t properly performed
Importance of Quality Control
Importance of Quality Control
Summary

- Replace joints in a timely manner
- Spend resources wisely
  - Emphasize preventive maintenance
  - Make data-driven decisions when selecting interventions
  - Constantly evaluate new materials and methods
  - Balance spending
- Perform high quality work