Long-Term Bridge Performance

LTBP Road Map

Roadmap: First Five Years

PRESENTED BY:
Malcolm T. Kerley, P.E.
Chief Engineer

Virginia Department of Transportation
Program Outcome

- **Improved Knowledge of Bridge Performance**
  - *Structural*
    - Better Understanding of Bridge Deterioration
    - Improved Predictive Models
    - Next Generation Design Methods
  - *Operational*
    - Improved Bridge Preservation Practices
    - Improved Life Cycle Cost Models
    - Next Generation BMS
LTBP Road Map

**Step 1**
Defining Bridge Performance (Hooks)

**Step 2**
Data to be Collected & Collection Methods (VTRC & Advitam)

**Step 3**
Data Management System (Siemens)

**Step 4**
Design the Experimental Program (Full Team)

**Step 5**
Data Collection (Full Team)

**Step 6**
Data Analysis & Modeling (Full Team)

**Step 7**
Dissemination of Findings (CAIT)
Step 1 – Defining Bridge Performance

**Current Status:**

- Conducted Focus Groups with CA, FL, VA, NY, NJ, MN, IA, UT, and TX; interviews planned with MT, OR, AL, IL, OH, NE
- Consultation with Expert Working Group
- Drafted primer on bridge performance
- Identified 20 issues affecting bridge performance to be studied under LTBP

**Project Goals**

- Stakeholders
- Focus Groups
- Advisory Board

**Input From:**

**Definition of Bridge Performance**

Define Bridge Performance that is acceptable to FHWA and address broad categories of structural condition, response to loads and impact on traffic service and safety
Step 1 – Defining Bridge Performance

Current Status:

- Conducted Focus Groups with CA, FL, VA, NY, NJ, MN, IA, UT, and TX; interviews planned with MT, OR, AL, IL, OH, NE
- Consultation with Expert Working Group
- Drafted primer on bridge performance
- Identified 20 issues affecting bridge performance to be studied under LTBP

Establish what aspects are critical to FHWA, SHAs. Select those that can be addressed within LTBP resources and recommend for first 5 years of study
Step 1 – Defining Bridge Performance

Current Status:

- Conducted Focus Groups with CA, FL, VA, NY, NJ, MN, IA, UT, and TX; interviews planned with MT, OR, AL, IL, OH, NE
- Consultation with Expert Working Group
- Drafted primer on bridge performance
- Identified 20 issues affecting bridge performance to be studied under LTBP

Identify and classify the factors that impact the aspects of performance determined above
Step 2 – Data to be Collected

Current Status:
- Conducted literature review of the 20 performance issue topics
- Identified salient research questions yet to be answered under each topic
- Defined the data required to address these questions and fill the knowledge gaps

Identify all of the relevant parameters for which high quality data should be documented and/or measured to assist with evaluating performance - Las Vegas Document as start
Step 2 – Data to be Collected

**Current Status:**
- Conducted literature review of the 20 performance issue topics
- Identified salient research questions yet to be answered under each topic
- Defined the data required to address these questions and fill the knowledge gaps

Determine and evaluate the usefulness of relevant bridge and transportation data that is currently being collected
Step 2 – Data to be Collected

Current Status:

- Conducted literature review of the 20 performance issue topics
- Identified salient research questions yet to be answered under each topic
- Defined the data required to address these questions and fill the knowledge gaps

Determine the items of relevant bridge and transportation data that are not currently being collected but are critically needed
Step 2 – Data to be Collected

**Current Status:**

- Conducted literature review of the 20 performance issue topics
- Identified salient research questions yet to be answered under each topic
- Defined the data required to address these questions and fill the knowledge gaps

Investigate the feasibility and cost of obtaining and managing high quality, quantitative data on the items identified above
Step 2 – Data to be Collected

**Current Status:**
- Conducted literature review of the 20 performance issue topics
- Identified salient research questions yet to be answered under each topic
- Defined the data required to address these questions and fill the knowledge gaps

**Recommend what relevant bridge data should be collected**
Step 3 – Data Management System

Current Status:

- Prototype database system established to house/link to:
  - *NBI data*
  - *Pontis data*
  - *Inspection reports, maintenance records, photos, etc. as available*
  - *Weather, traffic and seismic data*
  - *‘Legacy’ or historic/external data collected by different states*
  - *Geographic/GIS data*

- Developed BridgePortal prototype, providing users web-based navigation and querying of the database system, and as well as graphical representation of data
- Ability to integrate with other asset management systems, i.e., pavement and safety
- Developing plans to roll-out system to bridge community
Categories of Performance:
• Damage
• Deterioration
• Operation
• Service

Hierarchy of Data Needs

Testing Program
Data Mining

Visual

Structural Sensors Instrumentation

NDE/NDT

Full-Scale Load Test

Analytical CAD/FEM Modeling and Field Calibration Models

Interpretation of Bridge Performance

Crack sensor
Strain gages
Tilt meters
Accelerometers
Displacement including laser
Chloride
Load test
Weigh-in-motion scales
Wire breaks in prestressing strands
Corrosion sensors
Optical fiber
Step 4 – Design the Experimental Program

Current Status:

- Compiled data collection matrix, matching the data needs with applicable data collection methods, collection frequencies, cost considerations, priority rankings, etc.
- Drafted NDE/NDT protocols
- Drafting visual inspection protocols
  - Utilizing segmental approach
  - Quantitative measures
- Selected pilot bridges in VA & UT
- Drafted instrumentation plans for VA & UT pilot bridges
- Conducted feasibility study and conceptual design of an Accelerated Infrastructure Testing Facility
Step 5 – Data Collection - Pilot

Current Status:
Initiating Pilot Phase

- Evaluate and refine protocols for:
  - Visual Inspection / Documentation
  - NDE (GPR, Impact Echo, Ultrasonics)
  - Electrochemical Testing
  - Physical Sampling and Testing
  - Structural Load and Dynamic Testing
  - Structural Modeling
- Install Long-Term Instrumentation to monitor:
  - Loading (Superstructure Stress/Strain/Tilt)
  - Environment (Wind, Precipitation, Temp)
  - Traffic (Vehicle Type/ Frequency/WIM)
NDE Techniques

- **GPR**
- **Seismic / Ultrasonic**
- **Resistivity**
- **Ultrasonics**
- **Ultrasonic / Impact Echo**
- **Half-Cell**
LTBP Pilot Program – Virginia Pilot Bridge

- CIP concrete deck
- 16,500 AADT
- 6% truck traffic
- NBI Deck condition rating = 6

Constructed in 1979
2-Span continuous built-up steel girder
LTBP Pilot Program – Utah Pilot Bridge

- CIP concrete deck with asphalt overlay and membrane
- \textbf{22,250} AADT
- 29\% truck traffic
- NBI Deck condition rating = 7

constructed in \textbf{1976}
Single span AASHTO beams with \textit{integral abutment}
### Step 5 – Pilot Phase Schedule

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th></th>
<th></th>
<th></th>
<th>2010</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern</td>
<td>VA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
|        |      |      |      |      |      |      |      |      |      |      |      | Virginia
|        | NJ   |      |      |      |      |      |      |      |      |      |      | New Jersey
|        | FL   |      |      |      |      |      |      |      |      |      |      | Florida
|        | NY   |      |      |      |      |      |      |      |      |      |      | New York
| Western| UT   |      |      |      |      |      |      |      |      |      |      | Utah
|        | CA   |      |      |      |      |      |      |      |      |      |      | California
|        | MN   |      |      |      |      |      |      |      |      |      |      | Minnesota

- **Eastern:** VA, NJ, FL, NY
- **Western:** UT, CA, MN

Map showing states involved in the pilot phase.
Step 6 – Data Analysis & Modeling

Integration of Collected Data into LTBP DMS Platform

Improved Deterioration Models

Improved Life-Cycle Cost Models

Development of Guidelines and Recommendations
Step 7 – Dissemination of Findings

Outreach to all Bridge Stakeholders

Education

New FHWA Resources