Federal Highway Administration

Long-Term Bridge Performance Program

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FHWA Long-Term Bridge Performance Program

• Designated in the “SAFETEA-LU” surface transportation authorization legislation as a 20-year research effort to improve our knowledge of bridge performance

• Funding is currently only authorized through FY-2009
Challenges!
FHWA’s Perspective

1) Aging bridge population – performance poorly understood

2) Currently available data will not support desired performance assessments

3) LTBP Program is essential to understanding, improving bridge performance

LTBP program should,
   a. Focus on most common bridges
   b. Serve FHWA and stakeholder needs
   c. Not burden bridge owners with new requirements
   d. Encourage international cooperation
State DOTs’ Perspective

1) Available road and bridge funds have leveled off or decreasing
2) Key material prices escalating beyond inflation rate
3) Traffic Volume and load demands growing rapidly
4) Demand and expectations from users of the system will continue to grow
5) Eliminating deficient bridges

LTBP program should, 
   a. Help States meet challenges
   b. Set data protocols
   c. Focus on practical, useful data
   d. Take advantage of sensing technology
Availability and quality of data will affect the degree of uncertainty in assessing bridge performance, developing deterioration models and performing LCC analysis.

Uncertainty in data is:
- Aleatory— that is the inherent randomness or variability in the data
- Epistemic— that is the lack of sufficient knowledge or the inability to predict or estimate the desired data correctly
Bridge Performance?

• Define
• Measure
• National consensus
  – Number of bridges needing work
  – Structural deficiencies, posting or sufficiency rating (uncertainties)
  – Deficiencies and load carrying capacity
  – Customer satisfaction
Challenges in Measuring Bridge Performance

- It is not well defined and understood or documented
- Relies too heavily on expert opinion and not on objective data
- Based on significant assumption or generalization based on a very simplistic understanding of bridge behavior
- Uncertainties
  - Subjectivity of current condition ratings
  - Lack of proper documentation (i.e., records of actions and costs)
  - Incomplete data (i.e., cost, maintenance)
  - Many hidden deterioration and damage escape visual inspection
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Uncertain Action Effectiveness

1. different actions at a given application time \( t_1 \)
2. same action at different application time \( t_1 \) vs. \( t_2 \)

Uncertain Time of Applying/Delaying Actions

Uncertain Costs associated with applied actions

Uncertain Deterioration Rates associated with different actions

Uncertain Bridge Condition vs. Age
Measuring Performance

Moving Target!
Goals and Performance Categories

**Structural Condition & Integrity**
- Types, Materials and Specifications
- Clearance
- As built material and construction quality
- Traffic loads – trucks
- Environment – climate, air quality and marine atmosphere
- Snow and ice removal operations
- Type, timing and effectiveness of preventive maintenance
- Type, time and effectiveness of restorative maintenance and rehabilitation
- Hydraulic designs and scour mitigation programs
- Soil characteristics and settlement

**Safety of User**
- Structural geometry
- Vertical clearance
- Traffic volume and % trucks
- Posted Speeds

**Cost to User and Agency**
- User
  - Accident cost
  - Delay and detour costs to users
- Agency
  - Initial costs
  - Maintenance and rehabilitation costs
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Bridge Construction History

- Number of Bridges
- Year of Construction

~ 600,000
Mean Age: 40 yrs
Stewardship and Management

- Quantitative Database
- Better information
- Sensor Technology (i.e., NDE, SHM)
- Training and education
- Deployment
- Improved Bridge management
LTBP Program Objective

- Collect, document and maintain high quality, quantitative performance data
- Improved knowledge of bridge performance
- Improved asset management
Anticipated Impacts of the LTBP Program

- Improved knowledge of bridge performance
- Advances in deterioration and predictive models
- Effective use of Life-Cycle Cost Analysis
- Improved inspection/condition information thru NDE and SHM
- Help foster the next generation of bridge and asset management systems
Vision

• Detailed inspection, *periodic* objective evaluation and monitoring (Representative sample of bridges, excluding long-span bridges)

• Instrument and continuously monitor

• Forensic autopsies of decommissioned bridges
LTBP Team

FHWA
Turner Fairbanks Laboratory
LTBP Program Manager

Rutgers University
Center for Advanced Infrastructure & Transportation (CAIT)
Principal Investigator
Contract Management
Outreach / Communications
NDT / NDE
Modelling

PB
Coordination
Oversight
QA/QC
Visual Inspection

Turner Fairbanks Labs
BMISL
NDT/NDE

Utah State University
Utah Transportation Center
(Covering Western Half)
Bridge Health Monitoring

Virginia Transportation Research
Center (VTRC)
Virginia Tech
(Covering Eastern Half)
Bridge Health Monitoring

Siemens America
Data Infrastructure
Data Model
Database

Institute for Transportation Studies UC Berkeley
Life Cycle Cost Analysis
Bridge Asset Management

Bridge Diagnostic Inc.
Diagnostic Testing
instrumentation

Advitam
Data Interface Management
Long-Term Bridge Performance Program

LTBP Overview Map

Data Collection, Inspection & Monitoring
Including the use of NDE/NDT, visual inspections, instrumentation, diagnostics, and forensic autopsy
Development and Pilot Tasks and Responsibilities

- Road Map
- Specific Data to be Collected
- Development of Data Infrastructure
- Protocols for Data Sampling, Collection, and QA
- Bridge Sampling Methodology
- Synthesis of Bridge Monitoring and Autopsy Methods
- Protocols for Bridge Monitoring and Autopsy
- Communication/Marketing Plan and Products
- Project Coordination (for Fieldwork)
- Draft Pilot Study Plan
- Pilot Study Execution

Development Phase:
- CAIT
- PB
- UTC
- VTRC
- Siemens
- Advitam
- BDI
- Program Consultant

- Team Member is Significant Participant
- Team Member has Primary Responsibility
LTBP Pilot Program
Concluding Remarks

• Current bridge performance assessments are based on subjective data and generalization

• There is a broad consensus in the bridge community that the state-of-the-knowledge about bridge performance can and should be greatly improved

• There is need for a quantitative bridge database
Concluding Remarks Continued …..

• Quantitative data and knowledge learned from the LTBP program could lead to
  – Better understanding of bridge performance
  – Improved knowledge of bridge deficiencies
  – Design and construction of bridge of the future
  – Improvements in the effectiveness of the NBI and PONTIS
  – Efficient management of highway systems
LTBP Program Information

LTBP Program Web site
www.tfhrc.gov/structur/ltbp.htm

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Thank You!