The FHWA Long-Term Bridge Performance Program

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In 2008, the Federal Highway Administration launched the Long-Term Bridge Performance (LTBP) program, a 20-year-long research program to collect, maintain, and study high-quality, quantitative performance data on bridges. These data will support a better understanding of how and why bridges deteriorate, how to best prevent or mitigate deterioration, how to advance the design and construction of the next generation of bridges, and how to focus the next generation of bridge management tools.

The LTBP program is an undertaking of immense complexity. There are dozens of factors and thousands of combinations of those factors that characterize the bridge population and influence the condition and performance of bridges. Bridges differ greatly by span type, design features, construction materials, dimensions, live load histories, environmental and climatic factors, physical changes that occur on the bridge, and history of maintenance, preservation, and rehabilitation. Each and every bridge represents a unique combination of these factors.

The LTBP Program Roadmap

These differences illustrate the challenges that the LTBP program must address. Because of these complexities and the intended 20-year duration of the program, a well-designed research plan is essential.

The roadmap steps include the following:

1. Defining bridge performance in terms of the specific important issues
2. Identifying critical gaps in knowledge and data
3. Creating a data infrastructure for bridge data from a variety of sources and with different formats
4. Designing experimental studies to answer key performance questions
5. Collecting data on representative samples of bridges, analyzing data, and creating performance models

Starting with What is Known

The National Bridge Inventory (NBI) contains records on every bridge on all public highways in the United States. The NBI provides information on location, age, type of construction and geometry, functional class of the route carried, and up-to-date data on the condition and adequacy of the structure. The NBI is an invaluable resource for matching bridge types and bridge conditions with factors such as age, average daily truck traffic, and environment, and revealing performance relationships and trends that should be studied further. When culverts and tunnels, which will not be studied under the LTBP program, are excluded, over 80% of the bridges in the United States are simple or continuous spans of steel or concrete I-beams, boxes, or slabs. These are the bridge types that will be the initial focus of the LTBP program.

As a part of the development phase, the LTBP program has identified 20 high-priority bridge performance issues in collaboration with 15 state Department of Transportation (DOT) bridge offices. Experts from the DOT offices included those responsible for the design, construction, inspection, management, and maintenance of bridges. These states were selected on the basis of size, geographic location, and climatic conditions to ensure broad national representation. The high-priority performance issues that have been identified are the most common concerns and the most costly activities that the states face in maintaining, repairing, and rehabilitating bridges. These state DOTs also helped identify what data they currently collect and use for their decision-making processes and what gaps they see in their currently available data. These performance issues include performance of cast-in-place (CIP) concrete decks with various protective measures, joints and bearings, coated steel and weathering steel girders, concrete and prestressed concrete girders, substructure members, and mechanically stabilized earth walls, plus foundation elements vulnerable to scour.

One of seven pilot bridges is located near Perry, Utah. Photos and graphic: Federal Highway Administration.

This California pilot bridge is located about 30 miles south of Sacramento.

The Pilot Bridge Phase

The quality and quantity of data collected under the LTBP program must be consistent with the needs of the LTBP experimental studies, and test protocols used for the LTBP inspections must be clear and consistently applied. Because of the complexities of the LTBP program, many uncertainties must be investigated in order to ensure collection of high-quality data while avoiding wasted efforts and costs and minimizing disruption to bridge owners and users. These uncertainties include the amount of time, effort and cost for office preparation, field work, collection and analysis of data; the costs of instrumentation and data collection systems; the time necessary to coordinate with bridge owners and obtain necessary permits; and the costs of maintenance and protection of traffic while field work is underway.

A 2-year pilot phase using seven bridges as field laboratories is helping to resolve these uncertainties. The selection criteria for pilot bridges ensure that the pilot bridges represent a cross section of the bridges that will be the focus of the LTBP program. Primary selection criteria are superstructure type, age, type of deck, composite or noncomposite design, deck condition, environmental factors, overall traffic, and percentage of trucks in the traffic stream. The seven pilot bridges are located in California, Florida, Minnesota, New Jersey, New York, Utah, and Virginia, creating a broad geographic distribution. Three concrete bridges are included.

A pilot bridge in Utah carries southbound I-15 over Cannery Road near Perry. The bridge, constructed in 1976, is a single span of AASHTO precast, prestressed concrete beams with integral abutments. The CIP concrete deck has an asphalt overlay and waterproofing membrane.

A pilot bridge in California carries I-5 over Lambert Road about 30 miles south of Sacramento. The bridge, constructed in 1975, is a two-span, post-tensioned, continuous CIP box-girder bridge with a CIP concrete deck.

The LTBP Program Roadmap.

The New York pilot bridge is the Karr Valley Creek Bridge on Route 21 in Almond, N.Y. The bridge, constructed in 1990, consists of two simple spans of adjacent precast, prestressed concrete box beams made continuous for live load using a continuity diaphragm over the center pier.

The ultimate goal of the pilot study phase is to make certain that all components needed to achieve the long-term objectives of the LTBP program are well tested before beginning the long-term data collection phase.

The pilot bridges were subjected to a comprehensive regimen of finite element modeling, detailed visual inspection, and live load testing and/or dynamic testing to provide a baseline for the condition and structural behavior of the bridges. The deck of each bridge was also inspected using several different nondestructive testing methods, and cores were taken to help characterize the material qualities of the deck and the type and extent of any deterioration. The results of the pilot bridge studies will be evaluated to determine what adjustments in the LTBP protocols are appropriate. The baseline testing of all pilot bridges is expected to be completed by the spring of 2011 and evaluation of all the pilot bridge testing data will be completed by the fall of 2011.

The long-term data collection phase of the program will begin early in 2011. The knowledge gleaned and lessons learned from the pilot phase will provide critical insight into the planning and implementation of the long-term data collection phase.

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EDITOR'S NOTE

More details of the Long-Term Bridge Performance program can be found in a paper prepared by John Hooks. The paper can be downloaded from the *ASPIRE*™ website: www.aspirebridge.org, click on "Resources" and select "Referenced Papers.