Long-Term Bridge Performance Committee Letter Report: February 23, 2016

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TRB

TRANSPORTATION RESEARCH BOARD

February 23, 2016

Mr. Gregory G. Nadeau
Administrator
Federal Highway Administration
U.S. Department of Transportation
1200 New Jersey Avenue, SE
HOA-1, Room E87-314
Washington, DC 20590-9898

Re: 6th Letter Report of the TRB Long-Term Bridge Performance Committee

Dear Mr. Nadeau:

I am writing to report the findings and recommendations developed at the meeting of the Transportation Research Board (TRB) Long-Term Bridge Performance (LTBP) Committee on November 17-18, 2015.

As explained in earlier letter reports, this Federal Highway Administration (FHWA) long-term program addresses the challenges faced by federal, state, and local transportation agencies in the operation and maintenance of their deteriorating highway bridges. The program will collect research-quality data on a large representative sample of in-service U.S. highway bridges and analyze these data to improve understanding of the mechanisms and timing of bridge deterioration due to age, materials, traffic, and weather. The data collection and analysis will also help evaluate the effectiveness of intervention options in ameliorating this deterioration.

Through a contractual arrangement with FHWA, the National Research Council of the National Academies provides advice and assistance on the conduct of the LTBP program through the work of its TRB LTBP Committee.

The agenda of the meeting consisted of informational briefings and status reports by members of the FHWA LTBP Research Team and the chair of the committee's Expert Task Group (ETG) on LTBP Special Activities, each followed by a question-and-answer period and discussion. Among the matters addressed were the following: the status of the program, updates on ongoing and newly initiated activities including the LTBP Business Plan, data collection, the Bridge Portal, data-driven research-oriented deterioration studies, cost analysis modeling, characterization of dynamic response to high loads, and program outreach.

At the conclusion of these open sessions, the committee held a closed session to deliberate on its findings and formulate its consensus advice[1]. The detailed findings and recommendations appear after the following general summary:

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[1] The committee's advice is presented as a set of pairs of findings and recommendations. A committee finding is a conclusion based on the meeting's reading material, presentations, and discussions. A committee recommendation is a suggested action by the LTBP team as a consequence of this finding. Each finding-recommendation pair is given a unique designator (letter report number/recommendation number) to facilitate future referencing. The usual format of a finding-recommendation pair is a paragraph or paragraphs summarizing the committee's finding and a paragraph

- Reports from committee members who attended a recent LTBP state coordinators' meeting indicate that the value of LTBP is now generally apparent.
- The LTBP Bridge Portal is seen as a rich source of bridge data.
- Element-level data are being added to the portal by state departments of transportation (DOTs), and higher-level modeling is being developed on the basis of those data.
- Data-driven deterioration modeling is being developed for use in defining performance.
- With the inclusion of nondestructive evaluation (NDE) data from the pilot bridges and the potential for more data from reference bridges in the clusters, performance modeling for various types of bridges is within reach.
- Protocols are in place to allow owner agencies to start replicating LTBP's data collection to determine the performance of bridge subsets and correlate them with LTBP's findings.
- The NDE Web Manual provides guidance on improving the collection of data-driven bridge performance information.
- The coordination with the pooled-fund program on the effect of truck size and weight on bridges will help establish a data-driven approach to this issue.
- The data collection and monitoring now being undertaken can be the means for quantifying the value of effective preservation actions and encouraging their application and the use of more durable materials.
- Outreach efforts highlighting applications of the Robotics Assisted Bridge Inspection Tool (RABIT[2]) were effective in demonstrating LTBP accomplishments, and similar efforts with regard to the Bridge Portal would be appropriate. Future efforts should be planned, especially those concerning bridge preservation and management. However, the committee recommends development of an additional parallel approach targeting DOT upper management and CEOs.

LR06/01

The committee noted significant progress in several areas: development and availability of LTBP's Bridge Portal, collection of historical data and data monitoring the performance of cluster bridges, completion of many data collection and analysis protocols, and development of deterioration modeling tools. LTBP's potential for improving the understanding of bridge performance and providing tools that will help translate that understanding into improved design, operations, and maintenance of highway bridges is evident.

We recommend that the development of data-driven decision-making tools be adopted as the key goal of all LTBP outreach efforts, especially in communications to LTBP's state coordinators, American Association of State Highway and Transportation Officials (AASHTO)

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containing the committee's recommendation. The latter paragraph is italicized and underlined.

[2] The RABIT™ bridge deck assessment tool was developed by the LTBP program to deploy a suite of nondestructive evaluation technologies simultaneously, and thereby to enhance the field assessment of bridge decks.. The technologies incorporated into the remotely controlled RABIT™ include:

- Panoramic Camera to collect high-quality, 360-degree images around the bridge deck.
- High-Definition Imaging to capture high-resolution images of the deck surface using professional-grade cameras.
- Electrical Resistivity to characterize the corrosive environment of the concrete.
- Impact Echo and Ultrasonic Surface Waves to evaluate concrete delamination and concrete deck strength.
- Ground Penetrating Radar to "map" rebar and other metallic objects below the surface using electromagnetic waves, and to provide a qualitative assessment of concrete deck deterioration.
- Global Positioning System to record and mark location data, making testing grids virtually obsolete.

committees, and individual state DOTs.

We request a briefing at the next meeting on the progress being made in improving access to the LTBP database.

LR06/02

The committee was pleased with the progress in defining the overall strategy, direction, and expected outcomes of the program in the LTBP Business Plan. We look forward to receiving periodic updates on the plan.

We suggest that the plan define and distinguish between LTBP's short- and long-term goals, establish measurable outcomes, and include contingency plans for reduced funding scenarios. We also suggest that the plan for collection and analysis of performance data and for the development of data-driven decision-making tools based on such data and analysis be structured in a way that identifies and prioritizes the key components of highway bridges influencing their service life. Most important is a clear statement of how LTBP supports federal and state agency efforts to improve the management and preservation of highway bridges.

LR06/03

With field monitoring data from LTBP's pilot bridges and the potential for collection of additional data from reference bridges in LTBP's clusters, the analysis of performance data for various types of bridges is clearly within reach. Considerable effort has been expended by LTBP in developing a data-driven bridge deterioration prediction procedure, but the committee is uncertain of the procedure's value because it is highly theoretical and based on complex statistical analysis. LTBP's approach is claimed to include auto adjustments ("learning") similar to AASHTO's ongoing BrM software development[3] because numerical iterations with additional data are conducted, except that BrM uses visual element-level data and the LTBP model can incorporate direct NDE measurements. Some time will be required before the LTBP database is sufficiently well-populated with research-quality data to enable full demonstration of this procedure.

We suggest that development of this procedure continue but that additional numerical cases be studied by using a variety of mechanistically based deterioration models and weighting values to demonstrate the fundamental assumption that this procedure can "learn" through numerical iterations and that its results are independent of the initial weightings used.

We request a briefing at our next meeting that focuses on the need for this new deterioration model, its extension of the capabilities of BrM, and its expected applications within the LTBP program.

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[3] The AASHTOWare Bridge Management software (BrM), formerly Pontis, was first developed under a National Cooperative Highway Research Program (NCHRP) project sponsored by FHWA in the early 1990s and soon thereafter was transferred to AASHTO for further development, maintenance, and support. For more than 20 years BrM has seen dramatic improvements due to technological changes, product innovations, and, most important, direct user feedback. BrM is a key product in the AASHTOWare software suite and continues to be the primary bridge management software among transportation agencies across the United States and internationally.

LR06/04

The committee is impressed by the use of the THMPER and RAMPS[4] systems in identifying and quantifying bridge response to heavy loads but questions the role of these systems in facilitating the achievement of LTBP's goal. For example, how do these response results help locate and quantify the extent of deterioration of individual structural members? We encourage continued development and testing of this technology with emphasis on establishing a correlation between response results and bridge performance.

We request briefings at our next meeting that focus on how the use of THMPER and RAMPS accelerates the development of data-driven decision-making tools.

LR06/05

The committee agrees with the LTBP team's stated need to collect bridge maintenance and preservation action data, including costs, life extension, and other benefits.

We recommend focusing first on the results of NCHRP Project 14-15, NCHRP Report 668: Framework for a National Database System for Maintenance Actions on Highway Bridges, to determine whether the resulting database of maintenance costs can be incorporated into the Bridge Portal and related to some of the reference or cluster bridges. Preparation of a protocol for the type of maintenance data needed would also help in the collection of data for LTBP's reference and cluster bridges in each state. State data concerning construction quality issues on reference and cluster bridges should also be requested.

In closing, as before, we recognize that the preparations for this meeting required extensive effort by many people. We appreciate everyone's efforts and particularly thank Hamid Ghasemi, Susan Lane, Robert Zobel, and their colleagues for a highly informative and productive meeting.

Sincerely,

Bruce V. Johnson
TRB LTBP Committee

Attachment 1: Roster, TRB Long-Term Bridge Performance Committee
Attachment 2: Agenda, Meeting of the TRB Long-Term Bridge Performance Committee, November 17–18, 2015

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[4] THMPER (Targeted Hits for Modal Parameter Estimation and Rating) combines a self-contained rapid modal testing trailer and streamlined data processing software to extract modal parameters. RAMPS (Rapid Automated Modeling for Performance of Structures) is a software tool used for finite element modeling, calibration, and simulation. It builds and updates a finite element model with field-collected data in a fraction of the time required for traditional impact testing.

ATTACHMENT 1

TRB Long-Term Bridge Performance Committee

Membership Roster

Bruce V. Johnson, Chair
State Bridge Engineer
Oregon Department of Transportation

R. Scott Christie
Deputy Secretary for Highway Administration
Pennsylvania Department of Transportation

Matthew M. Farrar
State Bridge Engineer
Idaho Transportation Department

Karl H. Frank
Chief Engineer
Hirschfeld Industries, Austin, Texas

Gregg C. Fredrick
Assistant Chief Engineer
Wyoming Department of Transportation

Malcolm T. Kerley
President
NXL Construction Services, Inc., Richmond,
Virginia

John M. Kulicki
Chairman Emeritus
Modjeski and Masters, Inc., Mechanicsburg,
Pennsylvania

Richard D. Land
Quality Practice Leader, Complex Bridges
AECOM, Sacramento, California

Sandra Q. Larson
Director, Systems Operations Bureau
Iowa Department of Transportation

Paul V. Liles, Jr.
Roswell, Georgia

Samer Madanat
Xenel Professor of Engineering
University of California, Berkeley

Ananth K. Prasad
Senior Vice President and National
Transportation Practice Leader
HNTB Corporation, Tallahassee, Florida

Kenneth D. Price
Vice President—National Bridge Practice
HNTB Corporation, Chicago, Illinois

LIAISONS

Patricia Bush
Program Manager for Bridges and Structures
American Association of State Highway and
Transportation Officials, Washington, D.C.

Waseem Dekelbab
Senior Program Officer, TRB NCHRP,
Washington, D.C.

Danielle Kleinhans
Concrete Reinforcing Steel Institute,
Schaumburg, Illinois

William F. McEleney
Director
National Steel Bridge Alliance, Cranston, Rhode
Island

Ted M. Scott III
Director of Engineering
American Trucking Associations, Alexandria,
Virginia

ATTACMENT 2

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Agenda
TRB Long-Term Bridge Performance Program Advisory Committee (BCOM)
November 17–18, 2015
Arnold and Mabel Beckman Center
100 Academy, Irvine, California
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<td colspan="3">
This committee provides an ongoing peer review of the Long-Term Bridge Performance (LTBP) program, which is an extended research effort to measure and monitor the performance of a nationally representative sample of bridges. The committee reviews the LTBP program's plans, operations, progress, and products and provides advice to FHWA on the program's strategic plan; data definition, standardization, quality control, and collection efforts; sampling plan; and overall R&D program management and direction.
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Tuesday, November 17, 2015
Board Room

Time	Topic	Presenter	Type
8:00–8:30 a.m.	- Welcome, Introductions, Administrative Matters - Review of Staff Notes, Adoption of Agenda - BCOM Scope, Role, and Operations	*Bruce Johnson (BCOM Chair)* *Rob Raab (TRB Staff)*	I/A[a]
8:30–9:00 a.m.	BCOM Letter Report No. 5 FHWA Response to BCOM Letter Report No. 5	*Bruce Johnson, Rob Raab* *Rob Zobel (FHWA), Hamid Ghasemi (FHWA)*	I
9:00–9:15 a.m.	Special Activities ETG Report	*Jugesh Kapur (BSPEC Chair)*	I
9:15–10:00 a.m.	LTBP Program Update - Data Collection, Management, and Analysis - LTBP Draft Business Plan	*Rob Zobel*	I
10:00–10:15 a.m.	Break		
10:15–10:20 a.m.	LTBP Share Point Site	*Rob Zobel*	I
10:20–11:15 a.m.	LTBP Bridge Portal Demonstration	*Rob Zobel*	I
11:15 a.m.–noon	***BCOM Guidance*** - Business Plan, High-Priority Issues, Moving Forward - LTBP Bridge Portal—Future Development - Data Collection Efforts	*Rob Zobel*	A
Noon–1:00 p.m.	Lunch		
1:00–1:45 p.m.	LTBP Data-Driven Research-Oriented Deterioration and Cost Analysis Modeling Efforts	*Rob Zobel, Haotian Liu (Rutgers)*	I
1:45–2:15 p.m.	Bridge Dynamic Characterization—THMPER	*Frank Moon (Rutgers)*	I
2:15–3:15 p.m.	***BCOM Guidance*** - Bridge Characterization—THMPER - Deterioration and Cost Analysis Modeling	*Rob Zobel*	A
3:15–3:30 p.m.	Break		
3:30–4:00 p.m.	Outreach/Leveraging	*Dick Dunne (Michael Baker)*	I
4:00–4:30 p.m.	Discussion/Recap	*Bruce Johnson*	I/A
4:30–5:30 p.m.	Closed Session - Biases and Conflicts of Interest - Consensus Deliberations		
5:30 p.m.	Adjourn for the Day		

Wednesday, November 18, 2015 Balboa Room		
8:00–11:15 a.m.	***BCOM Guidance*** 1- Working Group Development 2- Business Plan 3- High-Priority Performance Issues 4- BEAST—Leveraging with LTBP 5- Weathering Steel White Paper 6- Glossary White Paper 7- Status Reports—3 Months	*Rob Zobel*	I/A
11:15-11:30 a.m.	Chairman's Recap of Issues	*Bruce Johnson*	A
11:30 a.m.– noon	Closed Session - Committee Disclosure of Biases and Conflicts of Interest	*Rob Raab*	A
Noon–1:00 p.m.	Lunch		
1:00–2:00 p.m.	Closed Session - Committee Deliberation on Consensus Statement	*Rob Raab*	
2:00–2:30 p.m.	Open Session -Concluding Remarks	*Bruce Johnson*	
2:30 p.m.	Adjourn		

a The labels "I" and "A" signify that the respective agenda items are intended to provide information (I) to the committee or to request committee action (A) in the form of feedback. The absence of an "A" is not intended to prevent committee feedback on any agenda item.

This meeting was held to gather information that will form the basis of BCOM's findings and recommendations. The findings and recommendations will be reported in writing to FHWA and AASHTO in the weeks after the close of the meeting.