

INFRASTRUCTURE facts

- There are approximately 600,000 highway bridges in the United States
- Average age of structures in the interstate highway system is 35 to 40 years old
- 26 percent of U.S. bridges are rated either deficient or functionally obsolete
- More than 4 million miles of public roads exist in the United States, enough to circle the globe more than 160 times
- Number of miles Americans drive each year has nearly doubled since 1980 and more than quadrupled since 1960



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WHY bridge research matters

The U.S. highway system is immense, aging rapidly, and being used more heavily every day. Highway bridges are vital components in the transportation network we all rely on.

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Federal Highway Administration

LONG-TERM bridge performance PROGRAM

Bridges do more than help us get from here to there: They are critical links that make mobility and commerce possible. The entire transportation system is so integrated in our daily lives that it's easy to take for granted, like tap water and electricity. But when a bridge we cross every day is closed, it's suddenly no longer "invisible."

According to the U.S. Department of Transportation (USDOT), one of every eight bridges in the United States is rated structurally deficient, that is, in need of significant maintenance, rehabilitation, or replacement to remain in service. Many more bridges are functionally obsolete, meaning that to serve the traffic demands generally placed upon them they should be updated or otherwise improved.

The continuous upkeep of transportation assets like bridges is one of the ongoing planning, operational, and economic challenges that federal, state, and local transportation agencies constantly grapple with.

ADDRESSING A national need

To help address the issue of our aging infrastructure, the Federal Highway Administration (FHWA) initiated the Long-Term Bridge Performance (LTBP) program. LTBP is envisioned as a 20-year comprehensive examination of our nation's "workhorse" highway bridges—structures that include what many people commonly think of as elevated roadways. Funding for the program was included in legislation for surface transportation programs enacted by the U.S. Congress in 2005, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU).

Rutgers' Center for Advanced Infrastructure and Transportation (CAIT) is leading the study, coordinating a diverse team of experts from industry, government agencies, and academia.

WHAT IS BRIDGE PERFORMANCE?

Bridge performance encompasses how bridges function and behave under the complex and interrelated factors and stresses they are subject to day in and day out—traffic volumes, loads, and environmental assaults like de-icing chemicals, freeze-thaw cycles, rains, or high winds. Bridge design and construction, materials, age, and maintenance history also play huge roles in performance. A bridge that is performing well is doing the job it is intended to do safely, efficiently, and reliably.

BRIDGE data today

Most state highway agencies examine highway bridges biennially to collect information on their status, mainly through visual inspections. This data is maintained by FHWA in the National Bridge Inventory (NBI) database, which contains information on the physical characteristics (material, design, age, etc.) of more than 590,000 bridges. Although NBI is one of the most comprehensive sources of bridge data in the world, a basic limitation of both NBI and the element-level inspection approach currently used is that the data collected is largely subjective, variable, and general—not conducive to reliable, long-term bridge management. The minimal data on traffic, climate, and maintenance history contained in NBI also is not adequate for accurate life-cycle cost and performance modeling.

LTBP will greatly enhance the current information, providing comprehensive, uniformly collected data that will be more useful for long-term, life-cycle decision support and a broader understanding of bridge performance.

WHAT IS INFRASTRUCTURE ASSET MANAGEMENT?

Infrastructure asset management—in this case bridge management—is a system of cost-benefit analyses that combines engineering principles with sound business practices and economic theory. It provides a decision-making framework and tools for bridge owners to better plan what maintenance and repair actions should be taken, when these actions should be taken, and how priorities should be set so that they can get the most "bang for the buck" from limited funds available for bridge upkeep.

A CLOSER look

The objective of the LTBP program is to compile a comprehensive database of quantitative information from a sampling of bridges nationwide, looking at every element of a bridge and all the factors that affect its performance—material, design, condition, use, history, and environment.

By taking a holistic approach and analyzing all of the physical and functional variables that affect bridge performance, the study hopes to provide a more detailed and timely picture of bridge health and better bridge management tools.

Throughout the program, LTBP researchers will conduct detailed inspections, monitor, and evaluate select bridges that are representative of the most common structures in the U.S. bridge inventory. They will use proven nondestructive evaluation techniques—such as ground-penetrating radar that allows them to detect flaws and corrosion inside the structure—and sensor technologies that monitor traffic, environmental, and other data.

GATHERING DATA, GAINING KNOWLEDGE

The LTBP pilot program is studying a representative sample of bridges across the nation. These structures are evaluated, instrumented, and will be closely monitored for the next several years. The test bridges vary in age, length, and design and are subjected to a range of environmental and traffic conditions. They are located in California, Florida, Minnesota, New Jersey, New York, Utah, and Virginia. On each pilot bridge, researchers conduct at least five different structural tests, gathering as many as 5,000 data points on each bridge. Using sensors and field inspections, they will continue to study the pilot bridges and others, gathering valuable data that will increase our understanding of how bridges react to a spectrum of factors.

IMPROVING THE SYSTEM through better understanding

Measuring and evaluating performance is the most critical attribute of addressing bridge deficiencies, and the knowledge gained in doing so will allow us to design and build bridges that last longer, perform better, and are less costly to operate and maintain.

The wealth of data collected through the LTBP program, and the subsequent data analyses, will lead to improved life-cycle cost and predictive models, better understanding of bridge deterioration, and more effective maintenance and repair strategies. LTBP findings also should support improved design methods and bridge preservation practices and help develop the next generation of bridges and bridge management systems.

Ultimately, improved understanding of bridge performance will promote safety, mobility, longevity, and reliability of our nation's highway transportation assets.

LTBP LEADERS AND PARTNERS

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Industry Partners

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• Bridge Diagnostics, Inc. (BDI)
• Advitam

Academic Partners

• Utah Transportation Center, Utah State University
• Virginia Transportation Research Council (VTRC), University of Virginia, Virginia Tech
• Institute of Transportation Studies, University of California, Berkeley

