

“Using the most innovative testing technologies available through SHRP2 will enable us to better maintain our bridge and tunnel infrastructure and spot problems sooner, which will save time and money as well as improve safety.”

— MICHAEL P. LEWIS, EXECUTIVE DIRECTOR, COLORADO DOT



Photo courtesy KYTC



Photo courtesy Rutgers University

“The SHRP2 program has worked well for us. By using the SHRP2 bridge-related technologies, especially Innovative Bridge Designs and accelerated bridge construction techniques, we have saved millions of dollars in our bridge program while also significantly reducing traveler delays.”

— DAVID B. BERNHARDT, COMMISSIONER MAINE DOT

# America's Bridges Need Repair or Replacement

## SHRP2 is on the Job

Photo courtesy ADOT

### SHRP2's Emphasis on Bridge Innovations

The nation's aging bridge inventory calls for new solutions for bridge maintenance, repair, and construction. The second Strategic Highway Research Program (SHRP2) offers an array of innovative products, processes, and tools to support transportation agencies:

- 1 Building bridges more quickly
- 2 Building on the proper foundation
- 3 Using specifications that deliver the right project
- 4 Designing for longer-lasting bridges
- 5 Generating new load and resistance factor design specifications
- 6 Inspecting concrete bridge decks with greater accuracy
- 7 Applying new portable technologies to map and inspect tunnel linings

These innovations can be used alone or in combination at every stage of the bridge design, construction, or preservation process to maximize impacts and save lives, money, and time.



Photo courtesy Texas DOT

“Improved nondestructive technologies to more rapidly and safely inspect aging bridges and tunnels are helping to revolutionize our industry.”

—MARK LOWE, DIRECTOR IOWA DOT

## Knowing Where and When to Apply Your Maintenance Dollars—Preservation

### 6 Inspecting Concrete Bridge Decks With Greater Accuracy

Nondestructive testing (NDT) technologies reduce costs and the time associated with bridge deck inspections while improving the accuracy and condition assessment of these inspections. New mobile technologies can reduce safety risks for inspectors and minimize road closures and delays to the traveling public caused by inspections. Using the data from these inspections, agencies can rehabilitate aging bridges more cost-effectively based on improved life-cycle condition assessment data.

**Nondestructive Testing for Concrete Bridge Decks (R06A)** includes a collection of geophysical technologies for evaluating and inspecting concrete bridge decks. A web-based evaluation tool assists with selecting appropriate NDT technologies for specific applications and identifies test procedures, protocols, and available standards and guidelines. Information on these and other NDT products can be found in the FHWA Nondestructive Evaluation Web Manual at <https://fhwaapps.fhwa.dot.gov/ndep/>. For helpful tools and information, visit: [http://shrp2.transportation.org/Pages/R06\\_NondestructiveTesting.aspx](http://shrp2.transportation.org/Pages/R06_NondestructiveTesting.aspx).

Twenty states are implementing **NDT for Bridge Decks**. Contacts: Hoda Azari, FHWA, [hoda.azari@dot.gov](mailto:hoda.azari@dot.gov), or Patricia Bush, AASHTO, [pbush@aaashto.org](mailto:pbush@aaashto.org).

### 7 New Portable Technologies to Map and Inspect Tunnel Linings

With new National Tunnel Inspection Standards for Highway Tunnels issued by the FHWA, now is the time to take advantage of the SHRP2 Solution, **Nondestructive Testing for Tunnel Linings (R06G)**. With NDT mapping, agencies can establish baseline conditions or cross-check hammer-sounding investigations,

collecting data where it would not be feasible otherwise. This product also assists in developing more targeted and cost-effective maintenance and rehabilitation plans. Advanced NDT technology will allow an agency to get ahead of a problem before costly repairs are needed and can reduce the need for lane closures. NDT technologies also provide rapid structure assessment options following any incident or damage to tunnel linings.

**NDT for Tunnel Linings** includes information on mobile and hand-held NDT methods for mapping voids, debonding, delaminations, moisture, and other defects behind or within tunnel linings. A user's manual and guide for evaluating the best NDT technologies for specific situations, as well as a web-based evaluation tool to select appropriate NDT technologies for specific applications, is included. For helpful tools and information, visit: [http://shrp2.transportation.org/Pages/R06\\_NondestructiveTesting.aspx](http://shrp2.transportation.org/Pages/R06_NondestructiveTesting.aspx).

California, Colorado, Oregon, Pennsylvania, and Virginia are currently implementing **NDT for Tunnel Linings**. Contacts: Hoda Azari, FHWA, [hoda.azari@dot.gov](mailto:hoda.azari@dot.gov), or Patricia Bush, AASHTO, [pbush@aaashto.org](mailto:pbush@aaashto.org).

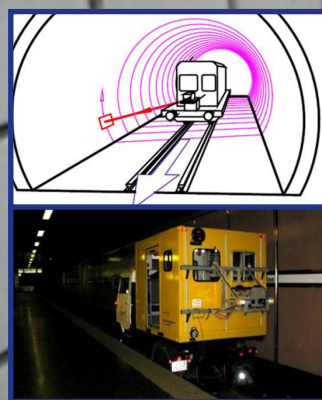
### What's Ahead?

Numerous showcases, webinars, and peer exchanges are being scheduled for these and other SHRP2 products. For information on any of these bridge-related SHRP2 products, visit: [www.fhwa.dot.gov/goshrp2/](http://www.fhwa.dot.gov/goshrp2/) or <http://shrp2.transportation.org>.

<sup>1</sup>Federal Highway Administration (FHWA). 2013. *2013 Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance*. Available at <https://www.fhwa.dot.gov/policy/2013cpr/>.

<sup>2</sup>Transportation Research Board (TRB). 2010. *Nondestructive Testing to Identify Concrete Bridge Deck Deterioration*. SHRP2 R06A. Available at [http://onlinepubs.trb.org/onlinepubs/shrp2/LLB\\_Gucunski.pdf](http://onlinepubs.trb.org/onlinepubs/shrp2/LLB_Gucunski.pdf). Prepared by Nenad Gucunski, Rutgers University; Soheil Nazarian, University of Texas at El Paso; Herbert Wiggemhauser, BAM, Berlin; Doria Kutrubes, Radar Solutions International. Presented at SHRP2—FEHRL Workshop,

BRIDGE SOLUTIONS



State participants gather to observe hand held (or various types of) NDT equipment testing on tunnel infrastructure. Photos courtesy Texas A&M University



Hydraulic pumps help slide the new and improved Gila River Bridge (Str. 145) in place significantly reducing the long detour caused by the bridge closure for the Gila River Indian Community in Sacaton, Arizona. Photo courtesy Nenad Gucunski





Systematic Maintenance.  
Photo courtesy Nenad Gucunski

## SHRP2 Solutions for Better Bridges

### A Good Bridge Starts with Design

#### 1 Building Bridges More Quickly

With so many small- and medium-sized bridges needing replacement, state DOTs need innovative practices that use precast alternatives. Choosing accelerated bridge construction technologies can reduce the time bridges are closed for construction, thus reducing or eliminating the need for long term detours.

The **Innovative Bridge Designs for Rapid Renewal** (R04) product includes standard design plans for foundation systems and substructure and superstructure systems, subsystems, and components that can be installed quickly with minimal traffic disruptions. It provides detailed standards and design examples for complete prefabricated bridge systems, as well as flexible design concepts that can be adapted to most small- and medium-sized bridges. For details, toolkit, videos, and peer exchange information, visit <http://shrp2.transportation.org/Pages/Bridge-Designs-for-Rapid-Renewal.aspx>.

“The toolkit provides central concepts—it includes standard plans but it doesn’t force the designer to use them. The intent of the toolkit isn’t so much to provide a recipe, but rather a philosophy.”

—MARK CHASE, VICE PRESIDENT  
AZTEC ENGINEERING

The **Innovative Bridge Design** product is being successfully applied in **Arizona, California, Iowa, Kentucky, Maine, Michigan, Missouri, New York, Rhode Island, and Wisconsin**. Contacts: **Jamal Elkaissi**, FHWA, [jamal.elkaissi@dot.gov](mailto:jamal.elkaissi@dot.gov); and **Patricia Bush**, AASHTO, [pbush@ashto.org](mailto:pbush@ashto.org).

#### 2 Building on the Proper Foundation

A significant number of construction claims are related to geotechnical issues. Consideration of applicable geotechnical solutions in all phases of project development and delivery can lead to more informed and better decision making. By using these tools, geotechnical specialists and other users can more effectively communicate with each other and with their project managers earlier in the process, generating safe and cost-effective project solutions.

**GeoTechTools.org** (R02) is a web-based technology catalog with detailed information on more than 50 geoconstruction and ground modification techniques. A Technology Selection System helps users identify potential solutions to project delivery issues which factor in constraints and address risk. GeoTechTools improve communication during project planning and scoping, solution identification during preliminary engineering, and decision making during final design and quality assurance.

Extensive photographs, case histories, and examples from past practices are available to assist users in selecting and applying the most appropriate solution to site-specific problems and conditions.

Fourteen states and the **FHWA Federal Lands Division** are now using **GeoTechTools**. Contacts: **Silas Nichols**, FHWA, [silas.nichols@dot.gov](mailto:silas.nichols@dot.gov); and **Kate Kurgan**, AASHTO, [kkurgan@ashto.org](mailto:kkurgan@ashto.org).

#### 3 Using Specifications that Deliver the Right Project

Conventional method specifications place the burden on bridge owners to design, specify and control construction processes. These requirements often hinder the innovation needed to deliver projects faster or to find methods that minimize disruption. By adding **Performance Specifications for Rapid Renewal** (R07) to a DOT bridge builder’s toolbox, costly construction oversight and change orders can be reduced; performance measure goals required under the Moving Ahead for Progress in the 21st Century Act (MAP-21) may be achieved; and new faster, less expensive delivery methods may help save scarce resources.

This SHRP2 Solution includes model performance specifications in 5 categories with 23 different specifications. A decision tree helps users identify a particular specification approach for their projects; and a Specification Writer’s Guide offers a step-by-step “how-to” guide for developing performance specifications. Recognizing that DOTs need flexibility to meet their unique needs, a framework for tailoring performance specifications to specific construction projects is included. For helpful tools and information, visit: [http://shrp2.transportation.org/Pages/R07\\_PerformanceSpecificationsforRapidRenewal.aspx](http://shrp2.transportation.org/Pages/R07_PerformanceSpecificationsforRapidRenewal.aspx).

**Performance Specifications** is being used by **Alabama, Maine, Missouri, Pennsylvania, and Vermont**. Contacts: **Jennifer Balis**, FHWA, [jennifer.balis@dot.gov](mailto:jennifer.balis@dot.gov), or **Keith Platte**, AASHTO, [kplatte@ashto.org](mailto:kplatte@ashto.org).

#### 4 Designing for Longer-Lasting Bridges

With scarce resources, DOTs must design and build new structures to have the longest service life possible. Not only will this approach reduce the pressure on construction budgets, it can also free up funds for preservation activities, pushing out maintenance on new projects and providing more dollars for repairs on existing structures.



Missouri has done multiple ABC bridges including Route B Business Loop over Route 70 in Boone County. Photo courtesy MoDOT



Researchers collect data efficiently using NDT equipment on bridge decks. Photo courtesy Rutgers University

By using **Service Life Design for Bridges** (R19A), DOTs and other bridge owners can apply a formal approach to service life design either programmatically or individually. Owners can plan, design, construct, evaluate, and preserve bridges and bridge components for a targeted service life and create a uniform process that leads to a life-cycle cost analysis to assist in the decision-making process. The product includes design methods that take into account materials, environmental factors, and new technology to allow for a longer service life of bridges. For helpful tools and information, visit: <http://shrp2.transportation.org/Pages/ServiceLifeDesignforBridges.aspx>.

The **Service Life Design for Bridges** product is being implemented by **Iowa, Maine, Oregon, Pennsylvania, Virginia**, and by **Central Federal Lands in Hawaii**. Contacts: **Raj Ailaney**, FHWA, [raj.ailaney@dot.gov](mailto:raj.ailaney@dot.gov); and **Patricia Bush**, AASHTO, [pbush@ashto.org](mailto:pbush@ashto.org).

#### 5 Generating New Load and Resistance Factor Design Specifications

The existing Load and Resistance Factor Design (LRFD) - Bridge Design Specifications (LRFD Specifications) - are federally mandated for all bridge designs in the United States using federal funds. The SHRP2 product, **Service Limit State Design for Bridges** (R19B), identified the service limit states that can be statically calibrated to produce uniform performance with the goal of generating a 100-year service life for bridges. Included are basic changes to the load and resistance factors related to the SLSs as well as suggested changes to the typical bridge design process.

The research has produced a calibration process that can be adjusted and applied to any limit state. The calibration of current limit states resulted in proposed revisions to the LRFD Specifications that may alter how bridges are designed across the country. Several of the proposed revisions have already been adopted by AASHTO’s Subcommittee on Bridges and Structures (SCOBS). These adopted revisions are now part of the AASHTO LRFD Specifications and the federal rule.

Training courses on the service limit state calibration and the development and background of the AASHTO provisions were presented at three Federal Lands Highway locations and are available on the AASHTO SHRP2 website at: [http://shrp2.transportation.org/Pages/R19B\\_ServiceLimitStateDesignforBridges.aspx](http://shrp2.transportation.org/Pages/R19B_ServiceLimitStateDesignforBridges.aspx).

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