Photo courtesy ADOT

America's Bridges Need Repair or Replacement

SHRP2 is on the Job

BRIDGES

SHRP2's Emphasis on Bridge Innovations

More than 604,000 bridges span highways across America, and state departments of transportation (DOTs) own 48 percent of them, including nearly all of our large, complex structures. Two out of three of the nation's bridges were built 26 or more years ago,[1] and many, if not most, need major repair or replacement.

Bridge decks, due to their higher exposure, deteriorate faster than other bridge components. As a result, between 50 and 85 percent of bridge maintenance funds are spent to repair or replace them. Conservative estimates are that more than $5 billion are spent annually to maintain, repair, and replace bridge decks.[2] Adding to the challenge is the fact that 85 percent of all vehicles travel on state-owned bridges, so any repair or replacement work generates detours, delays, and time costs for the economy.

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 in these efforts. They include:

- Tool kits and standard designs for prefabricated bridges
- Testing technologies to assess bridge deck deterioration
- Guidance, training, and technical assistance to build bridges that last longer and require less maintenance
- Model specifications to reduce claims and inspection costs and accelerate construction
- Web-based tools to select site-specific geotechnical solutions

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.

Combination of SHRP2 Products at Every Stage of the Process

> *"Significant program and project improvements and faster delivery can be accomplished when using more than one SHRP2 product – the benefits to the project are multiplied. This is exactly what we did in New York for the Tappan Zee Bridge and Kosciusko Bridge projects."*
>
> —Dan D'Angelo, Deputy Chief Engineer, New York State Department of Transportation (NYSDOT) and NYSDOT Project Liaison to the Tappan Zee Bridge project.

SHRP2 SOLUTIONS TOOLS FOR THE ROAD AHEAD

U.S. Department of Transportation
Federal Highway Administration

AASHTO


Photo courtesy MoDOT

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. This accelerated bridge technology can reduce the time bridges are closed for construction, saving time for travelers forced to use 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 has already been used successfully in **Arizona, California, Iowa, Kentucky, Maine, Michigan, Missouri, New York, Rhode Island,** and **Wisconsin**. *Contacts: Jamal Elkaissi, FHWA, **jamal.elkaissi@dot.gov**; and Patricia Bush, AASHTO, **pbush@aashto.org**.*

2 Building on the Proper Foundation

A significant number of all 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.

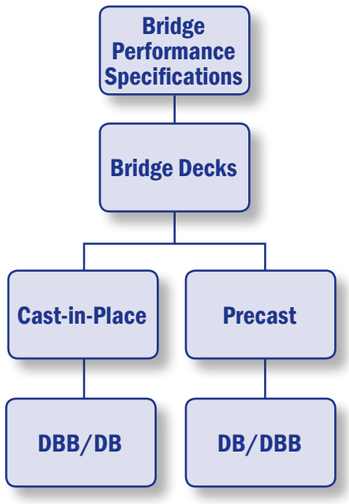
GeoTechTools.org (R02) is a web-based Technology Catalog with detailed information on more than 50 geoconstruction and ground modification techniques. A Technology Selection System assists users with identifying potential solutions to issues in project delivery that factor in constraints and address risk. GeoTechTools can be effectively used for 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**; and Kate Kurgan, AASHTO, **kkurgan@aashto.org**.*

3 Using Specifications that Deliver the Right Project

Conventional method specifications place the burden on bridge owners to design, specify, and control the work. 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 builders' 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 five categories with 23 different specifications, including those supporting bridge design: design-bid-build, design-build, design-build-warranty, and design-build-operate-maintain; concrete bridge decks; Portland cement concrete (PCC) modular precast bridge decks; and vertical support elements. 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**.

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

4 Designing for Longer-Lasting Bridges

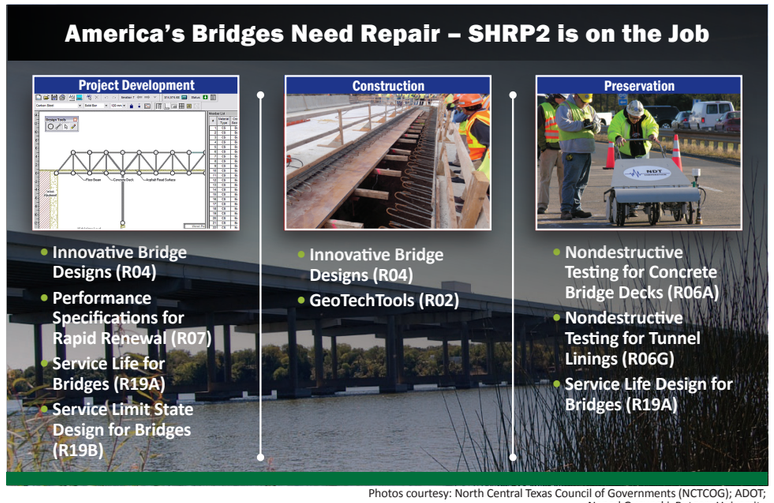
With scarce resources, DOTs must design and build new structures to have the longest service life possible. Not only will this approach reduce the pressure on construction budgets, it can also free up funds for preservation activities, pushing out maintenance on new projects and providing more dollars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

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**; and Patricia Bush, AASHTO, **pbush@aashto.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 using federal funds in the United States. The SHRP2 product, ***Service Limit State Design for Bridges*** (R19B), identified the statistically calibrated service limit states (SLSs) that would generate a 100-year service life for bridges. Included are basic changes to the load and resistance factors related to the SLSs; however, several proposed modifications are changes to the typical bridge design process. Also included are tools owners can use to track and adjust service-based reliability with time, including the database tables used during the calibration and instructions for a calibration spreadsheet. For helpful tools and information, visit: **http://shrp2.transportation.org/Pages/R19B_ServiceLimitStateDesignforBridges.aspx.**



Photos courtesy: North Central Texas Council of Governments (NCTCOG); ADOT; Nenad Gucunski, Rutgers University

Because any changes made to the LRFD Specifications will alter how bridges are designed across the country, these draft modifications are now being considered by AASHTO's Subcommittee on Bridges and Structures (SCOBS). If approved, the changes will appear in the next edition of the LRFD Specifications and will become part of the federal rule. ***Service Limit State Design for Bridges*** is being implemented by **California** and the **Federal Lands Highway**. *Contacts: Silas Nichols, FHWA, **Silas.Nichols@dot.gov**, or Patricia Bush, AASHTO, **pbush@aashto.org**.*

> *The Kentucky Transportation Cabinet is proud to be a leader in championing SHRP2. Through this program, we are replacing bridges in just a few weeks' time rather than 18 to 24 months.*
>
> —Mike Hancock, Secretary, Kentucky Transportation Cabinet

Photo courtesy KYTC

Photo courtesy RIDOT

> *SHRP2 was designed to be a game changer enabling us to improve the way we do things. It's great to see this latest example of innovative thinking on this exciting project here in Rhode Island.*
>
> —Colin Franco, Associate Chief Engineer, Rhode Island Department of Transportation

Knowing Where and When to Apply Your Maintenance Dollars—Preservation

6 Inspecting Concrete Bridge Decks With Greater Accuracy

Nondestructive testing (NDT) technologies can reduce costs and the time associated with bridge deck inspections while improving the accuracy and condition assessment of these inspections. The new mobile and portable technologies can reduce safety risks for inspectors and minimize road closures and delays to the traveling public due to 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. Also included are samples of data output from various technologies, as well as equipment features including cost, availability, and specifications. Information on these and other NDT products is available at **www.NDToolbox.org** For helpful tools and information, visit: **http://shrp2.transportation.org/Pages/R06_NondestructiveTesting.aspx**.

Twenty states are implementing ***NDT for Bridge Decks***. *Contacts: Hoda Azari, FHWA, **Hoda.Azari@dot.gov**, or Patricia Bush, AASHTO, **pbush@aashto.org**.*

7 New Portable Technologies to Map and Inspect Tunnel Linings

With new National Tunnel Inspection Standards for highway tunnels recently issued by the Federal Highway Administration, now is the time to take advantage of a new 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 followingany incident or damage to tunnel linings.

Photos courtesy Texas A&M University

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, are included. For helpful tools and information, visit: **http://shrp2.transportation.org/Pages/R06_NondestructiveTesting.aspx**.

California, Colorado, Oregon, Pennsylvania, and **Virginia** are currently implementing ***NDT for Tunnel Linings***. *Contacts: Hola Azari, FHWA, **Hoda.Azari@dot.gov**, or Patricia Bush, AASHTO, **pbush@aashto.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/** or **http://shrp2.transportation.org**.

Photos courtesy: KYTC; Ryan Berg, ADOT; Nenad Gucunski, Rutgers University

[1]Federal Highway Administration (FHWA). 2013. *2013 Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance*. Available at **http://www.fhwa.dot.gov/policy/2013cpr/overviews.htm**.

[2]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**. Prepared by Nenad Gucunski, Rutgers University; Soheil Nazarian, University of Texas at El Paso; Herbert Wiggenhauser, BAM, Berlin; Doria Kutrubes, Radar Solutions International. Presented at SHRP2—FEHRL Workshop, TRA 2010, Brussels, Belgium. June 10, 2010.