

# Products of



## SHRP 2

STRATEGIC HIGHWAY RESEARCH PROGRAM

# Renewal Research



*The second Strategic Highway Research Program (SHRP 2) focuses for a short time on a small number of large problems that confront transportation agencies: congestion, crashes, and the need to rebuild aging infrastructure. The mission is to strategically advance innovative ways to plan, renew, operate, and improve safety on the nation's highways. To achieve this, research focuses on four related areas, including driving behavior, highway capacity, travel time reliability, and rapid renewal methods.*

Now transportation agencies can more confidently use advanced methods to deliver highway renewal projects. SHRP 2 Renewal research has evaluated technologies, developed missing or strengthened weak components, tested applications, documented strengths and limitations, described selection criteria, and developed guides and models so that transportation agencies can employ a range of advanced methods and technologies to achieve rapid renewal with minimal traffic disruption as a routine practice rather than only on special or large projects.

SHRP 2 Renewal products include advanced methods for bridges, nondestructive testing techniques, pavements, project delivery, and underground utilities. Tools, guides, and other products of SHRP 2 research are the focus of this document. To support their best and broadest use, these products may be published, disseminated, or hosted by partner organizations whose mission encompasses implementation, including the Federal Highway Administration and the American Association of State Highway and Transportation Officials. The objectives and methods for each research project are documented in a numbered report published by TRB and available as noted.

**PRODUCT****IMPACT ON PRACTICE****STATUS OF RESEARCH PRODUCT****Bridges**

These products address the need to replace sequential onsite bridge construction activities that disrupt traffic and degrade highway safety with complete bridge systems that come ready for installation with typical equipment, minimize disruption to traffic and business, and are more easily inspected and maintained.

**Service Life Guide for 100-Year Bridges**

Guide includes: standard plans, model specifications for design and construction, detailed examples, and fault tree flow charts.

Framework for modifications to AASHTO specifications for more efficient load and resistance factor design and load rating.

The Guide and framework provide the basis for evolutionary change in designing for service life. They provide next-generation details and concepts and support selection of strategies that enhance the service life of bridge components that are easier to inspect and suited to their environment.

Research ongoing. Report and Guide available online in summer 2012. (Project R19A) Load and resistance factor design and load rating model specifications available online in mid 2013. (Project R19B)

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**Innovative Bridge Designs for Rapid Renewal**

Design tool kit that includes standard plans and details for designing bridges that are light, simple, and easier to design, fabricate, transport, and erect. The kit features concepts for innovative foundation systems, substructure and superstructure systems, subsystems, and components.

With this standardized design tool kit, local contractors using standard equipment can apply accelerated bridge construction methods to renew typical bridges. The designs can be incorporated into project plans with minimal additional design effort, making benefits of faster project delivery and reduced disruption available in thousands of bridge renewal projects.

Research ongoing. Report, tool kit, and training materials available online in mid 2012. Updated tool kit available online in mid 2013. (Project R04)

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**Nondestructive Testing Techniques**

These products advance technologies that simplify, accelerate, and improve inspection of existing facilities and new construction to support rapid renewal projects.

**Selection Tool for Concrete Bridge Deck Assessment Techniques**

Comprehensive assessment of capabilities and detailed description of nondestructive technologies for evaluation of concrete bridge decks

Web-based selection tool for choosing among validated assessment methods

Timely and accurate condition assessments of bridge decks can save money and reduce traffic disruption. Now practitioners can use the results of validation testing and analysis of a wide array of technologies to identify the advantages and limitations of each technology and select the most appropriate one for rapid assessments of bridge deck condition.

Research in Project R06 complete. Report S2-R06-RW: *A Plan for Developing High-Speed, Nondestructive Testing Procedures for Both Design Evaluation and Construction Inspection* available online. Research in Project R06A completes in late 2012, report available online in summer 2013. The selection tool will be available online in spring 2012.

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**Techniques to Fingerprint Construction Materials**

Database of spectra for many routinely used materials

Model AASHTO standards for methods to identify or measure materials with various portable devices

Field manuals that identify and evaluate promising spectroscopic testing methods and construction materials

Simple protocols for using spectroscopy devices in the field to validate that delivered materials match the chemical spectra identified in the lab will provide faster inspection and quicker project delivery. Methods will speed quality control and quality assurance of paints, coatings, concrete, asphalt, and chemical additives.

Research completed. Report and database available online in mid 2012. (Project R06B)

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**PRODUCT**

**IMPACT ON PRACTICE**

**STATUS OF RESEARCH PRODUCT**

**Nondestructive Testing Techniques** *(continued)*

**Rapid Technologies for Quality Control Data on Asphalt Pavements**

Evaluations of practical performance values of infrared and radar technologies to detect defects during construction of hot and warm mix asphalt pavements

Training video

Validation of these technologies for assessing asphalt pavement layers during construction will advance their use in the United States and provide more methods to speed inspection and quality assurance testing, contributing to faster project delivery.

Research completed. Report and training video available online in late 2012. (Project R06C)

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**Advanced Methods to Identify Pavement Delamination and Other Subsurface Conditions**

Improved ground penetrating radar and mechanical wave technology and data processing software

Ground penetrating radar and prototype technology using impact echo and seismic analysis of surface waves significantly speeds data acquisition with an accurate full-lane measurement. These technologies will provide a fast, new way to detect pavement distress so that timely rehabilitation strategies can be applied.

Research completed. Report available online in mid 2012. Ground penetrating radar hardware ready for implementation; analysis software requires further refinement. (Project R06D)

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**Achieving Smoothness Measures on PCC Pavements During Construction**

Results of field evaluation of advanced technologies and successful practices for interpreting real-time smoothness data

Model specifications

The model specifications developed from formal field evaluations support using innovative tools to evaluate portland cement concrete pavement smoothness during construction and link profile characteristics to construction activities. The products improve process control and reduce project delays and disputes.

Research completed. Report and model specifications available online in mid 2012. (Project R06E)

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**Continuous Pavement Deflection Device Assessments**

Catalog and fact sheets for technologies related to data interpretation and analytical methods, including capabilities and limitations.

Training materials for interpreting data, procedures to evaluate accuracy and repeatability, examples of methods of data analysis and comparison.

Reliable information on pavement joint condition supports long-lasting pavement rehabilitation designs. Accuracy evaluations of continuous deflection devices provided in the catalog support network-level pavement management, allow data collection at highway speed, and improve the safety of data collection personnel.

Research completed. Report and training materials available online in late 2012. (Project R06F)

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**Mapping Defects In or Behind Tunnel Linings**

Recommended inspection methods for tunnel linings and finishes based on comprehensive evaluation

User's manual for each recommended technology

Software to analyze data from the methods evaluated

The need to inspect tunnels for safety can be balanced with the need to minimize tunnel closures and traffic disruption with these automated, quantitative, and rapid test methods to assess the condition of tunnel linings.

Research completes mid 2012. Report, software, and user's manual available online in early 2013. (Project R06G)

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**PRODUCT****IMPACT ON PRACTICE****STATUS OF RESEARCH PRODUCT****Pavements**

These products provide the basis for broader use of pavement types and techniques that reduce traffic disruption, speed completion of renewal projects, and produce long lasting roadways.

**Modular Pavement Solutions**

Model design specifications  
Construction installation and inspection guidelines

Uniform modular pavement design procedures for a range of applications will help transportation agencies speed construction while maintaining quality, minimize lane closures and traffic disruption, and use advanced materials and methods for construction.

Research completed. Report, guidelines, and model specifications available online in mid 2012. (Project R05)

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**Composite Pavement Systems**

Guide for designing, constructing, and managing the quality of two new composite pavement types: asphalt layer over a portland cement concrete (PCP) layer and high-quality concrete layer over a PCC layer

Training materials for design and construction

Database with models for predicting performance of pavement systems

Advances in pavement technology can produce long-lasting pavements that are easier to maintain, resulting in less traffic disruption. The Guide and the performance prediction models for two pavement systems that can provide long-lasting pavements and high-strength bonds between pavement layers will promote use of these advances.

Research completed. Report available online in mid 2012. SHRP 2 First Fruits Report S2-R21-RW1: *2008 Survey of European Composite Pavements* is available online. Guide and database available (Project R21)

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**Preservation Guidelines for High Traffic Volume Roads**

Guidelines and technical summaries of preservation treatments to help practitioners match condition to treatment strategy

Pavement preservation strategies appropriate for roads with high traffic volume can help agencies realize savings that are more typically derived from preservation treatments used on low-volume roads. Preserving pavements can increase their service life.

Research completed. Report S2-R26-RR-1: *Preservation Approaches for High-Traffic-Volume Roadways* and S2-R26-RR-2: *Guidelines for the Preservation of High-Traffic Volume Roadways* available online and in the TRB bookstore. (Project R26)

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**Renewal Strategies for Design and Construction of Long-Life Pavements**

Interactive design scoping tool includes: treatment selection guidelines, project assessment manual, model specifications, life-cycle cost analysis method, and emerging technologies

This web-based tool can complement an agency's processes to encourage design of longer-lasting pavements, provide realistic scoping assessments, document successful practices, and combine key practices with model specifications.

Research completed. Report and initial version of the scoping tool and other products available online in mid 2012. (Project R23)

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**Geotechnical Solutions**

Web-based tool for selecting among 44 geotechnical solutions for construction over stable, stabilized, or unstable soils; geotechnical pavement components; and working platforms.

Design procedures and guidance

Model specifications for geotechnical materials and systems

This compilation of formal evaluations of many techniques for constructing embankments and stabilizing and improving soil provides in one place objective assessments of a wide range of technologies. The selection tool and guidance support broad application of methods known to benefit rapid renewal projects.

Research completed. Report and web-based selection tool available online in mid 2012. (Project R02)

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**PRODUCT****IMPACT ON PRACTICE****STATUS OF RESEARCH PRODUCT****Project Delivery**

These products help address infrastructure projects from a holistic perspective that emphasizes delivery and performance of the highway facility.

**Fatigue Risk Management Guide**

Tool kit for managing fatigue of workers and managers during rapid renewal projects, including scheduling aids, risk factor definitions, management practices, and techniques

Training and outreach materials

When fatigue and stress factors related to rapid renewal projects are well understood, risks can be managed and reduced. This guide will promote fatigue-reducing strategies into business practice and promote understanding of the importance of mitigating fatigue to improve safety and performance.

Research completed. Report, Fatigue Risk Management Guide, and training materials will be available online in late 2012. (Project R03)

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**Performance Specifications for Rapid Renewal**

Comprehensive guide to applying performance specifications in rapid highway renewal projects, with results of demonstration projects

Model specifications

Implementation guidelines and training materials

These products promote innovation by describing performance required of the final product rather than of the contractor. They provide a better indication of quality and performance and help relate design assumptions to as-constructed conditions. Key benefits include: shifting performance risk to the party best able to manage it, motivating contractors to be more quality-conscious, and reducing agency inspection costs during construction.

Research completes in late 2012. Report, Guide, Model specifications, specification writers' tool, and training materials available online in 2013 (Project R07)

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**Guide to Managing Risk in Rapid Renewal Contracts**

Guide to implementing risk management procedures for various contracting methods

Training materials

Achieving rapid renewal means applying innovative contracting in which risk can be identified, mitigated, and transferred to the best qualified party. This product provides objective guidance to assess the risk level of contracting options to support industry acceptance of innovation.

Research completed. Report and training materials available online in mid 2012. (R09)

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**Innovative Strategies for Managing Complex Projects**

Guide to using 5-dimensional project management methods and 13 project execution tools

Case studies

Training materials

5-D project management adds finance and context to the typical project dimensions of technical aspects, schedule, and cost. This process ties stakeholder success to project success, encouraging innovation and changes in standard practices. The guide supports sound decision making during rapid renewal projects.

Research completed. Report, Guide, case studies, and training materials available online in spring 2012. (Project R10)

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**WISE: Workzone Impact Estimation Software**

Software tool to assess optimal project sequencing and determine cost-effectiveness of strategies to minimize, mitigate, and manage road user costs. Modules for project planning and operations stages.

Training materials

The ability to analyze the impacts of multiple, concurrent work-zones across a network or complex corridor provides an integrated framework for agencies to evaluate planning decisions and operational strategies that have an impact on the traveling public.

Research completes mid 2012. Report available online in early 2013. Web-based impact estimation tool available online in fall 2012. (Project R11)

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**PRODUCT****IMPACT ON PRACTICE****STATUS OF RESEARCH PRODUCT****Utilities and Railroads**

These products advance the practice of identifying underground utilities and support coordination among transportation agencies, utility companies, and railroads.

**Model Agreements and Practices to Expedite DOT and Railroad Coordination**

Model legal agreements  
 Successful practices in project coordination  
 Framework to support a Community of Interest  
 Online library of model agreements, contracts, standard guidelines; includes a dialog function  
 Web-based training modules and other materials for implementing institutional processes and model agreements

With standard mechanisms to expedite the permit and review processes and establish cooperative practices, transportation agencies and railroads can reduce costs, conflicts, and delays when their projects intersect. Communicating successful practices and supporting community interest will further develop cooperative practices

Research completed. Report S2-R16-RR-1: *Strategies for Improving the Project Agreement Process between Highway Agencies and Railroads* is available online and through the TRB bookstore. E-book versions are available for iPad and Kindle readers and in the Google e-Bookstore. (Project R16) Building a community of interest (R16A) is active through November 2013. Online library and training materials (Project R16B) available in summer 2014.

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**Strategies for Integrating Utility Company and Transportation Agency Priorities**

Prototype utility conflict matrix database with analysis worksheets  
 Prototype scalable database to support conflict analyses, utility agreement development, construction letting, utility relocation scheduling, billings, and payments  
 Training materials for using databases

New efficiencies can result from having more standard procedures for documenting and managing utility conflicts. These products help optimize utility related activities and simplify coordination between transportation agencies and utility companies, which will reduce a major cause of delay in highway construction projects.

Research completed. Report S2-R15-RW: *Integrating the Priorities of Transportation Agencies and Utility Companies* (Project R15) is available online. Database prototypes and training materials developed in Project R15B will be available online in mid 2012.

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**Technologies to Store, Retrieve, and Use 3-D Utility Location Data**

Innovative database template for collecting, storing, rendering, updating, and viewing 3-D utility data  
 Model database to standardize storage of 3-D utility data

This recommended process and database for maintaining up-to-date records of utility locations will improve coordination, reduce risk of project redesign or delays, and reduce excavation damage. Over time, it could produce a current and comprehensive map of all utilities in a right-of-way, reducing or eliminating the need for new utility mapping at each project initiation.

Research complete, S2-R01-RW: *Encouraging Innovation in Locating and Characterizing Underground Utilities* and S2-R01-RW-2: *Development of the Selection Assistant for Utility Locating Technologies* (Project R01) are available online. Project R01A: Research completes February 2012, report available online in 2013.

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**Utility Locating Technologies**

Prototype imaging system to more robustly identify and classify underground utility lines, includes an innovative seismic method to detect both metallic and nonmetallic components  
 Software applications capable of quickly and efficiently handling large geophysical datasets, including 3D data

These products advance the ability to rapidly and reliably locate and identify underground utility lines. Collecting data through multiple sensors reduces data acquisition time, lane closures, and training requirements. Having more reliable information reduces the likelihood of project delays from utility conflicts.

Research completes late 2012. Report, prototypes and software available online in mid 2013. (R01B)

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**Innovation in Location of Deep Utility Pipes and Tunnels**

Improvements to five technologies including: active and passive acoustic locating, scanning electromagnetic locator, long-range RFID tags, seismic reflection locating, and inertial mapping systems  
 User guide and on-line training

As the near-surface area of rights-of-way becomes crowded, utilities are placed deeper beneath the surface and detection becomes more difficult. The technologies advanced in this project expand the 'locatable' zone of deep utilities with improved reliability. This location data eliminates delays when transportation projects involve underground utilities.

Research completes mid 2012. (Project R01C) Report, user guide and training available online early 2013.

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## **SHRP 2 Renewal Reports Now Available**

### **IN PRINT FROM TRB BOOKSTORE, AS E-BOOKS, AND ONLINE**

*Strategies for Improving the Project Agreement Process between Highway Agencies and Railroads* (SHRP 2 Report S2-R16-RR-1) E-Book for iPad, Kindle, Google Bookstore

### **IN PRINT FROM TRB BOOKSTORE AND ONLINE**

*Guidelines for the Preservation of High-Traffic-Volume Roadways* (SHRP 2 Report S2-R26-RR-2).

*Encouraging Innovation in Locating and Characterizing Underground Utilities* (SHRP 2 Report S2-R01-RW)

*Integrating the Priorities of Transportation Agencies and Utility Companies* (SHRP 2 Report S2-R15-RW)

### **ONLINE ONLY**

*Preservation Approaches for High-Traffic-Volume Roadways* (SHRP 2 Report S2-R26-RR-1)

Project Brief: Preservation Approaches for High-Traffic-Volume Roadways

*A Plan for Developing High-Speed, Nondestructive Testing Procedures for Both Design Evaluation and Construction Inspection* (SHRP 2 Report S2-R06-RW)

Project Brief: Tomorrow's Bridges

Project Brief: Railroad-DOT Institutional Mitigation Strategies

Project Brief: DOT-Utility Coordination: Understanding Key Aspects of the Problem and Opportunities for Improvement

**[www.TRB.org/SHRP2](http://www.TRB.org/SHRP2)**

