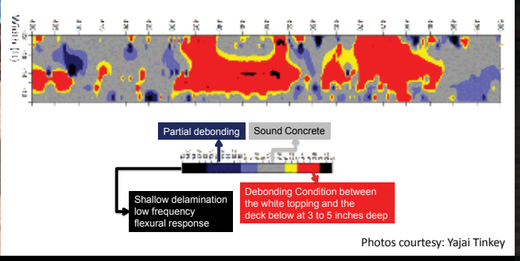


Photos courtesy: Yajai Tinkey

Improving Testing Methods

Tools to Detect Unseen Pavement Delamination

Delamination between asphalt layers results in initial cracking and surface tearing. Unfortunately, delamination is often undetectable by visual inspection, particularly in the early stages. NDT methods that properly identify potential asphalt pavement debonding issues help to reduce or limit the need for test cores; potentially provide better inventory for an agency's maintenance program; and extend pavement life by earlier identification of delamination.

Through ***Advanced Methods to Identify Pavement Delamination*** (R06D), three technologies have been identified that could make significant advances in detecting project-level pavement delamination and debonding before the deficiencies cause visual pavement distress, The technologies are GPR and IE technology, combined with the Seismic Analysis of Surface Waves (SASW) system. States currently implementing this product are **California, Florida, Minnesota, New Mexico,** and **Texas**.

*Contacts: Steve Cooper, FHWA, **stephen.j.cooper@dot.gov**, or Kate Kurgan, AASHTO, **kkurgan@aashto.org**.*

Improving Pavement Surface Smoothness During Construction

Achieving the kind of smooth concrete pavements valued by motorists can best be addressed when surface irregularities are corrected during construction, while the concrete is in a plastic state. Smooth concrete roads are more durable and lead to lower maintenance and vehicle operating costs. Access to real-time information on pavement smoothness also helps paving contractors with quality control and enables them to meet the ride quality requirements of transportation agencies.

Through ***Tools to Improve PCC Pavement Smoothness During Construction*** (R06E), information and tools are available to evaluate pavement smoothness in real-time while the concrete is still wet; complement existing quality control; and reduce must-grinds to reduce project delays and claims. Lessons learned from pilot projects and model specifications are included.

Technical assistance in the form of equipment loans and demonstrations is available to support as many as 11 states. States implementing this technology though the IAP include **Alabama, Idaho, Indiana, Nebraska, Ohio,** and **Pennsylvania**. Technical assistance is available to support additional agencies if requested.

*Contacts: Steve Cooper, FHWA, **stephen.j.cooper@dot.gov**, or Kate Kurgan, AASHTO, **kkurgan@aashto.org**.*

A Web Tool to Help You Select the Right Nondestructive Testing Technology for Your Project

FHWA's Nondestructive Evaluation (NDE) Web Manual allows users to search for technologies relevant to specific materials, types of deterioration, and/or infrastructure elements. It also includes best practices, sample applications, and performance attributes of various technologies.

Available at
https://fhwaapps.fhwa.dot.gov/ndep/

Learn More!

Events are being held across the country to help states implement these products. They include:

- *Product demonstrations*
- *Showcases*
- *Trainings*
- *Webinars*
- *Peer exchanges*
- *Presentations at conferences*

To stay abreast of these activities and to access helpful resources, go to: www.fhwa.dot.gov/GoSHRP2 or http://SHRP2.transportation.org

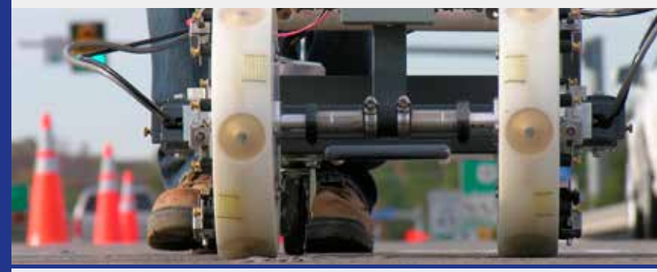
NONDESTRUCTIVE TESTING SOLUTIONS

Nondestructive Testing Solutions to Better Construct and Maintain America's Roads, Bridges, and Tunnels

Seven SHRP2 Forensic and Testing Tools for the Road Ahead

Beneath the surface of many of America's bridges, roads, tunnels, and interstates are structural deficiencies that the eye can't see. Traditional methods to detect these problems, such as hammer sounding, chain dragging, or destructive coring have been used since the early part of the last century. But they can be inaccurate and often put workers in harm's way on busy highways.

Now, new processes and technologies are available to help transportation agencies and their contractors inspect concrete bridge decks or tunnel linings and identify problems such as pavement delamination or poorly laid asphalt. Developed through the second Strategic Highway Research Program (SHRP2), these nondestructive testing (NDT) technologies can help states save tens of thousands of dollars by helping to verify the quality of construction materials at the time of a project and by identifying when a structure is beginning to deteriorate well before damage is visible.



"These NDT technologies could potentially save us hundreds of thousands of dollars by allowing us to make more informed decisions a lot faster and to budget projects more accurately."

—Jeremy Hunter, PE
Bridge Design Manager,
Indiana Department of Transportation

SHRP2 SOLUTIONS TOOLS FOR THE ROAD AHEAD
U.S. Department of Transportation Federal Highway Administration
AASHTO

July 2016 (updated) | *All photos courtesy of Rutgers University, unless otherwise noted.*

New Tools to Assist in Collecting Data to Improve Decision Making

These SHRP2 tools and accompanying technical assistance will assist transportation agencies in collecting high-quality NDT data and appropriately interpreting NDT results to support repair-rehab-replace decision-making.

As a result, states can make faster, minimally disruptive, and longer-lasting improvements and help keep our transportation infrastructure in a state of good repair.

Faster, More Accurate Methods to Evaluate Concrete Bridge Deck Conditions

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. Using the data from these inspections, agencies can rehabilitate aging bridges more cost-effectively.

Nondestructive Testing for Concrete Bridge Decks (R06A) includes a collection of geophysical technologies for evaluating and inspecting concrete bridge decks. These NDT technologies include the following:

- Impact Echo (IE)
- Ultrasonic Surface Waves
- Impulse Response
- Ground-Penetrating Radar(GPR)
- Infrared Thermography Analysis
- Electrical Resistivity
- Galvanostatic Pulse
- Half Cell Potential

A web-based evaluation tool helps transportation professionals select the appropriate NDT technologies for specific applications and identifies test procedures, protocols, available standards, and guidelines. Also included are samples of data output from various technologies, as well as equipment features including cost, availability, and specifications. For helpful tools and information, visit: **http://shrp2.transportation.org/Pages/R06_NondestructiveTesting.aspx**.

Alabama, Arkansas, California, Delaware, Florida, Georgia, Hawaii, Indiana, Iowa, Kentucky, Louisiana, Missouri, Nebraska, New Mexico, New York, North Carolina, North Dakota, Oregon, Pennsylvania, and **Virginia** are implementing ***NDT for Bridge Decks*** as part of the Federal Highway Administration (FHWA)/American Association of State Highway and Transportation Officials (AASHTO) Implementation Assistance Program (IAP).

*Contacts: Hoda Azari, FHWA, **Hoda.Azari@dot.gov**, or Patricia Bush, AASHTO, **pbush@aashto.org**.*

Nondestructive Testing to Quickly Pinpoint Defects In or Behind Tunnel Linings

Tunnels typically service high-volume traffic, making them difficult to inspect for maintenance concerns or deficiencies such as leaks, concrete liner cracking, or other debonding issues. ***Nondestructive Testing for Tunnel Linings*** (R06G) technologies are automated and can quickly capture the type of data needed for decision making. They allow specially equipped vehicles to drive through a tunnel and conduct the inspection without the need to close lanes.

Mounted on a single vehicle, the technologies can provide complete coverage compared with conventional visual inspections. Mobile-scanning is used to scope potential problem areas in a tunnel, and the hand-held methods are then used to target specific locations identified in the mobile scan for more in-depth evaluation.

Another advantage of mobile-scanning is the use of light detection and ranging (LiDAR) to pick up all portal and tunnel subassets, such as lighting, signage, drains, fire standpipes, utilities, or fans and generate photographs of each item. This helps tunnel owners quickly track tunnel assets scan-to-scan, compile condition assessments, and determine next steps. For helpful tools and information, visit: **http://shrp2.transportation.org/Pages/R06_NondestructiveTesting.aspx**.

NDT for Tunnels has been piloted for SHRP2 in **Colorado, Texas,** and in the **Chesapeake Bay area of Virginia**. **California, Colorado, Oregon, Pennsylvania,** and **Virginia** are currently implementing this product through the FHWA/AASHTO IAP.

*Contacts: Hoda Azari at FHWA, **Hoda.Azari@dot.gov**; or Patricia Bush at AASHTO, **pbush@aashto.org**.*

> *"NDT technologies can assist state DOTs not only with inspection and maintenance of their bridge, roads, and tunnels, but also with their asset management. Using the data collected through these NDT tools, agencies can predict deterioration rates and locations for life-cycle repair and cost estimates, providing an estimate on service life prior to replacement."*
>
> **—Hoda Azari**
> SHRP2 R06A and R06G Renewal Products Lead, Federal Highway Administration

Enhancing Quality Control on Asphalt Pavements

Real-time, high-speed NDT of asphalt pavements during construction can greatly improve quality, durability, and performance, stretching highway dollars and extending service life. ***Rapid Technologies to Enhance Quality Control on Asphalt Pavements*** (R06C) offers two products aimed at providing real-time testing of potentially 100 percent of the pavement area, providing much more inspection coverage than existing methods in hot- or warm-mix construction.

The products tackle two of the most challenging construction quality indicators—thermal segregation measured using an infrared (IR) scanner system, and density measured using the GPR system. Through an equipment purchase and demonstration program, showcase, and targeted workshops, selected states are receiving hands-on experience using these technologies under varying conditions. Testing protocols and guide specifications are also available. For helpful tools and information, visit: **http://shrp2.transportation.org/Pages/R06C_RapidTechnologiestoEnhanceQualityControl.aspx**.

States using IR technologies are **Alabama, Alaska, Illinois, Maine, Missouri, New Jersey, North Carolina, Virginia,** and **West Virginia**. The **Federal Lands Highway Division** is also using IR. States using GPR are **Nebraska** and **Maine**

*Contacts: Steve Cooper, FHWA, **stephen.j.cooper@dot.gov**, or Kate Kurgan, AASHTO, **kkurgan@aashto.org**.*

Providing Real-Time Verification to Ensure Construction Materials Meet Specifications

Although essential to quality assurance, verifying that construction materials meet specifications can be both time-consuming and expensive. Portability to conduct quality control in the field is critical to determining whether materials are potentially suspect on site. Identifying unique signatures found on many common construction materials using new field spectroscopy technologies is a new approach. By matching their signatures to those on file using new portable equipment, construction staff can quickly identify if materials are suspect to meeting contract specifications.

Techniques to Fingerprint Construction Materials (R06B) offers two market-ready technologies—X-ray Fluorescent Spectroscopy (XRF) and Fourier-Transform Infrared Spectroscopy (FTIR)—that have been identified in field trials with potential success. These technologies identify materials such as, asphalt binders, polymers, epoxies, cement, emulsions, structural steel, aggregate minerals, paints, and organic materials.

This product is currently being implemented in **Alabama, Maine,** and **Tennessee**.

*Contacts: Steve Cooper, FHWA, **stephen.j.cooper@dot.gov**, or Kate Kurgan, AASHTO, **kkurgan@aashto.org**.*

> *"We were really looking for ways to improve the quality of the pavement in our projects so we turned to the SHRP2 Infrared equipment and thermal profiling tool. Through the use of these products, our field personnel and contractors will be able to achieve a more uniform, longer-lasting product. This saves us money in the long-term because we aren't having to go back and do a preservation treatment or to come back in seven or eight years and repave."*
>
> **—Dale Peabody**
> Transportation Research Engineer, Maine Department of Transportation