GPR Technology operating at highway speeds, eliminating the need for closures. Photo courtesy of Texas A&M Transportation Institute and the New Mexico Department of Transportation

> *"Florida Department of Transportation is always looking into finding more innovative ways to monitor the performance, condition, and safety of its roadway infrastructure. Of greatest interest are those that would provide for versatility, ease and speed of use, which is why we are very interested in the SHRP2's R06D technologies. We believe they hold great promise of improving pavement structural adequacy evaluation while minimizing maintenance of traffic, expediting projects acceptance, and minimizing impact to the traveling public."*
>
> —Bouzid Choubane, FDOT State Pavement Materials Engineer

What's Next for R06D?

The six IAP states will continue to test the three technologies and ultimately report on their results. The NDT industry continues to improve both the hardware and software utilized in R06D to make these tools more effective for pavement evaluation. FHWA and AASHTO believe that future product demand by the highway community will drive software development to make data analysis more efficient. As software improves, field engineers will have better real-time displays to locate distress in the pavement.

The ultimate goal for the project is to achieve real-time reliable results that would be valuable not only for project-level forensics, but also network-level pavement assessment.

SHRP2 SOLUTIONS
TOOLS FOR THE ROAD AHEAD

HOW TO GET INVOLVED

To learn more about *Advanced Methods to Identify Pavement Delamination (R06D)* and all its resources, contact:

Steve Cooper (FHWA) at Stephen.j.cooper@dot.gov;

Kate Kurgan (AASHTO) at kkurgan@aashto.org; or

Stay up-to-date on R06D and other product news by visiting www.fhwa.dot.gov/goshrp2 or http://shrp2.transportation.org.

You learn more about R06D by visiting the AASHTO product webpage at http://shrp2.transportation.org/Pages/R06D.aspx.

SASW-IE equipment being tested in the field to locate pavement delamination.

Safer, Faster, and More Cost-Efficient Ways to Find Deficiencies in Pavement

Advanced Methods to Identify Pavement Delamination

Maintaining our nation's infrastructure is a big job. State departments of transportation (DOTs) and other agencies are working to preserve our roadways, keeping them safe and efficient for the motoring public. This can be a difficult task once pavement starts deteriorating, especially when it happens faster than planned. Delamination between asphalt layers underneath the surface can lead to several types of pavement surface problems, such as cracking in the wheel paths and tearing in the surface. Delamination is often due to layer debonding or stripping, which engineers can't see, especially in the early stages. Manual destructive methods for evaluating the pavement structure for problems can be time consuming and expensive to state DOTs.

Fortunately, new tools developed through the second Strategic Highway Research Program (SHRP2) allow transportation agencies to detect the location and severity of delamination before problems appear on the surface of the pavement. The SHRP2 product, Advanced Methods to Identify Pavement Delamination (or R06D), includes three new technologies that can detect problems in the asphalt pavement beneath the surface in a safer, faster, and less expensive way than previously done. Ultimately, the goal is to get real-time reliable results helpful for project-level forensics and network-level pavement assessment.

These three new technologies ultimately:

- **Save lives and reduce worker injury risk by cutting down on the time they are exposed to traffic**
- **Save time by reducing how long it takes to collect field data**
- **Save money through efficient data collection and better project decisions**

Single pass, full lane-width GPR system.

SHRP2 SOLUTIONS TOOLS FOR THE ROAD AHEAD

U.S. Department of Transportation
Federal Highway Administration

AASHTO


Testing utilizing GPR technology. Photo courtesy of Texas A&M Transportation Institute and the New Mexico Department of Transportation

R06D is just one product in a SHRP2 series that focuses on nondestructive testing (NDT) technologies and their current state of implementation for bridge, pavements, and tunnel renewal. You can learn more about the suite of NDT SHRP2 products at http://shrp2.transportation.org/Pages/NondestructiveTesting-Solutions.aspx.

Three Technologies, One Goal

To find subsurface pavement issues (in a nondestructive way) before they become problematic, three technologies were developed and are being tested under the R06D product. Each has its own advantages and limitations.

Ground Penetrating Radar (GPR)

The GPR technology being tested uses an antenna array with a frequency sweep that can be operated at speeds over 60 miles per hour. The wide antenna array reduces the number of passes required to cover the lane width.

GPR has some major advantages, especially that it can be used at higher speeds and covering large areas. Since it can be used at highway speeds, transportation agency staff can use this technology in live traffic, eliminating the need for closures. The GPR technology can detect certain delamination issues, but it cannot distinguish new debonding problems where the bond between the asphalt lifts is weak. For the technology to be effective, the asphalt layers being tested must be separated with air or water.


Close-up of GPR technology mounted to the front of a vehicle.

While specific use in finding debonding problems alone is limited, the GPR technology has the potential to be a helpful tool to identify moderate to severe distress as part of a systematic coverage plan of a highway network. GPR data analysis will require a skilled technician to identify distressed locations. However, as automated distress recognition software improves, the level of manual data analysis will lessen.

Spectra Analysis of Surface Waves (SASW) and Impact Echo (IE)

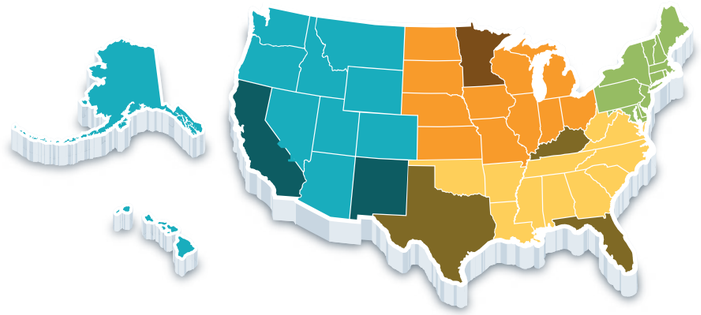
Although SASW and IE are two different technologies, together they help identify the location of pavement delamination with automated test frequency every six inches in less than 1 percent of the time required by manual point testing. The software uses real-time display to monitor the quality of the data collection. IE identifies variations in the pavement, though improved analysis requires the hot-mix asphalt to be cool and stiff. IE measurement also has limited ability to identify exactly how severe the delamination may be and cannot measure pavement conditions below the first level of damage.

SASW technology can identify variations in the top seven inches of pavement as long as the analysis uses a reasonable value for the stiffness of pavement. But like IE technology, SASW measurement has a limited ability to show how severe the delamination is and is unable to measure pavement conditions below the first level of damage.

State DOTs are currently testing the automated SASW/IE system, which travels down the roadway at walking speed. Compared to the GPR method the process is limited by the speed of data collection and reporting, which can be more complex. The SASW/IE technology is more applicable in pavement spot areas for verifying problems with bridge deck issues or with overlays that may be debonded. This technology is best used to collect more complex data at spot locations, and can be used for various applications as mentioned above, so it can be more versatile for DOTs.

State DOTs Testing Technology

Currently, six states are engaged in implementing R06D as part of the SHRP2 Implementation Assistance Program (IAP), sponsored by the Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO).



IAP PARTICIPATING STATES: California, Florida, Kentucky, Minnesota, New Mexico, and Texas

SASW/IE manual point testing (left) and automated testing (right). Photo on the right courtesy of Texas A&M Transportation Institute and the New Mexico Department of Transportation.

These states are conducting proof of concept pilot projects which are necessary to validate the results, and encourage equipment manufacturers to advance the technology, hardware, and data analysis software.

What the IAP States are Saying

The six IAP states are already seeing results from working with the GPR and SASW/IE technologies. While each state has their own ultimate goals and reasons for utilizing R06D, each state's results will ultimately provide SHRP2 with important feedback on each technology.

> *"Though we are still testing this technology and will continue to do so for some time, we are already seeing positive results. Not only is it faster than the technology we previously used, but we are getting more information with the readings. The speed in which we can collect this data allows for greater safety out in the field, which is always top priority. We look forward to seeing more results as we continue to test."*
>
> —Naomi Gaede, New Mexico Department of Transportation Pavement Engineer E.I.T

> *"We at Minnesota Department of Transportation are still evaluating the technology, but have already tested several pavement sections and took cores to verify radar results. We still have a long way to go and a lot more to learn, but our initial results are very encouraging and we look forward to seeing where this technology takes us."*
>
> —Shongtao Dai, MNDOT Research Operations Engineer