

RESEARCH

Makes the Difference 2015

INNOVATION ADVANCES TRANSPORTATION

The “Sweet Sixteen” state research projects highlighted on these pages were selected by the Research Advisory Committee of the American Association of State Highway and Transportation Officials. They comprise four high-value research projects from each of the four AASHTO regions, funded primarily through the **State Planning and Research (SPR) Program**.

As the nation’s cornerstone state research program, SPR provides federal aid funding to the states to address top concerns and identify solutions at the state level. States further address areas of common concern through the Transportation Pooled Fund Program.

Complementary to the states’ research programs is the **National Cooperative Highway Research Program**. State DOTs commit SPR funding to support and oversee NCHRP, which pools the states’ research dollars to find solutions to transportation challenges identified as critical by the states.

In addition, **U.S. Department of Transportation** research conducted through the Federal Highway Administration and other U.S. DOT channels allows the government to tackle high-priority needs and share new technologies and practices with the states.

“As good stewards of our citizens’ money, we innovate at the speed of business. That means strategic selection of research projects to drive implementation of the results.”

John Halikowski
Director, Arizona DOT, and
Chair, AASHTO Standing
Committee on Research

SAFER HIGHWAYS AND WORK ZONES

DIVERGING DIAMOND INTERCHANGES SIGNIFICANTLY INCREASE SAFETY IN MISSOURI

Missouri DOT pioneered the diverging diamond interchange (DDI) in the United States, aiming to reduce congestion and increase safety through the unique design that allows motorists to make left turns without crossing opposing traffic.



After studying operational benefits of DDIs, MoDOT turned to assessing the safety benefits of DDIs over conventional diamond interchanges. The research found that DDIs offered significant crash reduction benefits for all severities of crashes, with the highest crash reduction observed for fatal and injury crashes. Researchers evaluated data at both the project level at interchanges and the site-specific level at ramp terminals. They found that the total crash frequency decreased by 41 percent at the project level and by 57 percent at the site-specific level. As an added safety benefit, crashes occurring at DDIs also tended to be of lower severity than crashes at conventional interchanges.

ILLINOIS AND LOUISIANA WORK TO IMPROVE CRASH RESPONSE AND CLEARANCE

Even as DOTs seek to reduce crashes on Interstate highways and other busy roads, they recognize the aftermath of incidents can put motorists at risk and threaten additional injury and property damage. Illinois DOT saw that first responders to crashes can accidentally prompt secondary crashes when their actions unknowingly create new traffic conflicts. IDOT developed classroom training and 11 online training

modules to help prevent secondary crashes and reduce responder fatalities and injuries. To date, more than 3,000 responders from law enforcement, fire and rescue, transportation, and the towing and recovery sectors have been trained, and Illinois anticipates a drop in injuries and secondary crashes in the state.

Meanwhile, the Louisiana Department of Transportation and Development targeted the threat of disabled vehicles on roadways. A research study



found that the cost of programs that provide police and towing companies with incentives to rapidly tow disabled vehicles is far lower than the estimated cost of traffic delays when such programs aren’t in place. The report found that an expedited towing program could reduce the clearance time of an incident by as much as 58 percent, decreasing traffic congestion and reducing risk for responders and other motorists.

SAFER HIGHWAYS AND WORK ZONES, continued

CALIBRATING THE HIGHWAY SAFETY MANUAL FOR SAFER RURAL ROADWAYS IN MAINE

Lane departure and speed-related accidents account for nearly half of all crashes in Maine, with many occurring on rural two-lane highways. Maine DOT's use of the predictive models in AASHTO's *Highway Safety Manual* (HSM) will help the agency make improved design and construction decisions. Since the HSM works best when calibrated to local conditions, Maine undertook a study to develop HSM calibration factors for rural two-lane roads and intersections. Research revealed that prior to calibration, the HSM crash predictions were off by a factor as high as two. The locally calibrated HSM predictions, now completed, provide a close match with Maine crash data. This calibration effort is a critical step in HSM implementation to increase safety on Maine's rural roads.

OREGON IMPROVES CYCLIST SAFETY AT INTERSECTIONS

Research into the behaviors and performance of urban cyclists in several Oregon cities has yielded detailed information that can help prevent crashes and improve the safety and flow of traffic. Oregon DOT is targeting urban intersections, where the majority of bicycle-vehicle crashes occur. Researchers collected and analyzed video data of more than 4,000 cyclists at intersections with traffic signals. These data were then used to study cyclist performance, queue discharge, and signal compliance as well as to create



acceleration profiles that can be used for traffic signal timing. The study provided a vital set of baseline data on cyclist performance and behavior across several demographic groups. These results will help establish operational guidance for cities not just in Oregon but across the nation for the installation and timing of bicycle-specific signals to maximize traffic flow and intersection safety.

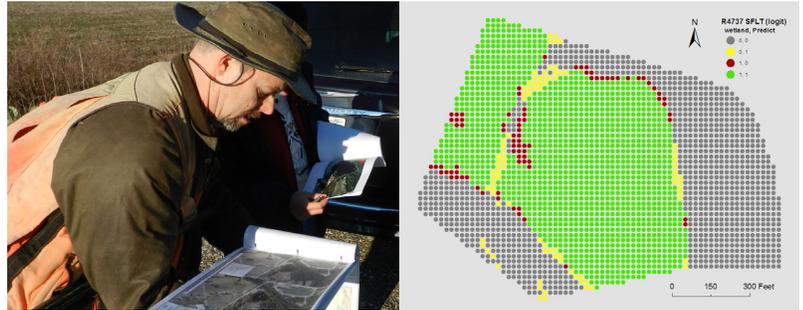
“AASHTO's annual High Value Research compendium and Sweet Sixteen showcase are invaluable tools to share the great work that's being done among the states.”

Linda Taylor

Director, Minnesota DOT Research Services, and Co-Chair, AASHTO RAC Value of Research Task Force

A GREENER TRANSPORTATION SYSTEM

AUTOMATION PROVIDES FASTER WETLANDS ASSESSMENT IN NORTH CAROLINA



North Carolina DOT received national recognition for developing prediction models to reduce fieldwork for wetlands management. Its next step was to build on those efforts, employing research to improve the models and processes and put them to work. NCDOT's follow-up study created an automated visualization tool for predicting and mapping wetlands. The tool displays predicted wetland regions by color and is compatible with NCDOT's current geographic information system platform. The state is already enjoying the benefits of the new system, saving \$350,000 on wetland and stream delineations on just one project. NCDOT anticipates added savings and further refinements in the future. Moreover, beyond the cost efficiencies, the automated tool provides early awareness of potential wetlands impact areas during project planning. This helps both state and federal agencies take follow-up measures in a timely manner.

VIRGINIA PROVES A “REDUCE, REUSE, RECYCLE” STRATEGY FOR PAVEMENT

Demonstrating a commitment to green construction techniques, Virginia DOT rehabilitated a 3½-mile stretch of Interstate 81 using three different in-place pavement recycling processes: cold in-place recycling, cold central-plant recycling, and full-depth reclamation. Even as these processes reduced initial construction costs and saved virgin materials and fuel, the agency needed to know that the highway was built to last. A three-year follow-up study involved extensive lab testing of pavement cores for strength and other physical properties as well as field testing of road surfaces to evaluate ride quality and structural capacity. The research showed that the pavement was still performing well, demonstrating in-place pavement recycling as a viable option for high-volume, high-priority routes. The project validated Virginia's savings both in dollars (in the millions) and construction time (reduced to just one-third of typical time required). Researchers have recommended that VDOT pursue in-place recycling where suitable, and a VDOT task force has its eyes open for future projects.



BUILDING LONGER-LASTING ROADS AND BRIDGES

PENNSYLVANIA AND TEXAS APPLY SURFACE TREATMENTS FOR PERFORMANCE AND SAFETY

Highway surface treatments are important for preserving safe and high-performing pavements. Pennsylvania DOT sought standard, cost-effective processes for using rumble strips as part of thin overlay construction. A research effort synthesized best practices from around the nation, and the resulting study provided a guide for installing or reinstalling rumble strips with overlays in Pennsylvania. The comprehensive guidance outlines clear direction for a range of rumble strip configurations (centerline, edge line, and shoulder); rumble strip depths ($\frac{3}{8}$ - and $\frac{1}{2}$ -inch); and thin overlay types (hot-mix asphalt, microsurfacing, and seal coat).

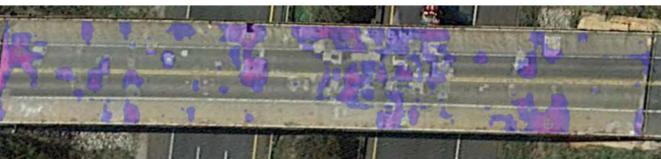
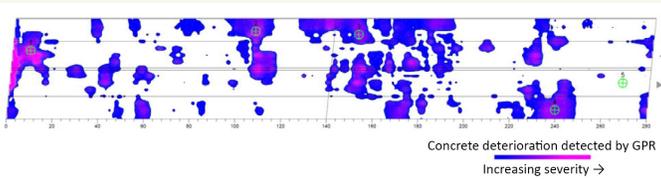


In Texas, the state DOT saw the potential of high-friction surface treatments at selected horizontal curve locations to improve driver performance and reduce the number and severity of crashes. Researchers developed the Texas Curve Margin of Safety worksheet to compute the benefits of increasing pavement friction through different means, such as high-friction surface treatments or increased superelevation (banking). The study also calibrated vehicle speed calculations for local curve sites and modeled the relationship of friction and crashes. The tools developed out of this research have given Texas the ability to make informed decisions about when to install a high-friction surface treatment compared with alternative treatments.

MARYLAND AND FLORIDA EXPAND NONDESTRUCTIVE TESTING TOOLBOX

Nondestructive testing ensures the safety and longevity of critical infrastructure, and states continually improve their range of techniques.

Maryland State Highway Administration extensively studied ground penetrating radar (GPR)—a proven technology to detect and evaluate subsurface features and anomalies—to take further advantage of its potential. The research showed that by using advanced application methods and analysis, GPR could be used to more accurately evaluate pavements and provide data needed for rehabilitation decisions. Maryland also uncovered potential for GPR in other applications, such as with bridge decks to reliably measure cover depth and analyze moisture,



and with precast concrete sections to measure section thickness, cover depth, and reinforcement locations. In Florida, the state DOT looked beyond traditional nondestructive techniques for evaluating welds. Radiographic testing is both disruptive to workers and costly due to the use of a radiation source, and ultrasonic testing does not allow inspection results to be recorded in real time. A research study examined phased array ultrasonic testing (PAUT) as an alternative method for testing welds and found it just as effective as radiographic and ultrasonic testing. PAUT also increases inspection speeds, leading to an expected savings of more than \$2 million on one large project underway in the state, with the potential for additional cost savings in the millions of dollars on future highway, bridge, and interchange projects.

NEW BRIDGE GIRDERS EXCEL IN SOUTH DAKOTA

South Dakota DOT uses precast double-tee girders as a quick and low-cost component for bridge replacement on local roads throughout the state. However, standard bridge designs had experienced premature deterioration at the longitudinal joints. SDDOT investigated improved designs of the girders and joints, testing full-size girders in the lab under accelerated loading conditions. The new girders outperformed the existing design in a side-by-side comparison, with the improved joints withstanding more than 100 years' worth of loading without signs of failure or reduction in stiffness. The new girders can carry 50 percent more load and have a safer failure mode at the joint as well. These strides forward in bridge life span and performance come at a mere 3 percent increase in cost, and South Dakota plans to tackle its backlog of bridge replacement needs with a better product that's built to last.



“Our focus on strategic research has allowed Wyoming to deliver projects that both increase safety and preserve our system. There is a real need for continued emphasis on quality research nationwide to deliver high-benefit projects.”

John Cox
Director, Wyoming DOT, and
President, AASHTO

PLANNING SMARTER, OPERATING BETTER



DISTRICT OF COLUMBIA CREATES NEW FRAMEWORK TO PREDICT TRAVEL IMPACTS IN URBAN AREAS

Assessing the impact of new land development on transportation, such as added trips and increased parking demand, can be especially complicated for large urban areas. To address this need in the District of Columbia, a District DOT research study piloted a data collection methodology to quantify travel impacts in the District. The study then compared the observed data against predicted

travel behavior from the industry standard Institute of Transportation Engineers' *Trip Generation* report as well as six additional methods. Results showed that none of the currently available methods were able to reliably predict actual travel impacts for mixed-use residential buildings in the District. As an alternative, the study presented a framework for collecting the data necessary for more accurate predictions and recommended next steps that can be applied to Washington, D.C., as well as other major urban centers across the country. This will result in more effective, data-driven urban development decisions and assessments nationwide.

IOWA, IDAHO, AND OHIO DEVELOP ADVANCED WINTER MAINTENANCE SOLUTIONS

With the costs of winter maintenance increasing steadily, several states have turned to innovative solutions to improve response times, reduce costs, and increase public safety.

- Iowa DOT recently launched its [Track-a-Plow website](#) to provide the public with a visual display of plow locations. The underlying data can be used for a range of applications: freight movement and travel-based decision making, weather studies, emergency management operations and coordination with the Department of Public Safety, and winter maintenance resources management.
- Idaho Transportation Department has successfully tested a system that can use infrasound (below the threshold of human hearing) to detect winter avalanches remotely and in real time. Idaho is aiming to implement the system to help detect and speed response to avalanche events, reduce road closures, and boost public safety.
- Ohio DOT is evaluating the use of a specialty bulk spreader capable of applying salt and brine over multiple roadway lanes in a single pass. An initial analysis showed that the spreader uses less salt than standard trucks, and when used on a tanker truck, it lowered costs by reducing anti-icing times by six hours per event. Ohio has gained knowledge and realized an average of 35 percent in salt savings since piloting the spreader in 2014, and has since completed an analysis on optimal placement for statewide implementation to maximize savings.



“Researchers are problem solvers. Today’s state DOT research managers have to do it better, faster, and with the most efficient use of resources.”

Harold “Skip” Paul
Director, Louisiana Transportation Research Center, and
Chair, AASHTO Research Advisory Committee

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Project links are available in the online version of this document at research.transportation.org:

MISSOURI’S DIVERGING DIAMOND INTERCHANGES
[Research report](#)

CRASH RESPONSE AND CLEARANCE
• [Illinois’ research report](#)
• [Louisiana’s research summary](#)

MAINE’S HSM CALIBRATION
[Research brief](#)

OREGON’S INTERSECTIONS FOR CYCLISTS
[Research report](#)

NORTH CAROLINA’S WETLANDS PREDICTION
[Project web page](#)

VIRGINIA’S PAVEMENT RECYCLING
[Research report](#)

SURFACE TREATMENTS
• [Pennsylvania’s research report](#)
• [Texas’ research report](#)

NONDESTRUCTIVE TESTING
• [Maryland’s research report](#)
• [Florida’s research report](#)

SOUTH DAKOTA’S IMPROVED BRIDGE BEAM
[Research project website](#)

DISTRICT OF COLUMBIA’S URBAN TRIP GENERATION
[Research report](#)

WINTER MAINTENANCE ADVANCEMENTS
• [Iowa’s website](#)
• [Idaho’s research report](#)
• [Ohio’s research report](#)

See AASHTO’s research website, research.transportation.org, for additional high-value state DOT research projects.