FHWA R&T NOW

A newsletter about research, development, and technology at the U.S. Department of Transportation's (USDOT) Federal Highway Administration (FHWA).

Sailing Into the Sunset

By Dawn Vanlandingham, Transportation Specialist, Office of Research Services, and Christopher McCoy, Technical Writer/Editor, contractor

Source: FHWA.
The wandering *S/V Peregrina* sails into the sunset.

As a leading facility for some of the world's most advanced transportation research, Turner-Fairbank Highway Research Center (TFHRC) requires an executive with high-level technical knowledge and top-notch managerial talent. In January 2020, FHWA selected Dr. Kelly Regal as the Office of Research, Development, and Technology's associate administrator and the first woman director in TFHRC's 70-plus year history.

Little did Regal know that almost immediately after starting, she would need to guide more than 300 employees and contractors through a worldwide pandemic, virtually, while still safely operating a facility and conducting research with minimum staff. Forget easing into a new position—her challenge was to immediately implement emergency plans, some of which did not exist before the pandemic, and maintain operations during the winter months when shutting the facility, turning out the lights, and locking the doors was not an option. Like other executives, Regal provides oversight of a Federal office, but also holds responsibility for a federally owned and operated research facility in McLean, VA. The facility is composed of three distinct buildings (the Turner Building, Fairbank Building, and Annex Building) with approximately 178,000 square feet housing 15 laboratories, a library, office space, and data centers situated on 43 acres of paved, turfed, and forested land. The facility houses approximately 300 (Government and non-Government) employees.

U.S. Department of Transportation
Federal Highway Administration

All images source: FHWA.
Far left photo: Regal with Bridge Engineering Team Leader Benjamin Graybeal. Center photo from left to right: USDOT Secretary Pete Buttigieg, FHWA Deputy Administrator Andrew Rogers, TFHRC Chief Scientist Craig Thor, and Regal. Far right photo: Regal and Research Civil Engineer Timothy Barrett.

Now, Regal is retiring after a distinguished career in private industry and in Federal service. She jokingly says,

> "I am on the exit ramp to retirement."

Regal started her career in the William J. Hughes Federal Aviation Administration Technical Center in New Jersey, then went on to assignments in the international transportation community. As the Berlin Wall came down, she helped Germany overhaul its air traffic control system.

At the Department of Homeland Security, Regal helped develop detection technologies for explosives and weapons smuggled through the transportation system. Regal also worked in surface transportation with the Federal Motor Carrier Safety Administration and at the Volpe National Transportation Systems Center in Cambridge, MA.

> "I have practically worked in all modes of the transportation system," says Regal. "But I am extremely proud to be the first woman selected to lead the TFHRC research facility."

Among the numerous accomplishments that defined her time at TFHRC, Regal stewarded several:

- Renovating the research facility and laboratories that will soon have a tremendous impact on future research.
- Hosting Secretary of Transportation Peter P.M. Buttigieg's visit to TFHRC for the opening of the newly rebuilt Pavement Testing Facility.
- Spearheading the big data and artificial intelligence initiatives to analyze large amounts of information to further the research mission.
- Embracing the technology transfer of ultra-high performance concrete to many U.S. States.
- Introducing the Intersection Safety Challenge.
- Launching the new biennial Transportation Pooled Fund Excellence Awards, and the first-ever Student Writing Competition for the *Public Roads* magazine.[1]
- Increasing digital subscriptions to *Public Roads* magazine, which has seen a staggering amount over the past few years.

Established in 1918, *Public Roads* is the premier quarterly magazine of FHWA. Each issue covers the latest in highway research and development (R&D), innovation and technology, and program advancements that benefit the Nation and create safer, more resilient roadways and structures. Working with the communications team, Regal revamped the magazine and launched a marketing campaign to increase readership. With layout changes, new authors coming on board, and engaging social media campaigns, the magazine continues to grow in leaps and bounds, attracting new readers with each issue. In the beginning, when the *Public Roads* GovDelivery database was created, there were just 1,794 digital subscribers in Summer 2019. Since the launch of the new direction and marketing campaign dedicated to *Public Roads*, the digital subscribers have grown from 2,543 (Winter 2021) to 27,721 (Summer 2024)!

Regal is also proud of the successful effort to rebuild the entire agency research portfolio, anchoring it in legislation and administration priorities. Based on Title 23 U.S. Code § 503, which outlines the Agency's legislative research responsibilities, the team developed a completely revamped Annual Modal Research Plan, which is required by statute and available to the public, providing transparency into how FHWA conducts and funds research.[2,3]

Reflecting on this achievement, Regal says,

> "I believe we have developed a methodology that enables us to conform to our legislative mission and clearly articulate the goals of the research portfolio and how we allocate funding. The process also helps us to select funding priorities."

When asked what advice she would give her successor, Regal emphasizes that TFHRC is a very close-knit group of people who work together like a family. One example of this family atmosphere was on display at Take Your Child to Work Day this year.

Children of TFHRC employees visited the facility to see what their parents do for a living. The children visited laboratories and were asked to think about how the transportation system works. More than providing entertainment, the staff challenged the children in a contest to build the strongest bridge out of ice-pop sticks. The winning bridge design would hold the most weight without collapsing. (On the side, a few adults were also spotted participating in the bridge design contest.)

> "I really enjoyed their visit," says Regal. "Forty-two of the kids showed up, and we made sure that all forty-two kids left—curiosity intact, well fed, and inspired to be the next generation of transportation employees."

As Regal prepares for her retirement, her career has come full circle.

> "I started my career in a Federal laboratory and wanted to end my career in a laboratory setting."

Regal's last day at the research facility is October 18, 2024. She continues,

> "I believe you should plan your retirement just like you plan your career—and my plan is to eventually sail around the world on my sailboat, the *S/V Peregrina*, which loosely translates to *wanderer*." She continues with a smile, "Even my retirement will have a transportation theme."

References

1. FHWA. 2024. "*Public Roads Magazine*" (web page). https://highways.dot.gov/public-roads/home, last accessed September 20, 2 024.
2. Research and Technology Development and Deployment. 2021. U.S. Code 23 § 503. https://www.govinfo.gov/app/details/USCODE-2021-title23/USCODE-2021-title23-chap5-sec503, last accessed September 16, 2024.
3. Annual Modal Research Plans. 2021. U.S. Code 49 § 6501. https://www.govinfo.gov/app/details/USCODE- 2021-title49/USCODE-2021-title49-subtitleIII-chap65- sec6501, last accessed July 29, 2024.

Exploratory Advanced Research Program

Using Advanced Artificial Intelligence (AI) to Predict Infrastructure Deterioration

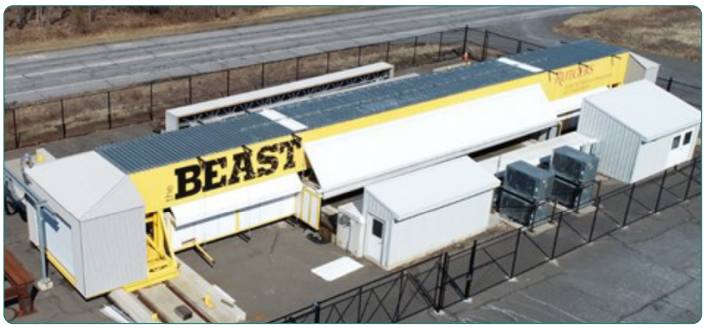
By Mehrdad Shafiei Dizaji, Postdoctoral Research Associate, TFHRC, FHWA, USDOT

The growing complexity of maintaining and repairing transportation infrastructure poses significant challenges. Traditional methods relying on visual inspection and basic nondestructive evaluation (NDE) techniques often fall short in capturing the detailed and dynamic progression of infrastructure deterioration, such as that in bridge decks. These conventional methods can be subjective and may not adequately forecast future deterioration, which is crucial for timely maintenance and ensuring public safety.

FHWA is at the forefront of addressing these challenges through innovative research and technology. One promising development is the integration of physics-informed neural networks (PINNs) and advanced machine-learning frameworks into NDE data analytics. This approach aims to enhance the precision and predictive power of infrastructure assessments by leveraging the latest advancements in AI and machine learning.

PINNs represent a significant leap forward in the analysis of NDE data. Unlike traditional models, which often use simple mathematical representations, PINNs incorporate the underlying physical principles governing the behavior of infrastructure materials.

This integration allows for more accurate and granular deterioration predictions. By analyzing spatial and temporal patterns in NDE data (like those from ground-penetrating radar (GPR)), these models can forecast the progression of subsurface abnormalities and predict the remaining lifespan of infrastructure elements with unprecedented detail.



Source: FHWA.
The overview of BEAST facility.

The Bridge Evaluation and Accelerated Structural Testing® (BEAST) facility in New Jersey exemplifies the practical application of these technologies. At BEAST, full-scale bridge components undergo accelerated testing to simulate years of wear and tear within a few months. The data collected from these tests, including GPR readings, are used to train PINNs, enabling researchers to validate performance models and predict deterioration more accurately. In addition to accelerating the testing process, this facility provides a comprehensive dataset that significantly enhances the reliability of AI-driven predictions.

For those interested in exploring the details of this research, additional information can be found on the InfoBridge™ website, which hosts extensive datasets and research outcomes from different programs.[1] The continued development and integration of AI into infrastructure assessment promise a future where maintenance decisions are informed by precise, predictive models, ultimately leading to safer and more resilient transportation networks.

For more information, visit the InfoBridge™ FHWA website.[1]

References

1. FHWA. n.d. "LTBP InfoBridge™" (website). https://infobridge.fhwa.dot.gov/, last accessed July 15, 2024.

Transportation Pooled Fund (TPF) Program

Collaborative Solutions—How a TPF Study Advances Transportation Through Technology

By Tricia Sergeson, TPF Program Manager, Office of Research Services

As transportation needs evolve, developing intelligent transportation solutions (ITS) innovations can help meet needs and improve safety across the Nation. Often researching ITS solutions can be resource intensive and not feasible for agencies with varying budgets. Since 1991, the Evaluating New Technologies for Roads Program Initiatives in Safety and Efficiency (ENTERPRISE) TPF study has looked to meet this challenge by bringing State departments of transportation (DOTs) and Canadian transportation organizations together to evaluate ITS research and innovation efforts.

Led by the Michigan Department of Transportation, ENTERPRISE has become a leading international consortium for the development and application of collaborative ITS research.[1] It has allowed partners to address common transportation challenges with ITS solutions through focus areas such as connected and automated vehicles, mobility on demand, and smart infrastructure.

ENTERPRISE addresses shared traffic operation concerns among partner agencies by conducting practitioner-oriented research. Partners meet twice a year to identify research projects, evaluate the latest ITS deployments, and share subject matter experience. This twice a year meeting helps to encourage both technology transfer and building a network among fellow subject matter experts.

Source: USDOT.
Example of an ATMS in use on a highway.

ENTERPRISE has had three phases. Phase I (TPF-5(231)) of ENTERPRISE saw innovations—like the deployment of an advanced traffic management system (ATMS) in Arizona—as early as 1991. ATM strategies use real-time information to manage traffic conditions, improving congestion management and creating a more efficient roadway network. Other innovations during this phase include automated traffic signal performance measures, vehicle probe speed data, automated commercial vehicle data sharing, and agency traveler information systems (such as 511 Travel Information Telephone Services).[1]

Phase II (TPF-5(359)) produced the following three major studies:[1]

- Deployment Strategy for Rural Connected Vehicle Systems—provided novel findings for the deployment, application, constraints, and recommended strategies for a complex rural connected vehicle system.

- Synthesis of Intelligent Work Zone Practices—resulted in a comprehensive report on the development, availability, and efficacy of four major work zone technologies: queue warning systems, dynamic merge systems, alternate routes, and variable speed limits.
- Model ATMS Concept of Operations and Requirements—documented support member agencies' systems engineering process and ATMS procurement, including a model ATMS concept of operations.

ENTERPRISE is currently in Phase III (TPF-5(490)). Areas of focus for this phase include roadway sensors, unmanned aerial systems in ITS, and ITS for asset management.[2] Interested organizations, including Federal, State, local, and foreign agencies as well as private-sector firms, can partner with ENTERPRISE and collaborate on any of these projects.

ENTERPRISE's emphasis on collaboration and resource sharing has allowed for the critical development, evaluation, and deployment of innovative ITS solutions. These solutions have significantly enhanced road safety, mobility, efficiency, and overall transportation system performance.

For more information about this TPF study or to participate, go to https://pooledfund.org/details/study/720.[2]

References

1. FHWA. 2024. *TPF Success Story: TPF-5(231) Evaluating New Technologies for Roads Program Initiatives in Safety and Efficiency (ENTERPRISE)*. Washington, DC: Federal Highway Administration.
2. National Cooperative Highway Research Program. 2024. "ENTERPRISE—Phase III (Phase II Continuation)" (web page). https://www.pooledfund.org/Details/Study/720, last accessed July 19, 2024.

Safety
Flashing Lights Alert Drivers to Pedestrian Presence

By Ann Do, Highway Research Engineer, Office of Safety and Operations R&D

Pedestrian fatalities are at an all-time high in recent years. A 2023 Governors Highway Safety Association report found that the number of pedestrian deaths in 2022 was the highest since 1981.[1] Between 2010 and 2020, pedestrian deaths increased by 46 percent.[2] According to the report, the causes of the crashes were gathered from the National Highway Traffic Safety Administration's Fatality Analysis Reporting System (FARS) database.[3] The crashes mostly dealt with "speeding, alcohol involvement, light condition, and roadway factors," such as sidewalks, intersections, and road types.[1,3]

Installing light-emitting diode (LED)-embedded signs (LED-Em treatment) at pedestrian crosswalks has emerged as a promising solution to enhance pedestrian safety. LED Em treatment consists of LED lights embedded in the border of pedestrian- and school crossing warning signs and pedestrian push buttons. When pedestrians want to cross the street, they press the button to get the LED lights to flash. This treatment is also less expensive than other pedestrian-crossing treatments, such as pedestrian hybrid beacons. But there has been limited research on how roadway environment impacts the effectiveness of this traffic control method and guidance on when and where to use it. To provide data about the efficacy of the treatment, FHWA sponsored a 2-year study to gather this information, and the agency published a subsequent report, *Driver Yielding with LED-Embedded Pedestrian- and School Crossing Signs*.[4]

The study evaluated the effectiveness of the LED-Em treatment based on roadway characteristics across multiple sites in two States. They used driver-yield values (i.e., percentage of drivers who yield at a pedestrian crosswalk) as a proxy safety metric to measure the effectiveness of the LED-Em treatment. Their work was conducted in Texas and California. In total, researchers collected data from 31 sites in California and 22 sites in Texas. Each site had a pedestrian-, school-, or trail-crossing warning sign with LED-Em treatment at a marked crosswalk activated by a pedestrian push button. Some sites had supplemental pedestrian-crossing treatments, such as in-pavement lights and advance-warning signs, but these treatments were considered distinct variables when evaluating the data.

After analyzing the data, the researchers found that LED-Em treatment was more effective on streets with lower speed limits, narrower crossing lanes, and lower volumes of traffic. Supplemental pedestrian treatment, such as advance-warning signs, advance-yield lines, and in-pavement warning lights, also improved driver yielding.

For more information on this topic, go to https://highways.dot.gov/research/publications/safety/FHWA-HRT-23-038.[5]

References

1. Governors Highway Safety Association. 2023. *Pedestrian Traffic Fatalities by State: 2022 Preliminary Data (January–December)*. Washington, DC: Governors Highway Safety Association. https://www.ghsa.org/sites/default/files/2023-06/GHSA%20-%20Pedestrian%20Traffic%20Fatalities%20by%20State%2C%202022%20Preliminary%20Data%20%28January-December%29.pdf, last accessed August 12, 2024.
2. Governors Highway Safety Association. 2021. *Pedestrian Traffic Fatalities by State: 2020 Preliminary Data*. Washington, DC: Governors Highway Safety Association. https://www.ghsa.org/sites/default/files/2021-03/Ped%20Spotlight%202021%20FINAL%203.23.21.pdf, last accessed July 19, 2024.
3. National Highway Traffic Safety Administration. n.d. "Fatality Analysis Reporting System (FARS)" (web page). https://www.nhtsa.gov/research-data/fatality-analysis-reporting-system-fars, last accessed August 2, 2024.
4. Fitzpatrick, K., E. S. Park, N. Johnson, and K. Falk. 2023. *Driver Yielding with LED-Embedded Pedestrian- and School-Crossing Signs*. Report No. FHWA-HRT-23-038. Washington, DC: Federal Highway Administration. https://highways.dot.gov/research/publications/safety/FHWA-HRT-23-038, last accessed August 23, 2024.
5. FHWA. n.d. "Driver Yielding with LED-Embedded Pedestrian and School-Crossing Signs" (web page). https://highways.dot.gov/research/publications/safety/FHWA-HRT-23-038, last accessed August 12, 2024.

Safety/Environment
Are the Traffic Barriers Behind Aesthetic Treatments Safe?

By Eduardo Arispe, Federal Outdoor Impact Laboratory (FOIL) Manager, Office of Safety and Operations R&D

The natural environment and scenic character of a national or State park are an integral part of the visitor experience. For some transportation agencies, the aesthetic look of infrastructure can be important in addition to safety of the road hardware. Along National Park Service (NPS) roads, a visitor might see a rockery wall. But does that wall meet the most recent safety standards to match ever-changing vehicle fleet models? Will that wall or traffic barrier or other roadside hardware pass current vehicle safety tests?

Although developed to meet previous crash test criteria, not all of these NPS aesthetic barriers have been tested in accordance with the *Manual for Assessing Safety Hardware*, the latest industry crash testing guidelines.[1] Over the last year, FHWA has been working with NPS to ensure these road barriers and hardware meet these standards.[1]

One of these collaborative projects involves the George Washington Memorial Parkway (GWMP). This high-traffic Washington, DC, area roadway has been undergoing a major rehabilitation, including an upgrade of its aesthetic barriers. As part of this upgrade, TFHRC's FOIL developed barriers that met the latest industry crash-testing guidelines.

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Two motor vehicles drive on the GWMP.

FOIL followed a three-step process to conduct the testing: simulation, design, and crash testing. Using finite-element computer models, FOIL simulated crashes with the different types of NPS aesthetic barriers, such as stone-faced walls and steel-backed timber guardrails.[1] Finite element computer models provide extremely accurate representations of the effects of a collision, allowing for more rapid development of safety barriers.[1] Through these simulations, researchers were able to design aesthetic barriers that met the latest industry crash-testing criteria. For example, the stone-face barrier became taller and stronger to account for current taller and heavier vehicle fleets. Such designs were subsequently confirmed through full-scale crash testing.

The upgraded aesthetic barriers for GWMP will be installed by fall 2025 and can be used in the future for any other NPS park road throughout the Nation.

References

1. Arispe, E. 2024. "The New George Washington Memorial Parkway Byway." *Public Roads*, Spring, Vol. 88, no. 1.

Infrastructure

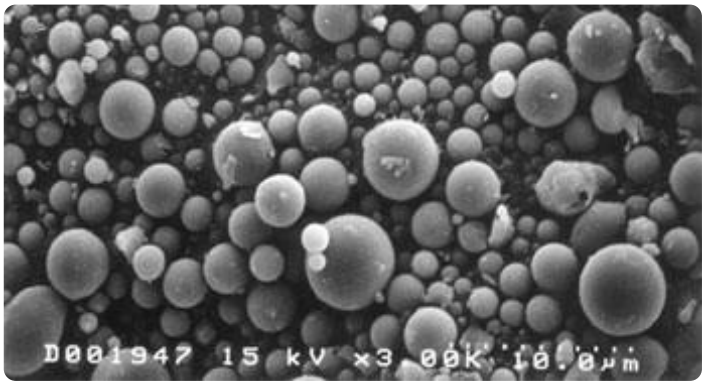
Maintaining Modern Concrete's Resistance to Cold Weather Conditions

By Jack Youtcheff, Principal Materials Research Engineer, Office of Infrastructure R&D

In colder regions of the United States, concrete structures experience severe freeze-thaw conditions, resulting in concrete's deterioration if cold weather conditions are not accounted for early in the concrete production process. Resistance to this deterioration requires concrete infrastructure to have adequate air entrainment. Concrete's air entrainment mostly comes from mixing in a liquid reagent at low levels during the concrete production process. However, the adsorption of the liquid reagent onto coal ash, a common supplementary cementitious material, hinders air generation and reduces freeze-thaw damage mitigation.[1]

Coal ash comes from a variety of sources, but its chief source is coal-fired power plants. Coal ash is a waste product that comes from burning coal for electricity; however, it is also a suitable substitute for a portion of the portland cement used in concrete production. Adding coal ash to concrete mixtures reduces cement content and therefore reduces overall carbon emissions coming from concrete materials, mitigating the risk of global warming. Measuring the coal ash adsorption capacity of the liquid reagent used in today's concrete is now critical to maintaining the structural integrity of concrete infrastructure subject to freeze-thaw conditions.[1,2]

To measure coal ash adsorption capacity, the FHWA funded the development of a new technology through the Small Business Innovation Research (SBIR) program. The SBIR program acts as America's seed fund for small businesses, and FHWA is one of many Federal agency participants.



Source: FHWA.[2]
Coal ash particles at 2,000x magnification.

> "Small businesses are essential to our economy, and this program plays an important role in advancing America's economic competitiveness by supporting domestic small businesses while stimulating technological innovation that can improve our transportation systems and lead to further economic growth," said USDOT Deputy Assistant Secretary for Research and Technology Dr. Robert C. Hampshire.

The new SBIR-funded technology is a small ultraviolet visible optical spectroscopy system. The system, known as IDSpectra™ (IDS), allows for quick analysis and quantification of chemicals present in concrete solutions. IDS works with personal computers using a USB port. The system can detect coal ash at low levels with its high sensitivity, making it easy to use in the lab.[3]

References

1. FHWA. n.d. "Fly Ash Facts for Highway Engineers" (web page). https://www.fhwa.dot.gov/pavement/recycling/fach01.cfm, last accessed August 8, 2024.
2. PhosphorTech Corporation. 2022. "Check out the latest on the novel method and spectroscopy instrument developed for the analysis and classification of coal-based materials at the 2022 International Pittsburgh Coal Conference (PCC)" (web page). https://phosphortech.com/check-out-the-latest-on-the-novel-method-and-spectroscopy-instrument-developed-for-the-analysis-and-classification-of-coal-based-materials-at-the-2022-international-pittsburgh-coal-conference-pcc/, last accessed August 5, 2024.
3. PhosphorTech Corporation. n.d. "Spectroscopy and UV/Vis/IR Analysis by IDSpectra" (web page). https://phosphortech.com/idspectra/, last accessed August 5, 2024.

Corporate

Rolling Out the Fiscal Year 2025 Annual Modal Research Plan (AMRP)

By Connie Tang, Legislative and Budget Analyst, Office of Research Services

Individual research programs are diverse and varied; however, with so many local, State, Federal, and privately owned organizations working on research and solutions, is the industry addressing the highest priorities across the Nation? FHWA was tasked with providing oversight for the overall direction of the highway research program and is responsible for working with States and other entities to establish nationwide priorities and provide guidance within the transportation industry.

Every June 1, FHWA submits a research planning strategy, known as an AMRP, to the USDOT Assistant Secretary for R&T. FHWA submits the AMRP per the requirements of Title 49 United States Code § 6501.[1] FHWA's AMRP provides a comprehensive plan for the upcoming fiscal year and a detailed outlook for the following fiscal year, including how FHWA research supports USDOT strategic goals (safety, economic strength and global competitiveness, equity, climate and sustainability, transformation toward a transportation system of the future, and organizational excellence).[2]

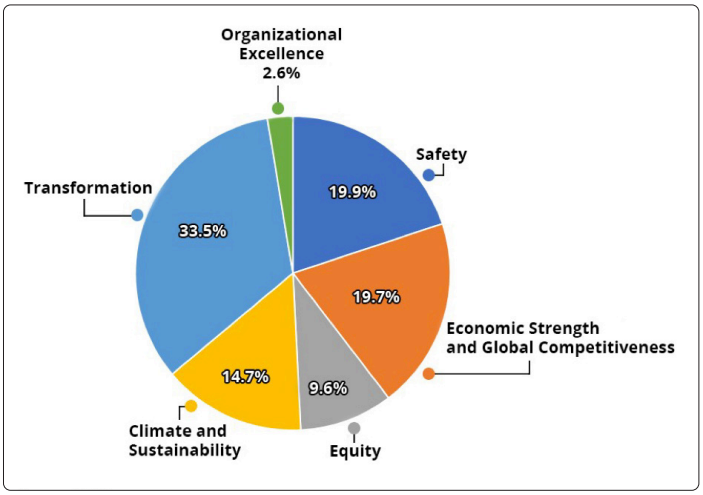
The research, development, and technology (RD&T) performed by FHWA focuses on areas of importance to the Nation that are not addressed by other research sponsors. Many of these research areas require higher complexity, higher risk, long-term commitment, or the areas fall under the responsibility of Federal agencies.[3]

The AMRP includes information on how FHWA's $257 million RD&T budget is divided between the USDOT strategic goals mentioned earlier and agency program offices to address national needs. The AMRP features descriptions of activities and programs undertaken to support these national goals for the upcoming two fiscal years.[3]

The AMRP also contains information on activity partners and potential impacts (effects on the transportation industry), outputs (summary of any tangible yields or products resulting from the research), and outcomes (real-world impacts of the research such as on policy,

rulemaking, patents, technology transfer outputs, commercialization, etc.) of the research described in the report.

Each operating administration (the Federal Aviation Administration, FHWA, Federal Motor Carrier Safety Administration, Federal Transit Administration, National Highway Traffic Safety Administration, Intelligent Transportation Systems Joint Program Office, Federal Railroad Administration, Pipeline and Hazardous Materials Safety Administration, Great Lakes St. Lawrence Seaway Development Corporation, and the Maritime Administration) is required to submit an AMRP. External audiences can use the reports to help guide their research initiatives or to better understand Federal research efforts.[3]



Source: FHWA.
Summary of fiscal year 2023 RD&T Program budget request by DOT strategic goal.[3]

References

1. *Annual Modal Research Plans*. 2021. U.S. Code 49 § 6501. https://www.govinfo.gov/app/details/USCODE-2021-title49/USCODE-2021-title49-subtitleIII-chap65-sec6501, last accessed July 29, 2024.
2. USDOT. 2022. *Strategic Plan FY* 2022-2026. Washington, DC: U.S. Department of Transportation. https://www.transportation.gov/sites/dot.gov/files/2022-04/US_DOT_FY2022-26_Strategic_Plan.pdf, last accessed July 29, 2024.
3. FHWA. 2023. *United States Department of Transportation Annual Modal Research Plans FY 2023 Program Outlook FY 2024*. Washington, DC: Federal Highway Administration. https://www.transportation.gov/sites/dot.gov/files/2023-11/AMRP%20FY2023-2024%20FHWA%20S1%20FINAL%2007132023.pdf, last accessed July 26, 2024.

Operations

Emergency Vehicle-to-Everything (V2X) Messaging System Developed for Emergency Response Vehicles

By James Austrich, Program Manager, Traffic Incident Management, Office of Transportation Operations, and Tiffany Hall, Highway Research Engineer, Office of Safety and Operations R&D

Emergency medical personnel, firefighters, police, towing and recovery, transportation or public works, and other incident responders face heightened risks in their professions when they respond to incidents on busy roadways, putting them at risk for secondary collisions with upstream or oncoming traffic, injuries, and death. On average, an emergency first responder is struck and killed by a motorist while responding to a roadway incident every 4.65 days in the United States; a much higher but unknown number of responders are injured.[1]

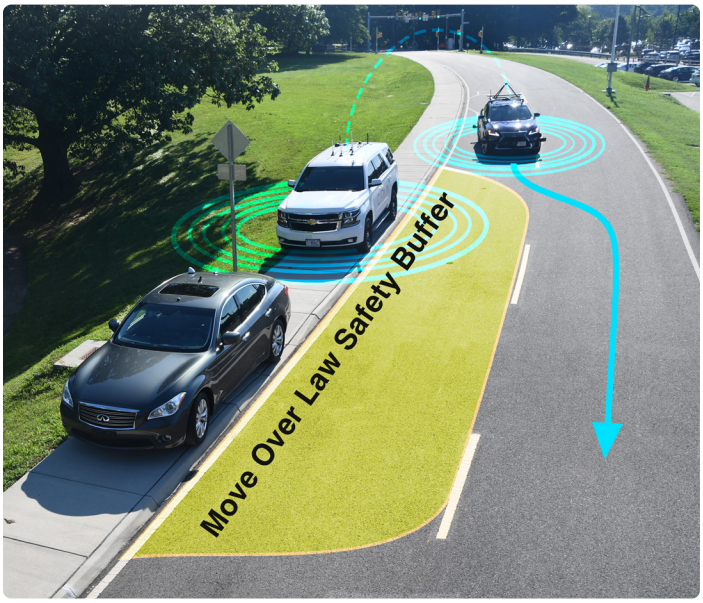
Many of these dangers could be mitigated.

All 50 States and the District of Columbia have enacted Move Over laws to prevent these fatalities. The Move Over laws require vehicles to slow down, switch lanes, or both whenever possible as soon as incident responders are on the scene of an incident in an adjacent lane or on a roadway shoulder.[1]

Now, FHWA is developing a new advanced warning system that enables emergency response vehicles to broadcast important safety information through V2X messaging. This V2X messaging consists of wireless communication between the emergency response vehicle and other entities that could affect or be affected by it. The purpose of the new warning system is to enable vehicles equipped with cooperative driving automation systems (C-ADS) to lessen the risk to incident responders during roadway incidents.

> "Responders are constantly fighting for their safety against dangerous drivers who are distracted, drugged, drunk, drowsy, and otherwise unsafe," says FHWA Transportation Specialist Paul Jodoin. "While current safety measures can help protect responders, stronger measures are necessary to address these hazards effectively. Widespread use of V2X technology has the potential to make a significant difference in enhancing safety for first responders."

The warning system will enable emergency response



Source: FHWA.
The new advanced warning system uses V2X messaging to alert road users to personnel responding to nearby incidents.

vehicles to announce their location with the Global Positioning System, the desired speed reduction for approaching traffic, and other key safety parameters for C-ADS-equipped vehicles to follow. The system will result in these vehicles taking the necessary precautions to follow the Move Over laws, saving lives.[2]

In a triumph for automation and V2X communication, researchers successfully demonstrated the advanced warning system at the Summit Point Raceway in May and June of 2021. The Volpe National Transportation Systems Center provided validation testing. During the tests, the CARMA Platform℠-controlled C-ADS-equipped vehicle successfully switched lanes after receiving the broadcasted message from the emergency response vehicle using the CARMA Messenger℠ application.[2,3,4]

One real-world challenge that the research team overcame concerned data accessibility. Emergency response vehicles currently in use on the Nation's roads would most likely not have access to the high-resolution proprietary mapping data used by C-ADS-equipped vehicles. During the tests, manual entry of the desired safety parameters for the C-ADS-equipped vehicle was performed in the CARMA Messenger application.[2,4]

Future next steps could involve FHWA working with industry partners to determine best practices for this new emergency broadcast messaging system.[2]

References

1. Richard Blumenthal: U.S. Senator for Connecticut. 2022. "Blumenthal & Braun Introduce Bipartisan Resolution to Support Slow Down, Move Over Laws" (web page). https://www.blumenthal.senate.gov/newsroom/press/release/blumenthal-and-braun-introduce-bipartisan-resolution-to-support-slow-down-move-over-laws, last accessed July 24, 2024.
2. FHWA. 2023. *Move Over Law for Traffic Incident Management Using Cooperative Driving Automation (CDA)*. Report No. FHWA-HRT-24-027. Washington, DC: Federal Highway Administration. https://doi.org/10.21949/1521467, last accessed August 9, 2024.
3. FHWA. n.d. *CARMA Platform* (software). Version 4.3.0.
4. FHWA. 2023. *CARMA Messenger* (software). Version 4.4.0.

Safety
The Human Factors Team Leads the Way in Applying Virtual Reality (VR) Technology

By Jesse Eisert, Research Psychologist, Office of Safety and Operations R&D

In 2022 alone, Fatality Analysis Reporting System data shows an estimated 8,627 pedalcyclist and pedestrian fatalities in the United States. Called vulnerable road users, the fatalities and injuries for these two groups rose much higher than other road user population segments.[1] Recreating the circumstances that contributed to these crashes—such as roadway design or poor lighting—can be problematic, leading to ethical issues. Instead, the FHWA Human Factors Team simulates the factors that lead to motor vehicle accidents using VR technology to recreate these unique situations in a safe and controllable environment and to help design ways to prevent the crashes. The VR Laboratory at TFHRC performs this work to gather more data on conditions leading to crashes with the goal of eliminating injury and death on U.S. roads.

VR technology is still new but offers a lot of advantages compared to work performed in the field. Administrators of VR can simulate multiple driving scenarios while testing new roadway and infrastructure designs. In addition, VR

technology allows for simulating futuristic designs and technologies that do not yet exist in the real world.

The VR Laboratory has two systems that make use of VR tools for pedestrians: an omni directional treadmill and a two-lane road. Both systems involve users wearing VR headsets. The headsets have light-emitting diode displays and provide a 110-degree field of view. The headset sensors create a virtual world for the wearer. While users navigate this virtual world, the headsets track the users' eye movements for future analysis. The Human Factors Team monitors and compiles a variety of data from the headset wearer when crossing an intersection, including the length of time, walking patterns, gait, proximity to other road users, and other behaviors. To follow up on more subjective user experiences, the Human Factors Team uses questionnaires to inquire about trust and safety perception.[2]

The VR laboratory's first study investigated how an Intersection Safety System (ISS) could potentially improve pedestrian safety while crossing an intersection. In this study, a protype ISS was integrated into a conventional crosswalk signal to see if providing an additional warning to pedestrians, when a potential conflict with a vehicle occured, would help inform the pedestrian and avoid the conflict. Additionally, the team examined if providing information that the pedestrian was detected by the ISS would make pedestrians feel safer at an intersection. A report and TechBrief derived from this study are forthcoming.

References

1. National Highway Traffic Safety Administration. n.d. "FARS Encyclopedia" (web page). https://www-fars.nhtsa.dot.gov/Main/index.aspx, last accessed August 23, 2024.
2. Arnold, M., and J. Eisert. 2024. "FHWA's Human Factors Automated Vehicle Research." *Public Roads* 88, no. 2.

HSIS
Highway Safety Information System

Congratulations to the winners of the FHWA 2024 Highway Safety Information System (HSIS) Excellence in Highway Safety Data Awards

Deciphering Seasonal Weather Impacts on Crash Severity: A Machine Learning Approach
Lead Author: Francisca Kasubi, Florida International University

Analyzing Head-On Crashes on Rural Two-Lane Roads
Lead Author: Harsha Gattupalli, Florida International University

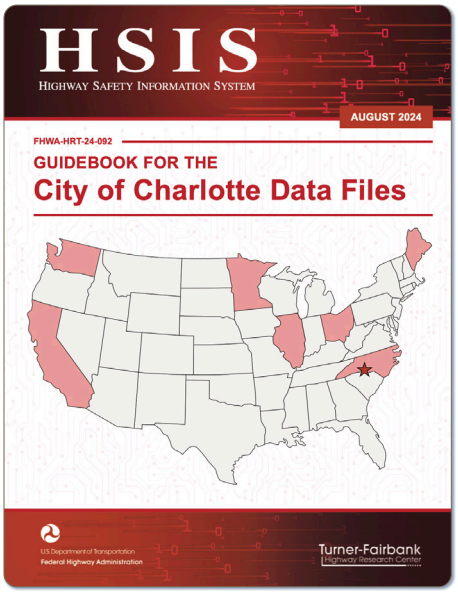
Supporting the Safe System Approach: Decision-Making Through Crash Sequence Analysis
Author: Cesar Andriola, University of Wisconsin-Madison

Thank you to all who entered and supported this year's awards!

For information on these winning efforts and next year's Excellence in Highway Safety Data Awards, click here.

Source: FHWA.

Recent Publications



Source: FHWA.

Measuring Decarbonization in the Pavement Cycle

Date: September 30, 2024
Publication No.: FHWA-HRT-24-056

Development of Next-Generation Pavement Performance Measures and Asset Management Methodologies to Support MAP-21 Performance Management Objectives

Date: September 13, 2024
Publication No.: FHWA-HRT-23-102

Using Artificial Intelligence to Evaluate Pavement Condition and Safety

Date: September 13, 2024
Publication No.: FHWA-HRT-24-058

Exploratory Testing of Stress Corrosion Cracking in Stainless Steels at Low Temperature

Date: September 11, 2024
Publication No.: FHWA-HRT-24-132

A Systematic Approach on CMS Messaging Selection During Nonrecurring Events: Decision Tree

Date: September 5, 2024
Publication No.: FHWA-HRT-24-139

Corrosion-Induced Major Tendon Failures in Post-Tension (PT) Concrete Bridges

Date: September 3, 2024
Publication No.: FHWA-HRT-24-148

Traffic Management Systems Managing the Use of Variable Speed Limits During Adverse Weather Conditions

Date: September 3, 2024
Publication No.: FHWA-HRT-24-157

The Transportation Pooled Fund (TPF) Excellence Awards Debut

Date: September 3, 2024
Publication No.: FHWA-HRT-24-119

Field Evaluation of At-Grade Alternative Intersection Designs, Volume II- Safety Report

Date: September 3, 2024
Publication No.: FHWA-HRT-24-156

Multidisciplinary Data Management Support - 101 Overview

Date: September 3, 2024
Publication No.: FHWA-HRT-24-164

Assessment of Data Sources for First Responder Struck-By Crashes

Date: September 3, 2024
Publication No.: FHWA-HOP-23-069

Guidebook for the Minnesota Data Files

Date: September 3, 2024
Publication No.: FHWA-HRT-24-120

Guidebook for the Illinois Data Files

Date: August 28, 2024
Publication No.: FHWA-HRT-24-114

Highway Safety Information System Guidebook for the California Data Files

Date: August 27, 2024
Publication No.: FHWA-HRT-24-115

Highway Safety Information System Guidebook for the City of Charlotte Data Files

Date: August 26. 2024
Publication No.: FHWA-HRT-24-092

The Next Generation of Traffic Management Systems and Centers

Date: August 26, 2024
Publication No.: FHWA-HRT-24-153

Validating a Density-Profiling System for Asphalt Compaction Assessment

Date: August 15, 2024
Publication No.: FHWA-HRT-24-143

Field Evaluation of At-Grade Alternative Intersection Designs, Volume I—Operations Report

Date: August 12, 2024
Publication No.: FHWA-HRT-24-126

Inventorying, Documenting, and Configuring Traffic Management System Assets and Resources—Current Practices

Date: August 12. 2024
Publication No.: FHWA-HRT-24-145

2022 CDA Annual Report

Date: August 12, 2024
Publication No.: FHWA-HRT-24-089

Redesign of the Third-Generation FHWA Pavement Testing Facility

Date: August 9, 2024
Publication No.: FHWA-HRT-24-124

Novel Alternative Cementitious Materials for Development of the Next Generation of Sustainable Transportation Infrastructure

Date: August 2, 2024
Publication No.: FHWA-HRT-24-012

[Fast Lane - Exploring Human Behavior - Volume 19]

Date: August 2, 2024
Publication No.: FHWA-HRT-24-152

[Multidisciplinary Data Management Support - 101 Overview]

Date: July 31, 2024
Publication No.: FHWA-HRT-24-150

[TPF Excellence Awards - Member-level Redundancy in Built-up Steel Members—TPF-5(253)]

Date: July 30, 2024
Publication No.: N/A

[TPF Excellence Awards - Clear Roads Winter Maintenance Research—TPF-5(353) Poster]

Date: July 30, 2024
Publication No.: N/A

[LTPP Analysis-Ready Datasets: New Features and Exciting Opportunities]

Date: July 26, 2024
Publication No.: FHWA-HRT-24-134

[State Planning and Research (SPR) Guide for SPR-B Peer Exchanges]

Date: July 23, 2024
Publication No.: FHWA-HRT-23-101

[TPF-5(385) Pavement Structural Evaluation with Traffic Speed Deflection Devices (TSDDs)]

Date: July 23, 2024
Publication No.: FHWA-HRT-24-059

[Evaluating the Relationship Between the Driver and the Roadway to Address Rural Intersection Safety by Using SHRP2 Naturalistic Driving Study Data and the Roadway Information Database]

Date: July 16, 2024
Publication No.: FHWA-HRT-24-140

[Evaluation of Advisory Exit and Ramp Speed Signs]

Date: July 16, 2024
Publication No.: FHWA-HRT-24-138

[Using Artificial Intelligence to Improve Safety for Vulnerable Road Users]

Date: July 15, 2024
Publication No.: FHWA-HRT-24-080

[Development of Balanced Mixture Design Index Parameters and the Flex Suite of Performance Analysis Tools for Asphalt Pavements]

Date: July 15, 2024
Publication No.: FHWA-HRT-24-113

[Development of Balanced Mixture Design Index Parameters and the Flex Suite of Performance Analysis Tools for Asphalt Pavements—Volume II]

Date: July 15, 2024
Publication No.: FHWA-HRT-24-111

[Development of Balanced Mixture Design Index Parameters and the Flex Suite of Performance Analysis Tools for Asphalt Pavements—Volume I]

Date: July 15, 2024
Publication No.: FHWA-HRT-24-112

[Asphalt Binder and Mixture Laboratory Look-In]

Date: July 15, 2024
Publication No.: FHWA-HRT-24-136

[Highway Safety Information System Guidebook for the Washington State Data Files]

Date: July 15, 2024
Publication No.: FHWA-HRT-24-077

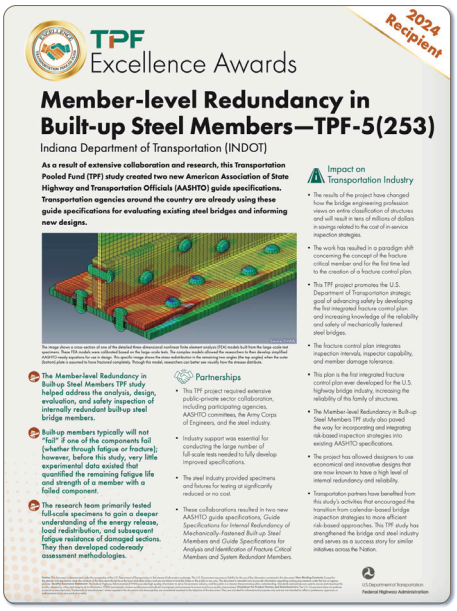
[Freeway Guide Sign Performance at Complex Interchanges: Reducing Information Overload]

Date: July 15, 2024
Publication No.: FHWA-HRT-24-070

[TPF Quarterly Update - June 2024]

Date: July 9, 2024,
Publication No.: FHWA-HRT-24-149

Source: FHWA.



Source: FHWA.

Events

Long-Term Infrastructure Performance (LTIP) Student Data Analysis Contest

October 10, 2024 2 p.m.

Webinar

Deborah Walker, deborah.walker@dot.gov
and Shri Bhide, shri.bide@dot.gov

The LTIP Team will announce this year's student contest, review the contest guidelines, and show the web portals that students are required to use to participate in the contest: Long-Term Pavement Performance (LTPP) InfoPave™ and Long-Term Bridge Performance (LTBP) Infobridge™.

TMCs Actively Managing and Operating Part-Time Shoulder Use

October 16, 2024 11 a.m.

Traffic Management Center Pooled Fund Study Webinar, McLean, VA

Jon Obenberger, jon.obenberger@dot.gov

UHPC Structural Design Guidance in the United States

October 22, 2024

UHPFRC 2024, Menton, France

Benjamin Graybeal, benjamin.graybeal@dot.gov

Low-Carbon Concrete in Pavement Applications

November 4, 2024

American Concrete Institute Fall 2024 Conference, Philadelphia, PA

Michelle Cooper, michelle.cooper@dot.gov

Feature Presentation: FHWA Activities in Emerging Data and Technology for Operations, and Safety

November 6, 2024

Iowa Traffic and Safety Forum, Ames, IA

James Pol, james.pol@dot.gov

Wire Arc Additive Manufacturing in Highway Bridge Infrastructure

November 7, 2024 1:30–3 p.m.

TRB Additive Manufacturing Conference, Irvine, CA

Ryan Slein, ryan.slein@dot.gov

LTPP Materials Data

November 14, 2024 2–3 p.m.

Webinar

Larry Wiser, larry.wiser@dot.gov

The LTIP Team will provide an overview of the LTPP's Materials Reference Library and inform LTPP data users of the type of materials data that are now available from the warm-mix asphalt test sites.

Methods and Tools to Estimate Traffic Management System Staffing Needs

December 11, 2024 11 a.m.

Webinar

Jon Obenberger, jon.obenberger@dot.gov

Invited Keynote: Solutions that Move the Needle

December 11, 2024

2024 World Bridge Engineering Conference, Miami, FL

Benjamin Graybeal, benjamin.graybeal@dot.gov

LTPP Backcalculation Analysis

December 12, 2024 2 p.m.

Webinar

Mohammed Elias, mohammed.elias@dot.gov

The LTIP Team will provide a summary of a recently completed backcalculation analysis study and present the study's data.

Data That Extends the Lifecycle of Highway Infrastructure Assets

January 5, 2025 9 a.m.

Transportation Research Board Annual Meeting, Washington, DC

Deborah Walker, deborah.walker@dot.gov

The LTIP Team has developed a workshop agenda that will discuss preservation, effects of climate and traffic loading, sustainability, and resilience on designing new and preserving existing infrastructure.

LTBP Program Lectern Session

January TBD, 2025

Transportation Research Board Annual Meeting, Washington, DC

Shri Bhide, shri.bhide@dot.gov

The LTIP Team will provide a summary of the LTBP Program events, what has been done this past year, and what is planned for the future. Also, the LTIP Student Data Analysis Contest winners will be recognized.

FHWA R&T NOW INTERCHANGES

Connecting Innovations and Solutions

NEW EPISODE

"Virtual Reality Helps Keep Vulnerable Road Users Safe"

TFHRC Virtual Reality Laboratory safely studies risks to vulnerable road users

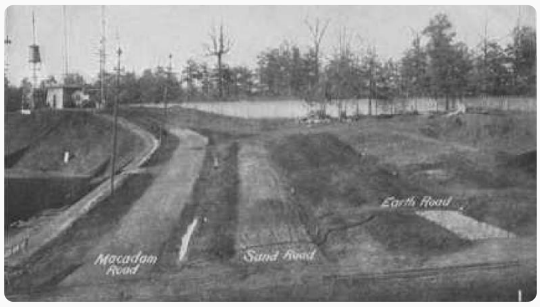
Listen in on the latest conversation on transportation innovations from TFHRC.

In this episode, Chief Scientist Craig Thor and Brian Philips, Team Lead for TFHRC Human Factors Research and Development, discuss ways the Virtual Reality Lab tools are minimizing danger for vulnerable road users.

LISTEN NOW

https://highways.dot.gov/research/publications/RTNowInterchanges

FHWA Trivia



Source: FHWA.
Photo from 1895 of first object-lesson road constructed in Atlanta.

Who was the first Federal Government political appointee to build short stretches of road to garner funding?

General Roy Stone

General Roy Stone was director of the Office of Road Inquiry (ORI), the first predecessor of FHWA, from 1893 to 1899. Before being appointed, General Stone, a Civil War hero and civil engineer, drafted and advocated for Federal legislation to improve public roads. As director of ORI, General Roy Stone proposed the first parcel post, first rural free delivery, and postal savings banks.

His office published an array of technical and promotional literature on roadbuilding. ORI also developed a highly successful object lesson road program that built short stretches of road to educate local engineers and gain popular support for funding road improvements. During this time, General Stone spoke at Good Roads conventions, helped States draft road legislation, and initiated tests of road materials. Resigning in 1899, his enduring legacy in ORI and future successor agencies included building a reputation for technical knowledge and promoting the gospel of good roads through State and local collaboration.[1]

1. Weingroff, R. 1993. "A Peaceful Campaign of Progress and Reform: The Federal Highway Administration at 100." *Public Roads*, Autumn, vol. 57, no. 2.

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FHWA *R&T Now* is available online at: https://highways.dot.gov/research/publications/RTNow.

Please forward this newsletter to others who might find it interesting or useful.

LINKS

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FHWA-HRT-24-174

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