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Autumn 2023

Making the Journey a Destination:

National Scenic Byways & All-American Roads

America's Byways®

Also in this issue:

Urban Congestion Report 2020 Highlights Recent Performance Measures

FHWA Improves Safety of Roads and Bridges Through Chemistry Lab

Data Fusion Innovation Taking NDE, Safety to New Levels

U.S. Department of Transportation

Federal Highway Administration

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DEPARTMENTS

COVERS and ABOVE—Antique cars travel along a cobblestone portion of the Nebraska Lincoln Highway Scenic and Historic Byway. The byway, first used by Native Americans and fur traders, was later used for the westward migration on the Oregon and Mormon trails. This byway would become the first transcontinental highway.

Photo: © Nebraska Lincoln Highway Scenic and Historic Byway. Modified by FHWA.

Base map: © 2023 Google ®. Modifications made by Lincoln Highway Association. Lincoln Highway Data: © 2012-2023 Lincoln Highway Association. https://www.lincolnhighwayassoc.org/map/.

Correction: Theodore Roosevelt was elevated to president in 1901 following the assassination of President William McKinley. An article in the Summer 2023 issue of *Public Roads* incorrectly stated this historical fact.

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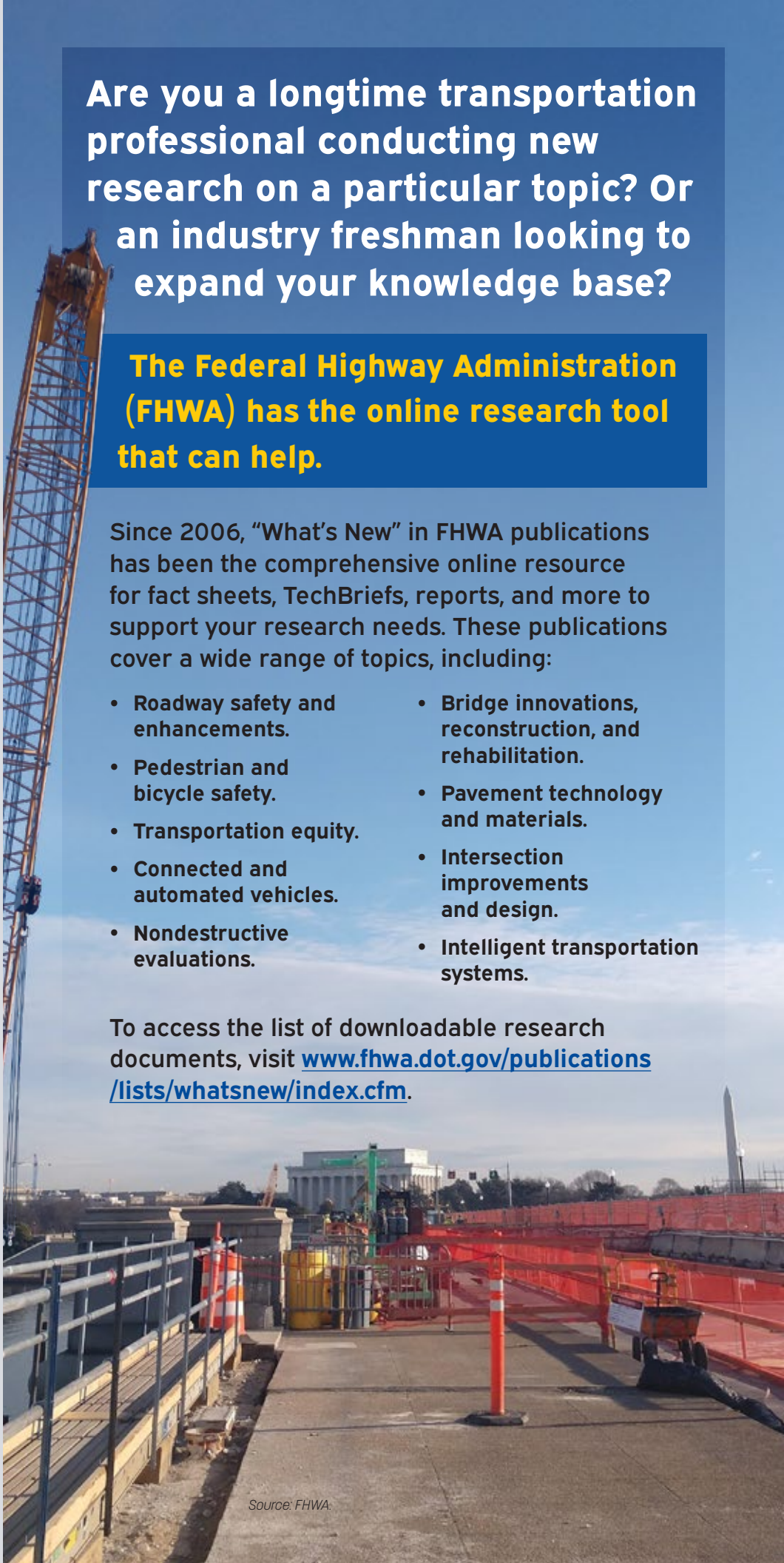
- **Roadway safety and enhancements.**
- **Pedestrian and bicycle safety.**
- **Transportation equity.**
- **Connected and automated vehicles.**
- **Nondestructive evaluations.**
- **Bridge innovations, reconstruction, and rehabilitation.**
- **Pavement technology and materials.**
- **Intersection improvements and design.**
- **Intelligent transportation systems.**

To access the list of downloadable research documents, visit www.fhwa.dot.gov/publications/lists/whatsnew/index.cfm.



Source: FHWA.

DRIVEN for the 21st Century:

Federal Highway Administration Executive Director Gloria Shepherd Highlights the Mindset That *Drives* FHWA

As a child growing up in Albany, NY, I understood that transportation was important—it seemed like you had to drive a car to get *anywhere*. Yet I had no way of knowing just how expansive the U.S. transportation system was, nor how much it would grow in the years to come. Now, U.S. roadways serve more than 220 million road users on more than 850 million trips every day. Roads are also becoming increasingly multimodal, catering not only to drivers, but to pedestrians, cyclists, and many other users. As a marathoner, it seems to me that kind of inclusion was long overdue.

Protecting roadway users is my passion, which is why I support FHWA Administrator Shailen Bhatt's new initiative, DRIVEN for the 21st Century. DRIVEN is a mindset that reminds us of the six aspects of our approach—Delivery, Resilience, Innovation, Values, Equity, and our Nation—as well as how safety underpins everything that we do. When Administrator Bhatt announced DRIVEN, I immediately identified with it. After all, it takes a DRIVEN mindset to run a marathon or two … or 30! I understand the necessity of sustained effort and tireless drive, which is why I am pleased to support the DRIVEN priorities with help from States and many other transportation organizations, as well as those who give their all for U.S. transportation—FHWA employees.

Source: FHWA.

Here are the components of the DRIVEN for the 21st Century mindset:

Delivery began with Secretary Buttigieg, who stated our 2023 focus is delivering results. This is particularly true when it comes to the Inflation Reduction Act and President Biden's Bipartisan Infrastructure Law, which provided unprecedented funding that will revolutionize our transportation system. In the time since the Bipartisan Infrastructure Law was enacted, FHWA has distributed more than $120 billion in highway formula funding, issued approximately $4.6 billion in Notices of Funding Opportunity, and is administering nearly 900 awards totaling approximately $7.5 billion. These are more than just numbers—these project funds will improve safety and people's lives.

Resilience refers to ensuring that infrastructure is ready to weather the climate crisis. FHWA administers numerous programs that target climate-resistant improvements, including the Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) Formula Program, the PROTECT Discretionary Grant Program, and the Carbon Reduction Program. These programs will keep our infrastructure strong and allow us to fulfill our most important duty: getting people where they need to go—and getting them there safely.

Innovation will help us tackle a broad range of issues, including improving safety, increasing resilience, and finding ways to fight climate change. Our National Electric Vehicle Infrastructure Formula and Charging and Fueling Infrastructure Discretionary Grant Programs support electric vehicle infrastructure, and the current round of our Every Day Counts Program supports safety, equity, and ways to combat the climate crisis. Finally, our research at the Turner-Fairbank Highway Research Center is leading to significant advances in bridge construction, paving materials, and other physical infrastructure, as well as technological improvements in infrastructure safety and operational performance.

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Values refers to the tireless commitment of our people to our organizational values. While our service to the American people is paramount, we must never forget that we are also responsible for the members of our agency. When we care for our people, support their wellness and professional development, implement succession plans, and create a workplace where they feel welcome and included, we empower our team to create a stronger transportation system.

Equity is a key priority for this administration and an integral part of every one of FHWA's programs, projects, and initiatives. FHWA is dedicated to ensuring the success of new programs created by the Bipartisan Infrastructure Law, the Inflation Reduction Act, and other legislation and executive actions, as we believe these programs will enhance equity and empower communities. We also created a Diversity Hiring Guide to help our managers develop diverse candidate pools and include a range of individuals and perspectives on interview panels.

Finally, ***Nation*** is a reminder that every aspect of our work is driven by the people and Nation we serve. There are no Democratic highways or Republican bridges—there are only American roads. Transportation infrastructure doesn't care about party labels or political clout, which is why I am grateful to people of all political affiliations who come together to support U.S. roads while working to achieve President Biden's vision of 21st-century transportation infrastructure. In the 20th century, our transportation system was the envy of the world. To remain transportation leaders throughout the 21st century, we must create and maintain a world-class system that delivers for our communities and our economy, gets people and goods safely to their destinations, and literally unites us as Americans.

Safety, our number one priority, is both all-encompassing and the basis of everything we do. In fact, our goal is zero fatalities on U.S. roadways. We support safety through several initiatives, including Safe Streets and Roads for All, the DOT Intersection Safety Challenge, the National Roadway Safety Strategy, and the Safe System Approach. I always said that my priorities were safety, innovation, succession planning, and wellness, and I am happy to see that DRIVEN for the 21st Century encompasses those priorities—and then some!

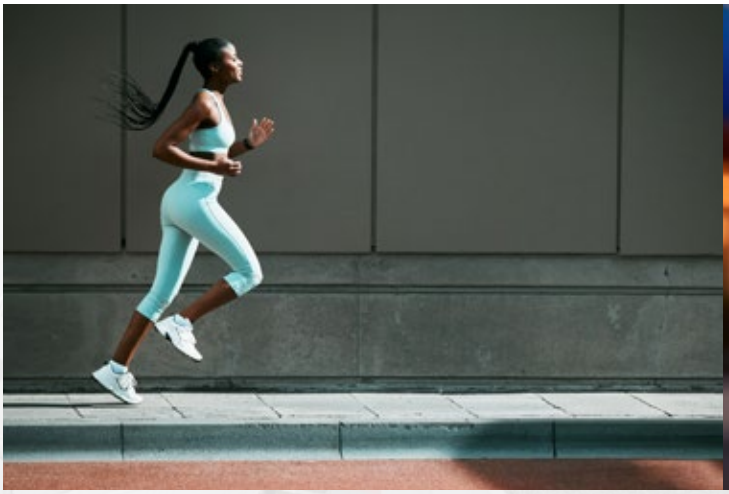
People often ask for the recipe to FHWA's success. No one thing makes us what we are: rather, like any good recipe, our success is a mix of several ingredients. First, our dedicated employees allow us to fulfill our mission and reach for new horizons. Second, funding from President Biden's Bipartisan Infrastructure Law, the Inflation Reduction Act, and other legislation is substantially expanding our positive impact. Finally, partnerships help us address the transportation needs of today while planning and building for tomorrow.

If you think of success as a recipe, I guess you could say that the proof is in the pudding. For nearly 13 decades, FHWA and its predecessors have played a central role in transportation. By providing national leadership, working to make our roadways safer, fostering innovation, planning for the future, and supporting the physical and emotional wellness of our employees, we will create a 21st-century transportation system.

I am confident that DRIVEN for the 21st Century will help us achieve our goals as we continue to deliver generational investments that benefit the hundreds of millions of people who travel on our Nation's roads and highways.

Safe roads, strong infrastructure, and a happy public—that's what keeps us DRIVEN for the 21st Century!

Gloria Shepherd
Executive Director
Federal Highway Administration



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TRB attendees listen to presentations by fellows during the 2023 DDETFP Research Showcase lectern session. *Source: FHWA.*

Dwight David Eisenhower Transportation Fellowship Program Research Showcase at Transportation Research Board Annual Meeting

by **LATOYA JONES**

The Dwight David Eisenhower Transportation Fellowship Program (DDETFP) advances the U.S. transportation industry's workforce by attracting the Nation's brightest minds, retaining top talent, and encouraging future transportation professionals to seek advanced degrees. Since 1983, the program has awarded more than 4,500 fellowships to students across the United States who are pursuing degrees in a transportation-related discipline while conducting transportation-related research.

DDETFP is a U.S. Department of Transportation program managed by the Federal Highway Administration's Office of Administration and annually awards approximately 150 to 200 merit-based fellowships. Applications are evaluated and ranked according to technical evaluation criteria listed in the Notice of Funding Opportunity (NOFO) posted to *https://www.grants.gov/*. The awards range from $1,500 to $35,500, based on ranking and academic level. NOFOs for DDETFP fellowships are typically posted annually on *https://www.grants.gov/* in late winter/early spring, and awards are announced in the fall of that fiscal year. DDETFP fellowships are awarded through a competitive selection process, and funding can be used to pay for things like tuition, a stipend, and travel costs to attend the Transportation Research Board (TRB) Annual Meeting.

There are three DDETFP Fellowship categories:

- Graduate: supports students pursuing a master's or doctoral degree in transportation-related disciplines.
- Local Competition: provides grants to students pursuing degrees in transportation-related disciplines at an institution of higher education designated as a minority-serving institution or a community college.
- Grants for Research: provides grants to students engaged in transportation research, development, and technology transfer activities at USDOT facilities.

During the 102nd TRB Annual Meeting held January 2023 in Washington, DC, fellows in the 2022 cohort participated in the 30th DDETFP Research Showcase. This showcase provided an opportunity for these fellows, 150 of the Nation's brightest emerging transportation professionals, to present their research, meet and network with other DDETFP fellows and transportation professionals from across the Nation, and take advantage of other TRB meeting sessions and workshops.

"The entire experience was 'eye opening' to put it all into one phrase. The exposure to different professionals in public and private organizations, spanning the entire country, was a one-of-a-kind educational opportunity. Being invited to participate was an honor, and I appreciate the mentorship I received from past DDETFP scholars," said Jeremiah Bailey, graduate-level fellow from Texas Southern University.

Highlighting the research work of the 2022 DDETFP cohort, the 30th DDETFP Research Showcase included three poster sessions during which the fellows shared their studies with TRB meeting attendees. The range of topics presented during the sessions represented the diversity of research that students are conducting across the Nation. Additionally, FHWA's Office of Administration organized one lectern session during which four graduate-level students presented their research findings to their peers with a question-and-answer session. Topics included individual needs and methodologies for an equitable and accessible transportation system; lawsuits, consent decrees, and ballot measures as tools for transit equity; and a study of transportation education and career readiness. Lastly, as a culmination of the DDETFP Research Showcase, a closing ceremony was held. At the ceremony, fellows heard speeches from senior transportation officials, including FHWA's Executive Director Gloria Shepherd and TRB's Executive Director Victoria Sheehan, and the accomplishments of the 2022 DDETFP cohort were recognized. DDETFP partners as well as former USDOT officials and program fellows also helped celebrate the 30th DDETFP Research Showcase. The DDETFP Research Showcase demonstrates the variety of solutions DDETFP fellows have developed to meet the future challenges in the transportation field.

Eisenhower believed that connecting, respecting, and educating people would lead to a better tomorrow. DDETFP continues to honor his vision and legacy. "The DDETFP is and has been a critical tool for the development of transportation professionals such as myself. If not for acceptance into the DDETFP, attending graduate school would have been very difficult and I may not have achieved the success that I've garnered," said Division Administrator Jermaine Hannon of the FHWA Indiana division office.

LATOYA JONES is the program manager responsible for administering the DDETFP in the FHWA Office of Administration. She has a B.S. in social science education and a master's in urban and regional planning from Alabama Agricultural & Mechanical University.

For more information about the DDETFP, visit *https://www.fhwa.dot.gov/careers/ddetfp.cfm* or contact Latoya Jones at *latoya.jones@dot.gov* or 404-562-3587.

SCRC

SMART COMMUNITY RESOURCE CENTER

Source: USDOT.

The Smart Community Resource Center

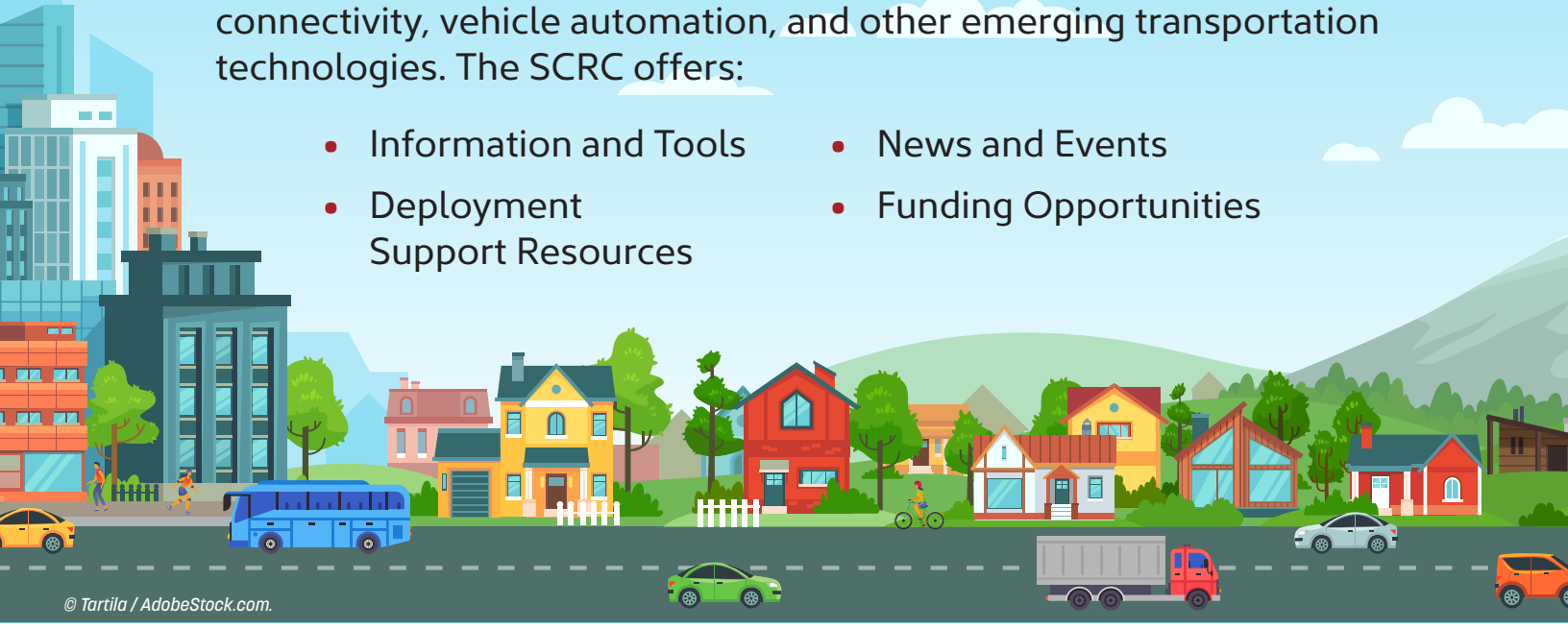
What You Need When You Need It

USDOT IS MAKING RESOURCES READILY AVAILABLE TO ITS DEPLOYERS.

Created by the U.S. Department of Transportation's Intelligent Transportation Systems (ITS) Joint Program Office (JPO), the Smart Community Resource Center (SCRC) helps connect States, Tribal governments, and local communities with the knowledge and expertise they need to advance their ITS and smart community transportation projects and programs.

The SCRC includes USDOT resources related to interoperable connectivity, vehicle automation, and other emerging transportation technologies. The SCRC offers:

- Information and Tools
- Deployment Support Resources
- News and Events
- Funding Opportunities



To access the SCRC, visit https://www.its.dot.gov/scrc.

2023 Build a Better Mousetrap Winners

by **TRINETTE BALLARD**

Transportation's number one priority is safety, and this year's nominations for the Build a Better Mousetrap (BABM) national competition reflected this priority. Innovations from all over the country poured into the Federal Highway Administration touting successes in a variety of areas, including improving a dust control process, clearing culverts, providing safer rail and pedestrian crossings, establishing youth training programs, and creating public awareness outreach campaigns. According to Joe Conway, FHWA's Center for Local Aid Support director, "the submissions are better and better every year! Selecting just four winners is a tough task because the State, local, and Tribal agencies are putting their best foot forward to solve problems and communities benefit."

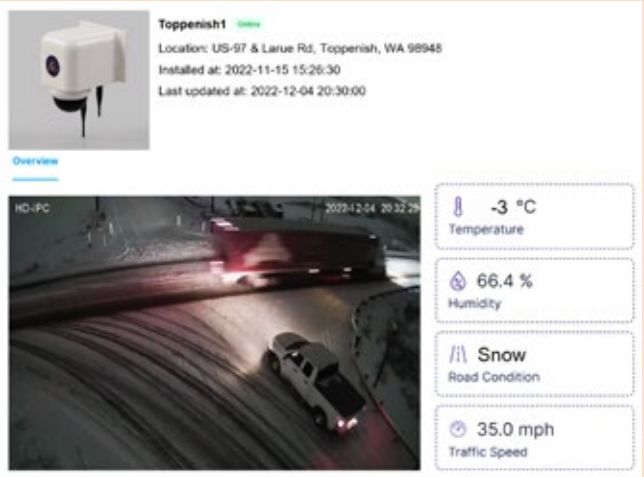
Source: FHWA.

The BABM national competition highlights innovative solutions in transportation programs. Benefits of the competition include encouraging collaboration, motivating others, and improving business practices. This year, FHWA received 53 nominations across four award categories: Innovative Project, Smart Transformation, Bold Steps, and Pioneer. The 2023 BABM winners were announced this past summer during the annual National Local & Tribal Technical Assistance Program Association Conference in Columbus, OH.

Innovative Project Award Winner:

The Confederated Tribes and Bands of the Yakama Nation

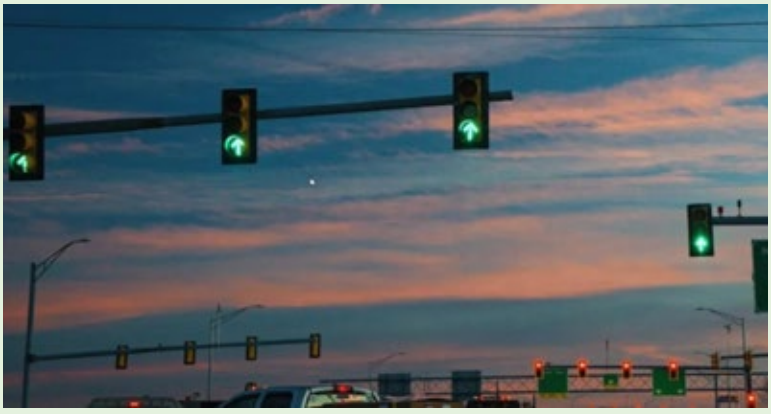
The Yakama Nation is a federally recognized Tribe that manages approximately 1,200 miles (1.931 kilometers) of public roads. Most of the roads are in rural agricultural settings where crashes happen every day. Some of those crashes result in serious injuries and are fatal. Their solution is the Mobile Unit Sensing Traffic (MUST) device, which is a comprehensive roadside sensing communication system tailored specifically for Tribal and rural roads. It is equipped with a multisensing camera and sensors that can monitor traffic, detect dangerous events, and provide real-time warning messages to users. "The successful deployment of our system has yielded invaluable safety data that supports our traffic planning efforts and enhances our ability to secure grants for future projects," says Yakama Nation representative HollyAnna DeCoteau Littlebull.



The Confederated Tribes and Bands of the Yakama Nation created the MUST device to monitor traffic, detect dangerous traffic events, and provide real-time warning messages.
© Yakama Nation.

Pioneer Award Winner:

City of Walnut Creek, CA

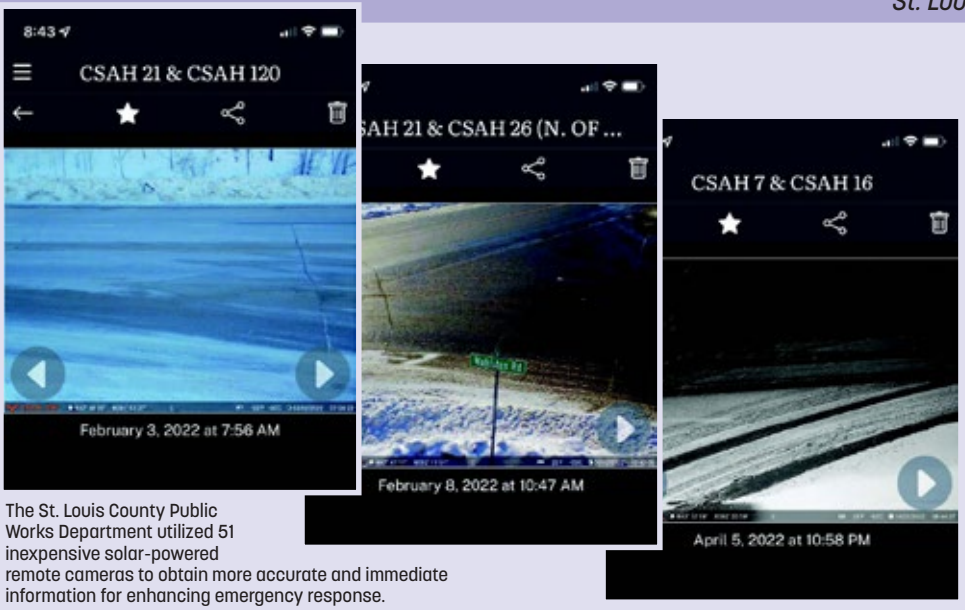


Maintaining traffic signal visibility requires trained personnel and regular inspections that are labor intensive. The City of Walnut Creek's solution is the implementation of an automated process to assess traffic signal visibility using off-the-shelf hardware components such as a cell phone with a built-in camera and GPS receiver, a windshield phone mount, and a laptop computer. The new process "saves time, increases accuracy, and significantly reduces the risk of error and danger to agency personnel and, ultimately, for the roadway users," according to Matt Redmond with the City of Walnut Creek.

The City of Walnut Creek created an automated process to assess traffic signal visibility.
© City of Walnut Creek, CA.

SMART Transformation Award Winner:

St. Louis County Public Works Department, MN



The St. Louis County Public Works Department utilized 51 inexpensive solar-powered remote cameras to obtain more accurate and immediate information for enhancing emergency response.

© St. Louis County Public Works Department.

The St. Louis County Public Works Department is responsible for the maintenance and snow removal of approximately 3,000 miles (4.828 kilometers) of roads. Road conditions can vary greatly at any given time during winter storms. Therefore, the county needed more accurate and immediate access to information to assist with emergency response. Their solution was to purchase 51 inexpensive solar-powered remote cameras. Brian Boder, deputy director of maintenance at the St. Louis County Public Works Department, says, "This option decreases service intervals and improves cold weather performance." The cameras are compatible with virtually any cellular network and are capable of being remotely operated.

Bold Steps Award Winner:

New Jersey Department of Transportation (NJDOT)

The Route 71 Drawbridge was built in 1932 and is heavily traveled. The mechanical span lock equipment that allows the bridge to open and close safely failed in 2021, causing damage to the structural steel. After much discussion and research, NJDOT's solution was to reduce the roadway to one lane in each direction to balance the load traveling over the bridge. This distribution of traffic (or Road Diet) moved travel lanes away from the damaged centersection of the bridge and was implemented in stages over the course of one month. Gerald Oliveto, a moveable bridge subject matter expert at NJDOT, says, "Taxpayer funds were effectively and efficiently used to preserve the existing drawbridge while also enhancing bicycle, pedestrian, and motorist safety on the roadway."

Route 71 prior to the Road Diet (left) and Route 71 after Road Diet implementation (right).

© NJDOT.

The BABM winners will be featured in the next Local Aid Support's newsletter and in various webinars and social media posts throughout the year. To subscribe to the newsletter, visit https://public.govdelivery.com/accounts/USDOTFHWA/subscriber/new?topic_id=USDOTFHWA_153. For more information on BABM, visit: https://www.fhwa.dot.gov/clas/babm/.

TRINETTE BALLARD is a Local Aid Support program manager in the Office of Transportation Innovation and Workforce Solutions and has been with FHWA for 16 years.

Tracking Congestion in 2020 via FHWA's Urban Congestion Trends Report

Performance measures reflect the effects of the pandemic on reliable travel.

by **RICH TAYLOR** and **PETE KOENEMAN**

Travel on the Nation's highways has changed substantially since the first automobile was invented by Karl Benz in 1885. Back then, the few cars that were in use shared roads with countless horses with carriages, bicycles, and pedestrians.

Today, our highways are flooded with cars, trucks, buses, and motorcycles. With more vehicles on the road, traveling safer and more efficiently takes time, funding, and planning. Measuring change in congestion levels and travel-time reliability plays a large role in those mitigation efforts and helps improve safety and efficiency on roads across the country.

The Urban Congestion Report (UCR) Program

The *2020 Urban Congestion Trends* (UCT) report provides the results of three congestion- and reliability-related performance measures during the pandemic that began to affect travel in March 2020. The UCT is developed annually by the Federal Highway Administration's Office of Operations to show trends in the year-to-year measures and provide examples of using the measures to better plan and operate the highway system.

FHWA's UCR program began in 2005 and was started as a research project to determine if travel-time data existed to calculate congestion performance measures. The program used travel times culled from traveler information websites to calculate congestion and mobility performance measures. The reports soon became a proof of concept for transportation agencies as a way to use their traffic sensor travel-time data to calculate meaningful operations-related performance measures on their roads. Changes in the program over the years included using vehicle probe-based travel-time data and updating and improving performance measures, including focusing more on the travel-time reliability measure. These revised measures were included in many internal FHWA and U.S. Department of Transportation plans, budgets, and performance reports.

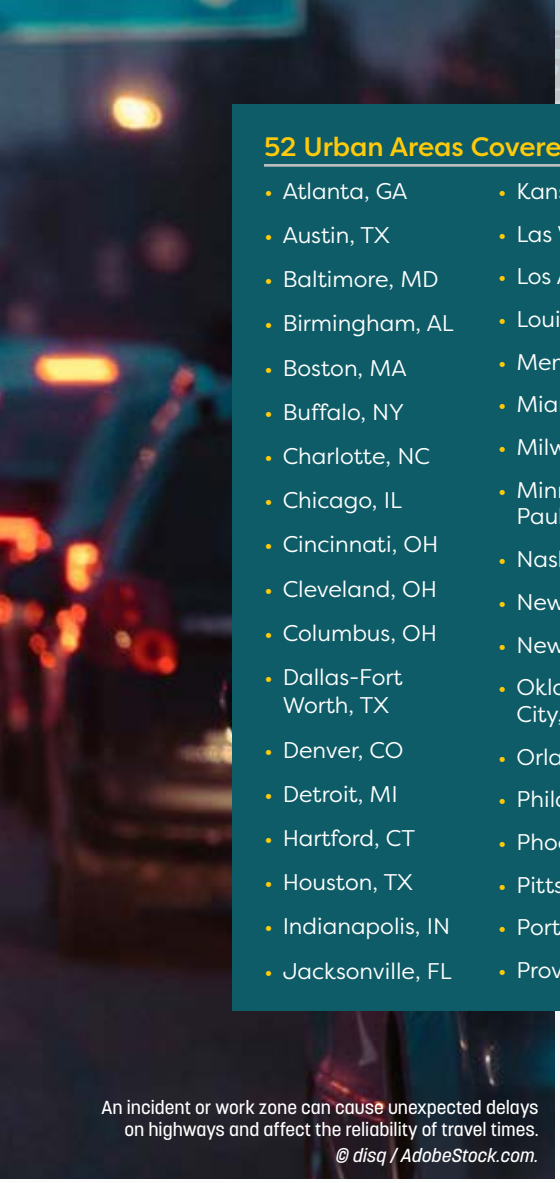
The UCR program currently produces a quarterly report using travel-time data on highways from 52 urban areas (those with over 1 million in population per the 2010 census). The travel-time data are obtained from the National Performance Management Research Data Set (NPMRDS), which provides data on the National Highway System for use by FHWA, as well as State departments of transportations (DOTs) and metropolitan planning organizations. The program also produces an annual UCT report that tracks annual performance measures from those same 52 urban areas.

The report also describes new approaches and tools for measuring congestion and related measures and shows examples of benefit evaluations of operational strategy implementation that help operating agencies manage congestion and improve mobility. Previous operational strategy examples in the UCT include freight operations,

52 Urban Areas Covered in the UCT

- Atlanta, GA
- Austin, TX
- Baltimore, MD
- Birmingham, AL
- Boston, MA
- Buffalo, NY
- Charlotte, NC
- Chicago, IL
- Cincinnati, OH
- Cleveland, OH
- Columbus, OH
- Dallas-Fort Worth, TX
- Denver, CO
- Detroit, MI
- Hartford, CT
- Houston, TX
- Indianapolis, IN
- Jacksonville, FL
- Kansas City, MO
- Las Vegas, NV
- Los Angeles, CA
- Louisville, KY
- Memphis, TN
- Miami, FL
- Milwaukee, WI
- Minneapolis-St. Paul, MN
- Nashville, TN
- New Orleans, LA
- New York, NY
- Oklahoma City, OK
- Orlando, FL
- Philadelphia, PA
- Phoenix, AZ
- Pittsburgh, PA
- Portland, OR
- Providence, RI
- Raleigh, NC
- Richmond, VA
- Riverside-San Bernardino, CA
- Rochester, NY
- Sacramento, CA
- Salt Lake City, UT
- San Antonio, TX
- San Diego, CA
- San Francisco, CA
- San Jose, CA
- San Juan, PR
- Seattle, WA
- St. Louis, MO
- Tampa, FL
- Virginia Beach, VA
- Washington, DC

2020 *Urban Congestion Trends* report.
Source: FHWA.



An incident or work zone can cause unexpected delays on highways and affect the reliability of travel times.
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signal systems, ramp metering, and more. According to Bill Eisele, associate agency director at the Texas A&M Transportation Institute and author of previous UCT reports, "These performance measures assist in identifying congestion trends. Like getting your vital signs checked at the doctor's office, using these state-of-the-practice performance measures is useful to identify if variations are systemic, or if they highlight a unique regional or local area change. These performance measures can also be a component of the decisionmaking process for implementing operational improvements (i.e., resource allocation)."

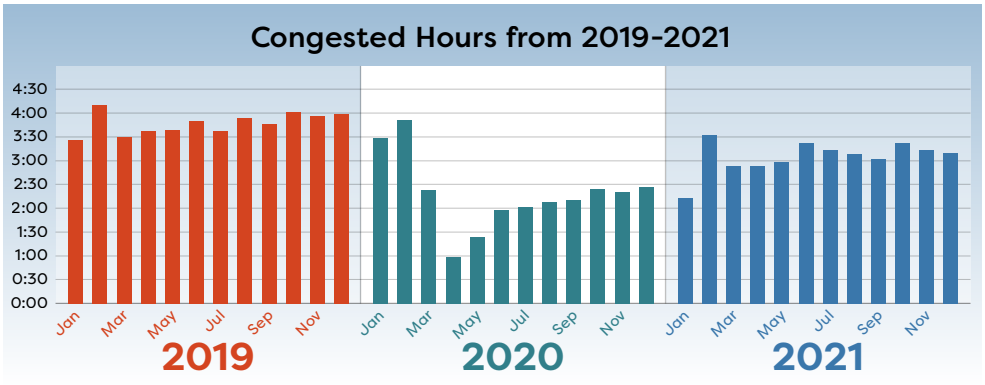
The current UCR program measures included in the report are as follows:

- Congested hours—The average amount of time (in hours) during a day when freeways operate in congested conditions. Congested conditions means when travel speed is at less than 90 percent of free-flow speed between 6 a.m. and 10 p.m.
- Travel-time index (TTI)—The time penalty for a trip on an average day. For example, a TTI of 1.30 indicates a 20-minute free-flow trip takes 26 minutes (20 × 1.30) during rush hours (weekdays 6 a.m. to 9 a.m. and 4 p.m. to 7 p.m.).
- Planning time index (PTI)—The time penalty for a trip to be on time for 95 percent of trips (e.g., late for work 1 day per month). For example, a PTI of 1.60 indicates a 20-minute free-flow trip takes more than 32 minutes (20 × 1.60) 1 day per month.

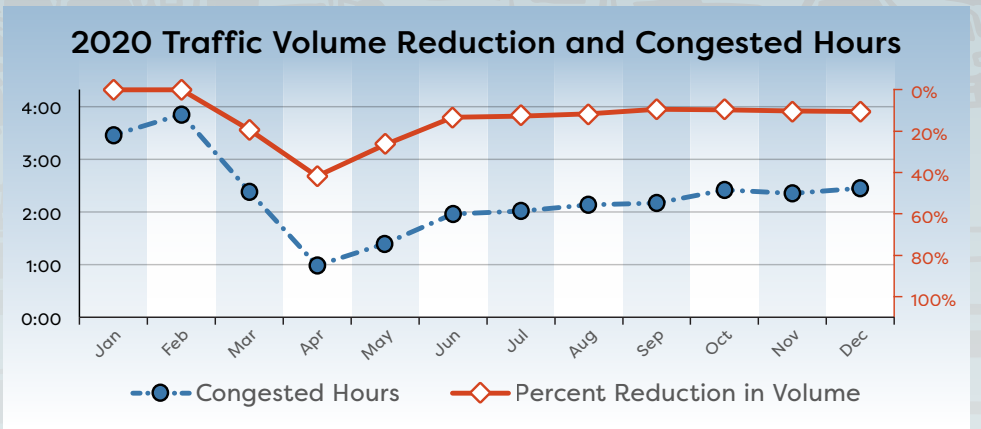
The free-flow speed is calculated as the 85th percentile of off-peak speeds, where off-peak is defined as Monday through Friday, 9 a.m. to 4 p.m. and 7 p.m. to 10 p.m., as well as Saturday and Sunday, 6 a.m. to 10 p.m. For the purposes of the UCR program, the free-flow speeds are calculated for each roadway segment grouping and are based on the previous 12 months of data.

The 2020 UCT Report

The 2020 UCT report showed noticeable impacts of the recent pandemic on congested hours, TTI, and PTI. The effect of reduced travel in the 52 largest urban areas is evident in the accompanying graph that displays the congested hours measured monthly from 2019 through 2021. A drop of nearly 3 hours of congestion per day



Monthly average congested hours from 2019 to 2021.
Source: FHWA.



Congested hours and reduced volumes by month in 2020. *Source: FHWA.*

occurred in April 2020 compared with the average in 2019. While conditions were returning to prepandemic levels by the end of 2021, there was still roughly 30 minutes less congestion on average than in 2019.

For additional context, a key graph from FHWA's Office of Highway Policy Information's *Traffic Volume Trends* report shows the 2020 traffic volume estimates. The graph combines the 2020 data for congested hours and percent reduction in volume. The reduction in volume dropped in April 2020 by roughly 40 percent. The number of congested hours also dropped sharply in April, decreasing by nearly 3 hours, to about 1 hour on average from the prepandemic 3.5- to 4-hour daily average. The recovery of traffic volumes into the fall of 2020 approached 90 percent of prepandemic levels and then held steady. The congested hours measure also flattened out to around 2.5 hours a day on average.

The 2020 UCT report also includes an evaluation of the cost savings from the implementation of automated traffic signal performance measures by the Maricopa County DOT in Arizona.

Another highlight of the report is a tool developed by the Sacramento Area Council of Governments (SACOG) that assists with on-the-fly project assessment. Their project performance assessment tool helps evaluate congestion metrics and the reliability of a submitted road project. The tool uses NPMRDS speed and travel-time data to measure how reliable and congested a road is. The tool allows users to select average speeds or reliability metrics by time of day and presents the metrics visually on a color-coded map.

Summary

The 2020 UCT report showed noticeable effects of the pandemic on three travel-time measures. The correlation with reduced traffic volumes, easing congestion, and improved reliability was notable. The UCT report series demonstrates a number of ways that operational strategies can help reduce congestion, especially at the local or regional level. As congestion returns to near normal levels after the pandemic, the use of operational strategies to reduce both recurring and nonrecurring congestion and improve the efficiency of our highway systems will continue to be profiled in the annual UCT report.

Look Ahead

In 2021 and 2022, the performance measures covered in the UCT reports continued to edge back to prepandemic levels. In the coming years, the UCT reports will continue to assess the impact of hybrid and remote work on commutes.

Learn More

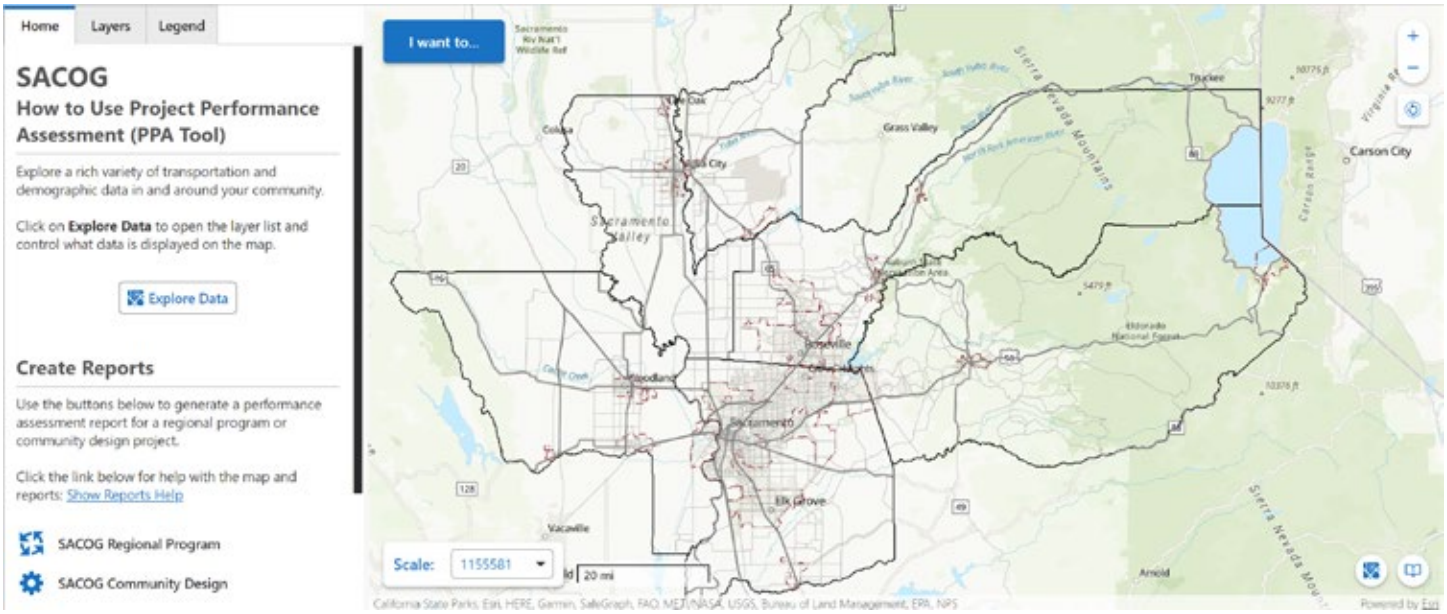
The SACOG performance assessment tool can be found at: *https://www.sacog.org/project-performance-assessment*.

Read the full *2020 Urban Congestion Trends* report here: *https://ops.fhwa.dot.gov/publications/fhwahop21010/index.htm*.

RICH TAYLOR is the Operations Performance Measures and Management program manager in FHWA's Office of Operations. He has three degrees from the University of Virginia.

PETE KOENEMAN is a research data scientist at the Texas A&M Transportation Institute and has a master's degree in operations research from the Naval Postgraduate School.

For more information, see *https://ops.fhwa.dot.gov/perf_measurement/reliability_reports.htm* or contact Rich Taylor, 302-734-1657, *rich.taylor@dot.gov*.



The SACOG project performance tool enables users to secure useful community and regional data. *© SACOG.*

THE FUTURE OF TRANSPORTATION IS IN THEIR HANDS

Public Roads First-Ever Student Writing Competition Winners Coming Soon!

In May 2023—for the first time in its 105-year history—the Federal Highway Administration's *Public Roads* magazine launched a Student Writing Competition.

Years in the making, this competition will highlight some of the brightest young minds who are passionate about transportation, technology, planning, and more.

The Winter 2024 issue will feature the winners of the inaugural competition and will be an issue worth waiting for! Look for that issue digitally and in print at the *Public Roads* booth at the Transportation Research Board Annual Meeting in January 2024.

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Join the more than 18,000 subscribers already enjoying *Public Roads* and sign up for a digital subscription now by visiting https://public.govdelivery.com/accounts/USDOTFHWA/subscriber/new?topic_id=USDOTFHWA_73.

The DEVELOPMENT of DATA FUSION and VISUALIZATION TOOLS for NONDESTRUCTIVE EVALUATION of BRIDGES

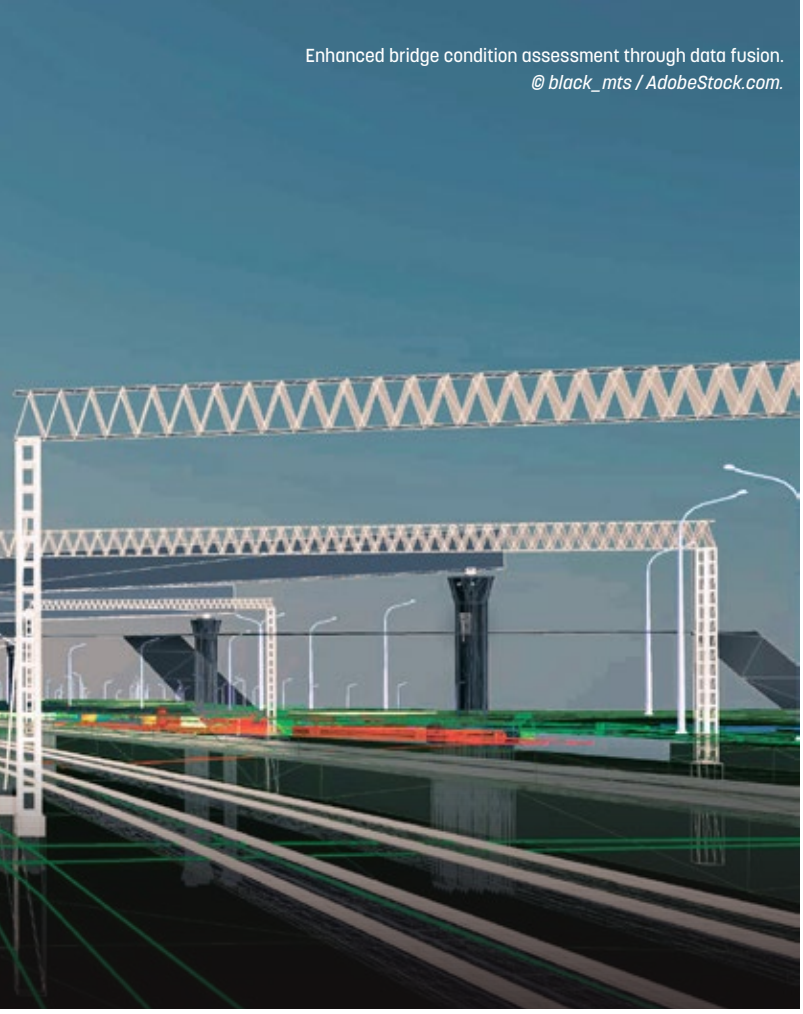
How fusing multiple, complementary technologies can enhance the condition, performance, and safety of bridges.

by **HODA AZARI**, **HENG LIU**, and **RAHUL TORLAPATI**

The Nation's highway infrastructure requires condition assessment of more than 620,000 bridges to ensure safety, sustainability, and resiliency. Traditional methods of assessing bridges, such as coring or chain dragging, can cause economic and time constraints as well as pose safety risks to the structure's integrity. However, revolutionary techniques are changing the way assessments are conducted and how bridge engineers are looking to a safer future—without physically impacting structures.

Nondestructive evaluation (NDE) of bridges involves the assessment of various structural components using acoustic, electrochemical, and/or electromagnetic methods, which do not change the structure's physical properties or structural integrity. Based on the latest data from InfoBridge (*https://infobridge.fhwa.dot.gov/*), more than 42,000 bridges in the Nation have been classified as poor condition, representing nearly 217 million square feet of deck area that needs prominent inspections. The implementation of NDE technologies, combined with the latest advancements in artificial intelligence (AI), hold the potential to significantly enhance the accuracy, efficiency, and economic viability of condition assessments of bridges. These technologies can play a crucial role in ensuring the ongoing structural integrity of aging bridges.

Data fusion is widely applicable across various fields and industries. In the context NDE, data fusion combines data from



Enhanced bridge condition assessment through data fusion.
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disparate sources to produce a probabilistically sound estimate of an object's current state. Recent advancements in the field of NDE have led to the use of multiple evaluation modalities, and fusion of these modalities can provide a more reliable condition assessment by leveraging the complementary strengths of different NDE technologies. Data fusion is expected to produce high-quality and definitive results that can assist in providing a better understanding of a bridge's condition.

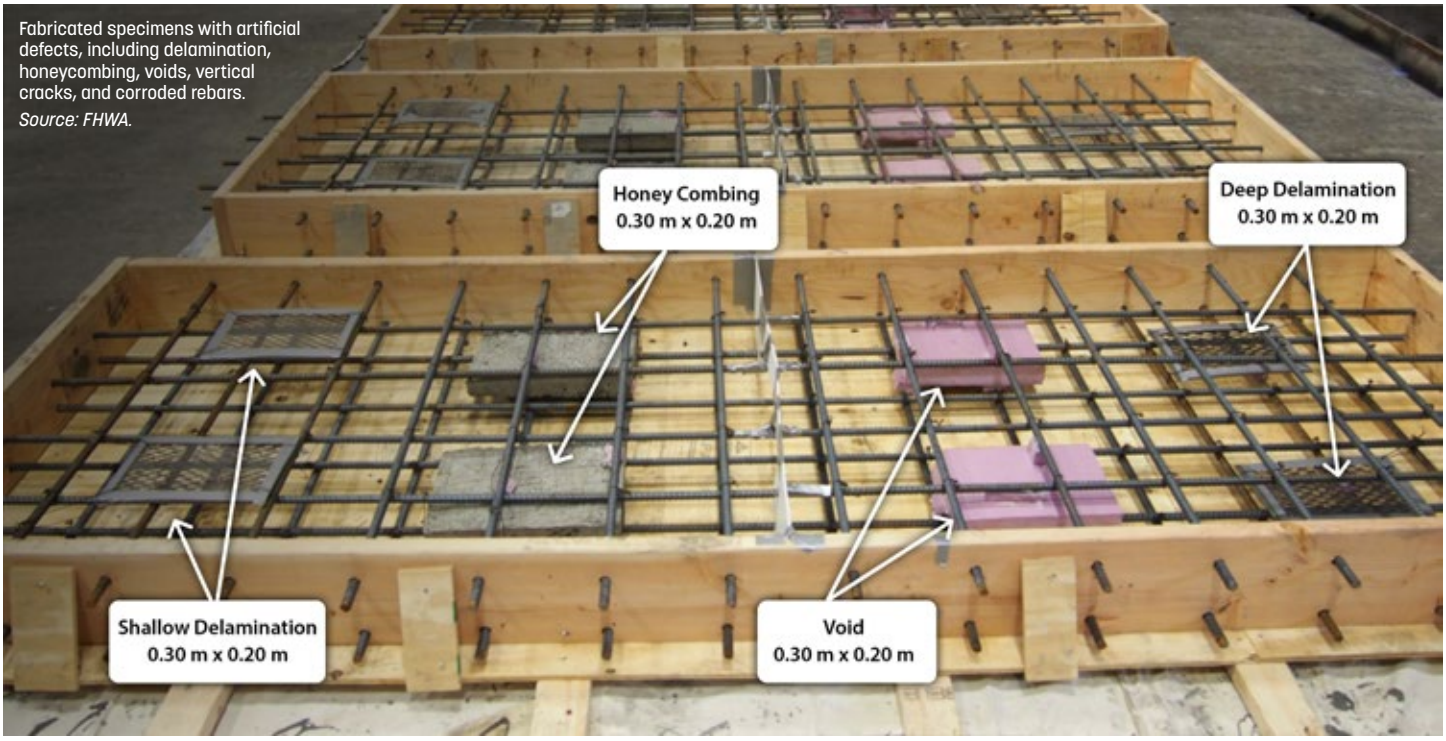
In 2020, the Federal Highway Administration's (FHWA) NDE Laboratory launched a research project focusing on the development of data fusion and visualization tools for the NDE of bridges and highway infrastructure. This project, currently in progress at the lab at the Turner-Fairbank Highway Research Center, aims to develop user-friendly data fusion and visualization tools for bridge inspectors to enhance current bridge inspection practices. These tools streamline analysis and fusion of multiple NDE sources by using cutting-edge techniques in machine learning, deep learning, and AI. The goal of these tools is to increase confidence in detecting, diagnosing, and quantifying bridge defects using various NDE technologies, including impact echo (IE), ground penetrating radar (GPR), ultrasonic surface waves (USW), half-cell potential (HCP), and electrical resistivity (ER), among others.

"Improving the ability to visualize and fuse multiple NDE data modalities provides valuable insights into the condition of bridge decks. It can potentially lead to better decisionmaking, more targeted maintenance strategies, and subsequent safety and serviceability of bridges," says Jean Nehme, director of FHWA's Office of Infrastructure Research and Development.

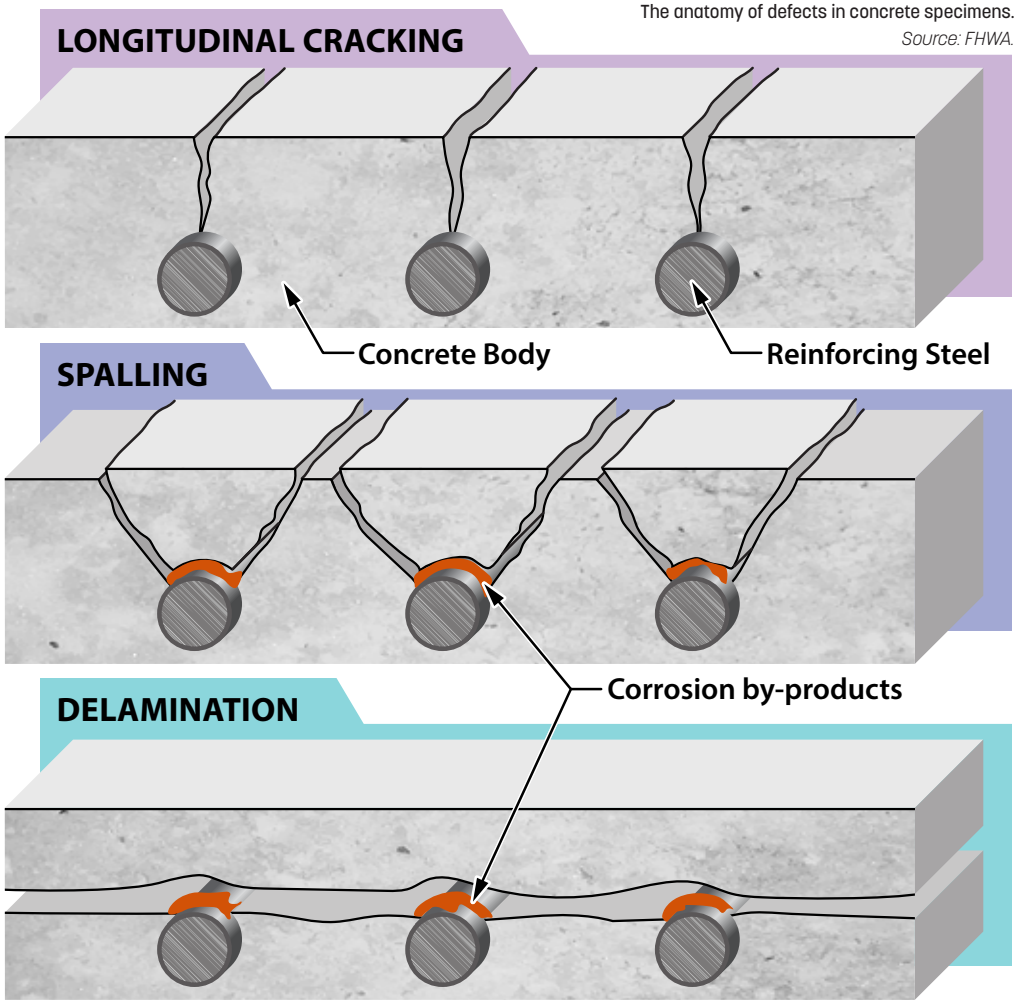
Laboratory Specimen for Concrete Bridge Decks

Given that bridge decks are statistically prone to faster deterioration than other bridge components, concrete bridge decks represent an area of high priority with the research and development of NDE technologies.

The FHWA project has used data acquired from laboratory testing of eight controlled specimens with various artificial defects, such as delaminations, honeycombing, voids, vertical cracks, and precorroded reinforcing steel. These specimens were then tested by various NDE technologies, including manual sounding, IE, USW, ultrasonic shear-wave tomography, infrared thermography, GPR, ER, HCP, and impulse response. Embedded artificial defects provide a known ground truth (e.g., types and/or locations of



Fabricated specimens with artificial defects, including delamination, honeycombing, voids, vertical cracks, and corroded rebars.
Source: FHWA.



The anatomy of defects in concrete specimens.
Source: FHWA.

assessing shallow delamination, which typically occurs in the early stages of deck deterioration when corroded rebar expands and results in horizontal cracking at that rebar layer. If the deck continues to deteriorate, the horizontal cracking may expand further and form a delamination that may eventually spall.

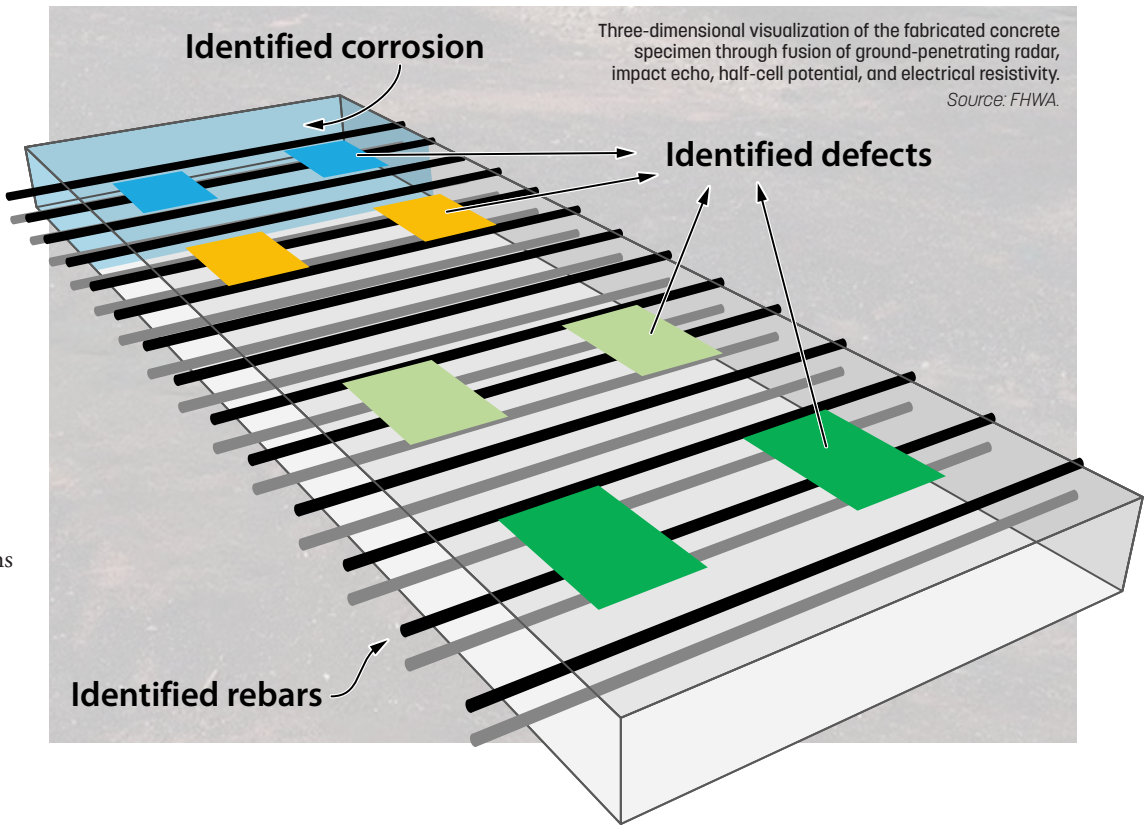
The delamination underneath the deck surface changes the mechanical properties of the deck locally. As a stress-wave-based NDE technique, IE is particularly sensitive to this change and detects delamination by observing shifts in the peak frequency of collected wave signals. However, because concrete is a heterogeneous material, local changes in material properties may also introduce slight shifts in peak frequencies. While IE is a reliable method for identifying delaminations in a bridge deck, it does not provide any information about the potential cause of the delamination.

GPR is typically used to assess the cover depth of rebar in concrete decks or to identify precursors to delaminations such as chlorides, moisture, or potential cross-section loss of the reinforcing steel. GPR emits electromagnetic (EM) waves into bridge decks and collects reflected signals. The transmission inside the material and reflection at material interfaces of EM waves depend on that material's dielectric constant or the

defects) for validating the NDE results and labeling the collected NDE data. The labeled data is a valuable resource in the supervised training of AI models. The well-trained models can analyze raw NDE data as inputs with automated damage detection and localization as outputs. Testing these controlled specimens has generated numerous AI models for automated NDE data analysis, including IE and GPR. These AI models built the basis for the following data fusion and visualization.

Data Fusion and Visualization

Data fusion integrates the strengths of multiple NDE modalities to provide an effective pathway for quantitative and spatial cross-validation of assessment results. One example of this integration uses IE, GPR, HCP, and ER for



Three-dimensional visualization of the fabricated concrete specimen through fusion of ground-penetrating radar, impact echo, half-cell potential, and electrical resistivity.
Source: FHWA.

A fabricated concrete specimen with chloride-treated corrosive area.
Source: FHWA.

relative permeability. The reflection of EM waves occurs in the presence of dielectric contrasts; the higher the dielectric contrast at the interface, the more energy of EM waves will be reflected. In the case of a bridge deck, the dielectric constant of concrete material is around 8, while the dielectric constant of the reinforcing steel is theoretically infinite. The infinite dielectric contrast between the steel and concrete results in a nearly perfect reflection of energy when EM waves reach to reinforcing steel in concrete. On the other hand, water has a dielectric constant of around 81, leading to a smaller reflection than the one from steel. Therefore, low signal amplitudes near reinforcing steels are typically associated with the presence of water, chlorides, or loss of steel cross-section, which are precursors to a delaminated area.

Electrochemical methods such as HCP and ER are common technologies used for corrosion assessment and are typically associated with the measurement of the probability of corrosion of the top mat of reinforcing steel. The combination of GPR with HCP and ER would provide complementary information to determine if the degradation identified by GPR is also presenting active corrosion. Active corrosion in the reinforcing steel of concrete bridge decks can better inform bridge owners about proper asset management with rising priorities.

While each NDE technology provides a measurement within a specific portion of the life cycle of a concrete bridge deck as it relates to corrosion-induced degradation, the fusion of the datasets can lead to a better understanding of the cause of degradation and subsequently provide asset owners with more information for data-driven decisionmaking.

Using the datasets collected on the fabricated decks during the research project, a three-dimensional reconstruction of the deck's deterioration can be achieved by fusing the knowledge gained from these NDE modalities. The results closely match the ground truth, with reinforcing steel identified at the top layer beneath the concrete cover. Cross-validation of IE, ER, and GPR results confirms the delamination in the corroded area near the top layer of reinforcing steel.

Next Steps

The success of data fusion relies on the successful acquisition and accurate analysis of each complementary NDE technology. Integrating current NDE technologies with machine learning and AI is one of the future goals of this FHWA project. The integration aims to provide more robust assessments for each technology and pave the road for advanced data fusion. Collecting more data and developing advanced algorithms for data analysis is another future effort designed to improve trained models for degradation prediction based on single NDE datasets. Those research results will be shared with Federal, State, local, academic, and industrial partners to foster NDE technology development and transfer.

"The integration of various NDE data sources and AI enables us to make more accurate predictions, identify potential problems earlier, and develop more efficient maintenance strategies," says Anne Rearick, director of bridge management for the Indiana Department of Transportation. "This approach has the potential to greatly enhance the safety and reliability of bridges while reducing costs and minimizing disruptions to traffic flow. Ultimately, the integration of these technologies has the potential to revolutionize the way we approach bridge deck assessment and maintenance, leading to a more sustainable and resilient infrastructure system."

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For more information, see *https://highways.dot.gov/research/laboratories/nondestructive-evaluation-laboratory/ongoing-projects*, or contact Hoda Azari, 202–493–3064, *Hoda.Azari@dot.gov*.

Making the Journey a Destination

The Federal Highway Administration celebrates the reemergence of the National Scenic Byways Program with 49 designations to the America's Byways® collection.

by **DANIELLE BLACKSHEAR**, **LILAH MORRISSEY**, and **EDWARD STARKS**

A hiker pauses to take in a brilliant sunset view of the Skagit River Valley near Cascade Loop Scenic Byway in Washington. *© Cascade Loop.*

For the first time since 2009, new National Scenic Byways and All-American Roads were named on February 16, 2021. The U.S. Department of Transportation approved 49 designations to the America's Byways collection. The latest designations confirmed 15 All-American Roads and 34 National Scenic Byways in 28 States, including Nebraska and Rhode Island that gained nationally designated byways for the first time. These designations increased the total number of America's Byways to 184 in 48 States. Prior to the 2021 designations, 150 byways were designated in a series of nomination rounds in 1996, 1998, 2000, 2002, 2005, and 2009.

Established in Title 23, Section 162 of the United States Code, the National Scenic Byways Program (NSBP) is a grassroots, collaborative effort that recognizes selected roads throughout the United States for their intrinsic historic, cultural, natural, archaeological, recreational, and scenic qualities. From its inception under the Intermodal Surface Transportation Efficiency Act of 1991 (Public Law 102-240), the NSBP has been one of USDOT's most popular programs, with consistent support from members of Congress, State and local officials, national byway nonprofit organizations, byway sponsors, area businesses, and many other stakeholders.

FHWA has lead responsibility for the NSBP and manages the byway nomination process within USDOT. "America's Byways enrich quality of life not only by preserving the character of designated byway corridors, but also by providing access to outstanding recreational opportunities," says FHWA Executive Director Gloria M. Shepherd. "The journey begins on the road, but exploring scenic byways is a tangible experience that allows you to truly enjoy the environment around you."

The Reviving America's Scenic Byways Act of 2019 (Public Law 116-57), signed on September 22, 2019, requires the U.S. Secretary of Transportation to conduct a one-time solicitation of nominations for designation of

All-American Roads and National Scenic Byways. This act reinstated the NSBP after funding for the program was discontinued in 2012 under the Moving Ahead for Progress in the 21st Century Act (Public Law 112-141) and designations were paused. Sixty-three nomination applications were submitted for consideration in 2020. Each application was reviewed by a Federal team of subject matter experts on historic preservation, design, cultural resources, visual impacts, tourism and economic development, highway safety, Federal lands, and Native American history and culture. Nomination applications were also sent to the U.S. Departments of Agriculture and Commerce for consultation.

Come Closer: States with First-Time Byway Designations

Nebraska: Lincoln Highway Scenic & Historic Byway

The Lincoln Highway Scenic & Historic Byway was designated as a National Scenic Byway for its intrinsic historic qualities. This Nebraska byway was first used by Native Americans and fur traders who began exploring the west. It was later used in the Nation's westward migration of people on the Oregon and Mormon trails, then Union Pacific Railroad, and ultimately became part of the first transcontinental highway.

The Lincoln Highway, in 1913, was 3,389 miles (5,454 kilometers) long and was among a collection of local roads connected by lines on a map. Later, upon the establishment of the U.S. Numbered Highway System in 1926, U.S. Highway 30 encompassed many of Lincoln Highway's alignments across America. Nationally, less than 25 percent of the original alignments are navigable, but across Nebraska, most of the original 1913 route can still be traveled. Travelers navigating the byway from east to west will see a changing geography as America's damp east meets the arid west.

The journey on this byway begins in the historically significant community of Blair, NE, mentioned in the journals of military personnel and explorers Meriwether Lewis and William Clark. From Blair, the route joins the Platte River valley continuing westward to the town of North Platte, NE, where the North and South Platte Rivers converge, and then to Brule, NE. In Brule, the byway diverges from the river valley and continues westward as the river turns to the south. The Lincoln Highway crosses through small rural towns that developed along the entire byway. The byway has many historical markers commemorating significant incidents along the highway, including dozens of original 1928 concrete Lincoln Highway markers placed by the Boy Scouts to mark the end of activities by the Lincoln Highway Association that had boosted the road since 1913. For more information on the Lincoln Highway Scenic & Historic Byway, visit https://lincolnhighwaynebraskabyway.com/.

Nebraska: Sandhills Journey Scenic Byway

The Sandhills Journey Scenic Byway was designated as a National Scenic Byway for its intrinsic natural qualities. The Nebraska Sandhills occupy nearly 20,000 square miles (51,8000 square kilometers) of dunes, native grasses, and lakes. The Sandhills Journey Scenic Byway, also referred to as Nebraska Highway 2, cuts through the largest area of stabilized sand dunes in the western hemisphere. The Nebraska Sandhills is touted as a world-class birding experience, featuring more than 300 species of migratory and indigenous birds during the spring migration. At the byway's eastern end, near Grand Island, NE, large migrations can be observed, including the largest gathering of cranes on the Platte River and the mating dance of the male Prairie Chicken and Sharptail Grouse in April.

The remote areas of the byway, away from artificial light, offer some of the best places to experience dark skies, perfect for star gazing and astronomy. The Sandhills Journey Scenic Byway Visitor Interpretive Center is a new venue that introduces travelers to educational exhibits showcasing the natural features of the Nebraska Sandhills, and demographic displays provide an insight into the thoughts and lives of settlers and present-day residents. For more information about the Sandhills Journey National Scenic Byway, visit https://www.sandhillsjourney.com/.

Picturesque view of the Nebraska Sandhills Middle Loup River Valley in early fall.
© Twila Phillips.

The Nebraska Lincoln Highway Scenic & Historic Byway is a surviving remnant of the most famous transcontinental named road of the 1910s and 1920s.
© Nebraska Lincoln Highway Scenic and Historic Byway.

Rhode Island: Revolutionary Heritage Byway

The Revolutionary Heritage Byway was designated as a National Scenic Byway for its intrinsic historic qualities. This byway, located in Bristol, RI, brings travelers through a quintessential New England town rich in history and culture, providing vistas of historic homes and waterfront parks. Additionally, downtown Bristol is listed on the National Register of Historic Places (NRHP). Along the northern portion of the byway is Colt State Park, a large public open space, and home to one of Rhode Island's most striking shorelines. Colt State Park is also listed on NRHP and provides access to the East Bay Bike Path from Bristol to Providence. In 2009, the town of Bristol was designated as one of the National Trust for Historic Preservation's Dozen Distinctive Destinations. This corridor is also part of the network of land and water trails that comprise the Washington-Rochambeau National Historic Trail.

The byway itself also has unique qualities, as it is home to the Nation's oldest continuous 4th of July celebration. An amendment added to the National Highway System Bill of 1995 allowed Bristol to permanently change the center line of the roadway to red, white, and blue for the entire length of the parade route. For more information about the Revolutionary Heritage Byway, visit *https://nsbfoundation.com/nb/revolutionary-heritage-byway/*.

Festive red, white, and blue bunting dresses the Linden Place estate for the annual 4th of July celebration in Bristol, RI. *© Linden Place.*

Continuing the Legacy

Since the reemergence of the NSBP, FHWA has organized several coordination activities to support local, statewide, and national byway efforts. In 2020, FHWA began hosting monthly coordinator calls with FHWA division offices and Office of Federal Lands contacts, State and Tribal scenic byways coordinators, Federal Land Management Agencies (FLMAs), and two national byway partners: the National Scenic Byway Foundation (NSBF) and Scenic America. These coordinator calls serve as a pivotal forum for FHWA to share information and provide technical assistance, and for byways coordinators and stakeholders to share current events and updates on behalf of the local byway communities.

The calls also provide a platform for coordinators to share their knowledge and passion with their peers. "The National Scenic Byways Program is an invaluable program that strives to protect and enhance our Nation's most scenic, historical, cultural, archeological, natural, and recreational enriched drives; along with providing economic development to communities along our Nation's Scenic Byways," says Holly Slagle, statewide scenic byway coordinator for the Minnesota Department of Transportation. "Our grassroots organizations, who give of their time freely, are vital to the success of the NSBP. Together we stand ready to ensure the NSBP is strong through leadership and perseverance."

Through the partnership with the NSBF, FHWA has also participated in coordinator trainings and conferences, such as the Heartland Byways Conference in May 2022. The Heartland Byways Conference is hosted biannually among the States of Kansas, Nebraska, and Iowa as an educational

opportunity for leaders and volunteers of designated byways in America. During the May 2022 conference, FHWA staff participated on a Federal and national byway partners panel to discuss the vision for a robust and collaborative scenic byways program over the next 30 years.

In addition to technical assistance, FHWA also provides NSBP discretionary grants to State departments of transportation (DOTs) and federally recognized Tribal governments to implement eligible projects on highways designated as National Scenic Byways or All-American Roads, State scenic byways, or Tribal scenic byways; and plan, design, and develop a State or Tribal scenic byway program. Since 1992, FHWA has provided more than 3,200 NSBP grants totaling over $526 million. In April 2023, FHWA awarded $21.8 million to 33 byway projects in 29 States, including five Tribal lands. These are the first NSBP grants awarded since 2012. There is currently up to $20 million available for the FY2023 NSBP Grants and Technical Assistance. FHWA anticipates awarding grants in 2024.

An interpretive sign along the Great River Road National Scenic Byway informs visitors about the Freedom Park Visitor and Learning Center in Prescott, WI.
© GRR Visitor & Learning Center.

Additionally, depending on the road, byways may be eligible for other Title 23 Program funds—such as the Surface Transportation Block Grant Program, the Federal Lands Transportation Program, the Tribal Transportation Program, and the State Planning and Research Program—to support eligible byways projects. States and Tribes can also consider byway corridor management plans (CMPs) and other criteria in their transportation prioritization and programming guidance.

NSBP directly impacts local communities. For example, Rhode Island DOT received $750,000 to repair a badly damaged sea wall, improve drainage, and replace sidewalk and curbing as part of the Hope Street Pedestrian and Resiliency Enhancements project along the Revolutionary Heritage National Scenic Byway. The Forest County Potawatomi Community Tribe in Wisconsin received more than $302,000 to enhance the Tribe's biking and pedestrian trail by designing and constructing four culturally interpretive rest areas along a path parallel to the Nicolet-Wolf River Scenic Byway, adding cultural artwork to the biking/pedestrian underpass and installing wayfinding signage. These projects capture and highlight the byway's intrinsic qualities and will improve quality of life for the byway communities.

As required by the Consolidated Appropriations Act, 2021, FHWA is also conducting an economic impact study of designated National Scenic Byways and All-American Roads. According to Lenore C. Bates, the Colorado scenic byway coordinator at the Colorado DOT, "Thirteen of Colorado's 26 byways are also designated as America's Byways by the U.S. Secretary of Transportation—more national designations than any other State. These are important assets since 19 percent of Colorado tourists visit our scenic byways. Predominantly, the synergy of the Colorado Scenic and Historic Byways increases regional effectiveness and promotes rural tourism, economic development, scenic conservation, historic preservation, and recreation."

Through the decades, the NSBP legacy has endured and thrived. FHWA is proud and excited to continue the journey and promote America's Byways. More information on National Scenic Byway Program can be found at *https://www.fhwa.dot.gov/hep/scenic_byways/*.

NATIONAL SCENIC BYWAYS

FHWA awarded $21.8 million to 33 byway projects in 29 states, including five Tribal lands. These are the first National Scenic Byways Program grants awarded since 2012.

U.S. Department of Transportation
Federal Highway Administration

Source: https://www.fhwa.dot.gov/hep/scenic_byways/grants/2022_awards/

DANIELLE BLACKSHEAR is a transportation specialist in the FHWA Office of Human Environment. As the NSBP lead, she provides program and policy direction for America's Byways designations and $42 million dollars in NSBP discretionary grants. She received her bachelor's and master's degrees in urban and environmental planning from the University of Virginia.

LILAH MORRISSEY has over 14 years of professional experience in project management and marketing. She has a master's degree in community and regional planning from the University of Oregon. As the marketing specialist for FHWA's Office of Planning, Environment, and Realty (HEP), Morrissey manages print, digital, social media, publications, and project management needs for the five HEP offices.

EDWARD STARKS is a transportation specialist in the FHWA Office of Human Environment. He supports the NSBP through technical assistance and program direction. He received his bachelor's degree in industrial engineering and master's degree in transportation planning and intelligent transportation systems from South Carolina State University.

For more information about the 2021 America's Byways Designations, visit *https://www.fhwa.dot.gov/hep/scenic_byways/designations/*. For more information on the National Scenic Byways Program, see *https://www.fhwa.dot.gov/hep/scenic_byways/* or contact Danielle Blackshear at *danielle.blackshear@dot.gov* or (202) 366-2064.

AMERICA'S BYWAYS is the umbrella term for the collection of 184 distinct and diverse roads designated by the U.S. Secretary of Transportation. America's Byways include National Scenic Byways and All-American Roads. The NSBP's May 18, 1995, Federal Register Notice (60 Fed. Reg. 26759) sets forth the criteria for the designation of roads as National Scenic Byways or All-American Roads.

To be designated as a National Scenic Byway, a road must possess at least one of the six intrinsic qualities—historic, cultural, natural, archaeological, recreational, and scenic—that is regionally significant. Regional significance means that the byway characteristics are representative of a geographic area encompassing two or more States.

For All-American Road designations, a road must possess two of the six intrinsic qualities that are nationally significant, and the road should be considered a destination unto itself. National significance means that the characteristics associated with the intrinsic qualities are those which best represent the Nation and contain one-of-a-kind features that do not exist elsewhere.

When FHWA issues a call for America's Byways nominations, anyone can nominate a road for designation, but the nomination must be submitted through a State or Tribal Government's identified scenic byway agency or a FLMA and must also include a CMP designed to protect the unique qualities of the byway. The road must also first be designated as a State, Tribal, or FLMA scenic byway.

The FHWA America's Byways website (*https://fhwaapps.fhwa.dot.gov/bywaysp/*) spotlights each of the 184 designated byways, including a brief description, photos, maps, and local byway contact information.

Source: FHWA.

CAN CHEMISTRY IMPROVE the NATION'S ROADWAYS?

FHWA's Chemistry Laboratory conducts fundamental studies of highway materials to understand both failure mechanisms and superior performance.

by **TERRY ARNOLD**

The Federal Highway Administration's Turner-Fairbank Highway Research Center (TFHRC) has had the Chemistry Laboratory for more than 100 years. That may seem strange in a highway-oriented world of civil engineers, program managers, construction inspectors, environmental and transportation specialists, planners, and other corresponding personnel; however, the scientists and researchers in the Chemistry Laboratory have been able to earn their keep, helping to foster innovation in support of FHWA's long-standing mission of increasing safety on the Nation's roadways.

From performing research on concrete and asphalt to the development of standards to conducting forensic investigations on pavements and other highway structures, the FHWA Chemistry Laboratory plays a key role behind the scenes to:

- Advance the understanding of chemical changes that contribute to road failure or damage.
- Advance the understanding of chemical changes that can contribute to potential performance enhancements.
- Develop state-of-the-art characterization tools.
- Test and foster new materials development.

"Chemistry provides an understanding of interactions at a molecular level and provides new solutions to pavement/material performance," says Jack Youtcheff, pavement materials team leader at FHWA.

Throughout the years, the Chemistry Laboratory has developed several testing standards that have been submitted to the American Association of State Highway and Transportation Officials (AASHTO)—as part of its "forensic toolbox" research—to improve and facilitate the chemical analysis of highway materials and to characterize and quantify new or alternative sustainable materials. For example, AASHTO recently designated provisional Standard TP144-21, as described below.

The FHWA Chemistry Laboratory develops new testing standards and field procedures to support the design and construction of highways, bridges, and other transportation infrastructures.
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Concrete Research

In FHWA's Chemistry Laboratory, scientists have worked diligently for the past 12 years to develop a test that detects the quality of aggregates (a group of raw materials including sand and stone used in the construction of roads) more accurately and quickly than ever before. In 1935, a distress mechanism in concrete was discovered on a bridge built in France; the first paper documenting the mechanism was published in the United States in November 1940 by Thomas Edison Stanton of the California State Highway Division. The paper detailed the chemical compound alkalis found in cement that can react with some aggregates in concrete to form a gel resulting from

An example of concrete cracking caused by alkali-silica reaction gels.
Source: FHWA.

A block farm where alkali-silica reaction expansion is measured outdoors. *Source: FHWA.*

an alkali-silica reaction (ASR). ASR, also referred to as concrete cancer, is a swelling reaction. The resulting gel can absorb water and swell causing concrete to crack. Even after all these years, this type of swelling is still a major issue in the concrete industry.

Aggregate tests first appeared in 1947. Generally, all aggregate tests rely on measuring the expansion of concrete or mortar samples placed in a sodium hydroxide solution at an elevated temperature. However, none of these tests work particularly well. Typically, they show about 65 to 70 percent accuracy.

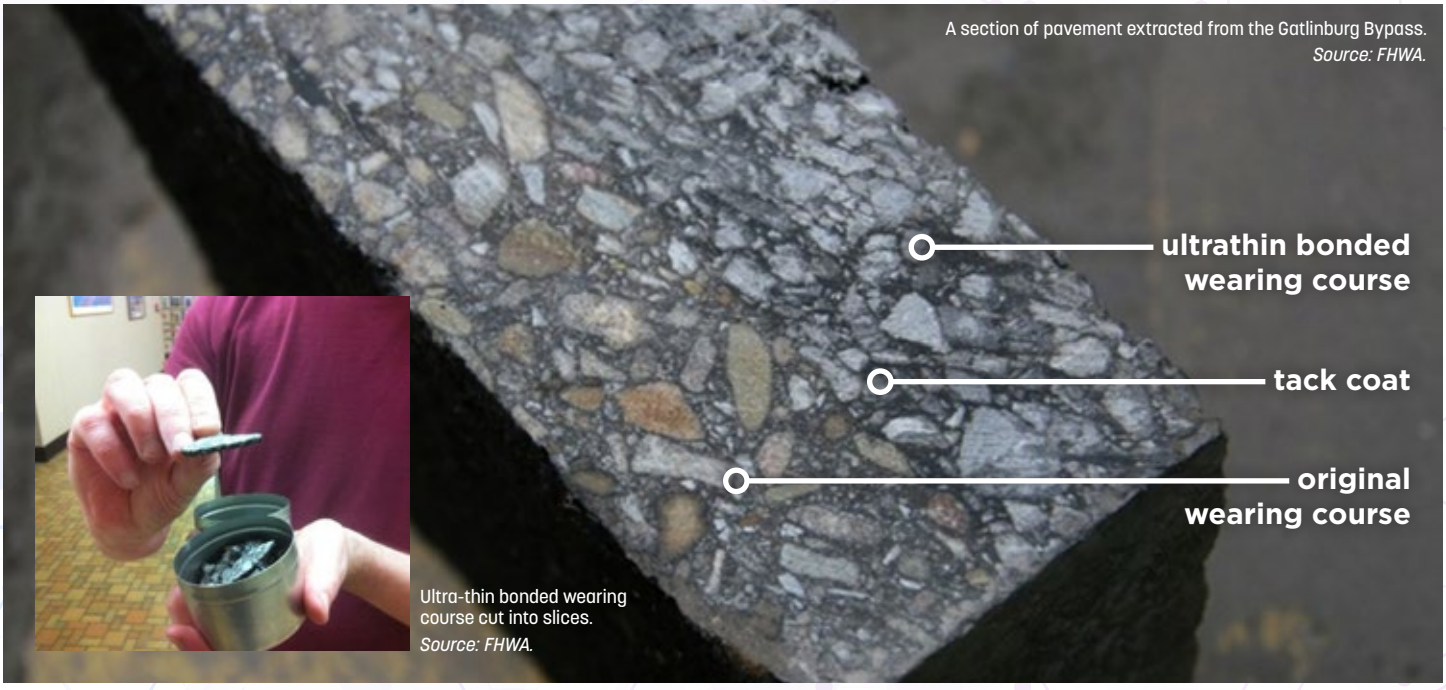
Currently, the best engineering test for aggregates is ASTM International's ASTM C1293: *Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction*, which takes nearly one year to garner results. By contrast, the scientists in the Chemistry Laboratory developed a test—dubbed T-FAST—which takes 21 days. It does not measure physical expansion, rather it predicts from chemical methods the potential of an aggregate or combination of aggregates to expand deleteriously due to any form of alkali-silica reactivity.

Several rounds of testing with T-FAST have produced results 100 percent in agreement with other field tests measured on concrete blocks exposed to the weather for many years. The Chemistry Laboratory is currently working with laboratories at 23 State agencies and universities on a round-robin testing schedule to bring awareness to and ensure proper usage of T-FAST. The T-FAST test has been approved by AASHTO as a provisional test method (TP 144-21: *Determining the Potential Alkali-Silica Reactivity of Coarse Aggregates (TFHRC-TFAST)*).

Forensic Studies

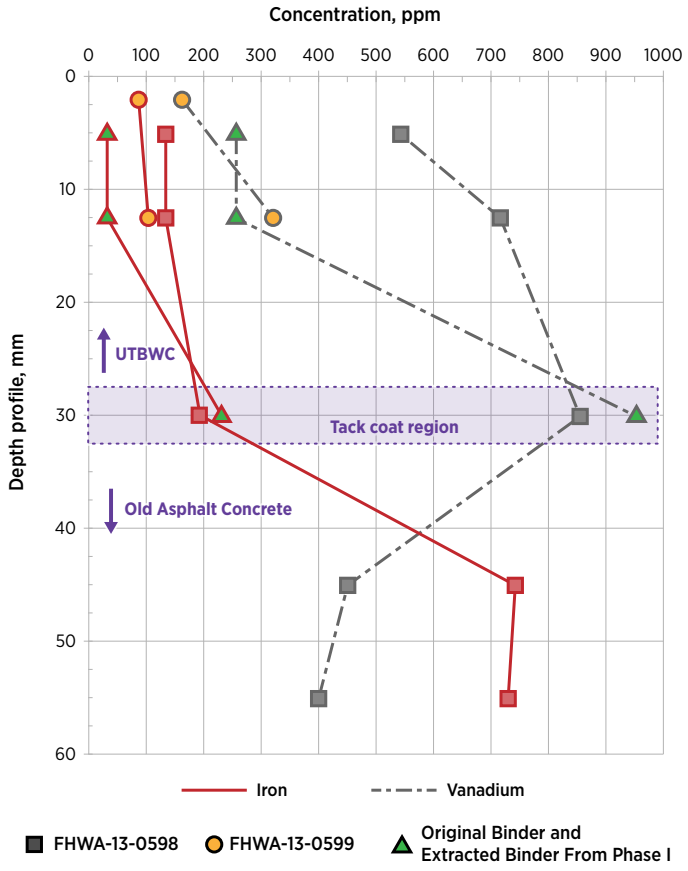
Improving Pavement Traction on Gatlinburg Bypass, Tennessee

The Gatlinburg Bypass in Smoky Mountains National Park is a 5.8-kilometer (3.6-mile) scenic roadway that connects Pigeon Forge, TN, to Gatlinburg, TN, circumventing the heavily trafficked commercial strip of Pigeon Forge. In 2013, the Bypass was repaved as part of normal maintenance with a 25.4-millimeter (1-inch) ultra-thin bonded wearing course (the upper layer in the roadway.) To ensure the wearing course had good adhesion to the old roadway, an asphalt emulsion tack coat was sprayed onto its surface. Within a short time, the pavement began exhibiting poor skid resistance and the bleeding of asphalt to



A section of pavement extracted from the Gatlinburg Bypass. *Source: FHWA.*

Ultra-thin bonded wearing course cut into slices. *Source: FHWA.*



Graph showing the high vanadium asphalt from the tack coat migrating to the surface.
Source: FHWA.

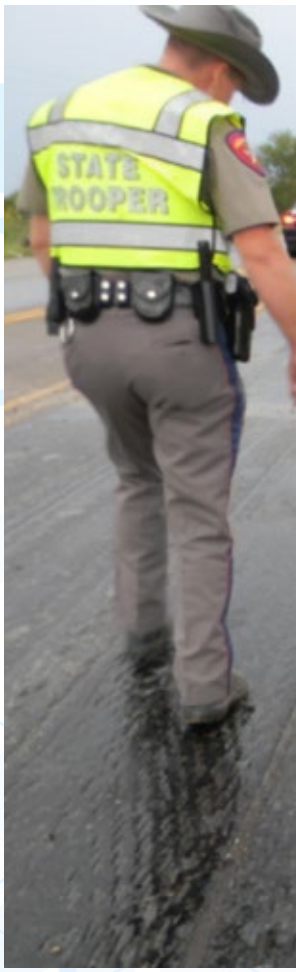
the surface caused black tracking marks on the white concrete bridges. However, it was not known at the time whether the asphalt bleeding to the surface was caused by too much asphalt in the hot-mix (a mixture of asphalt binder and graded mineral aggregate) or if excessive tack coat had been used.

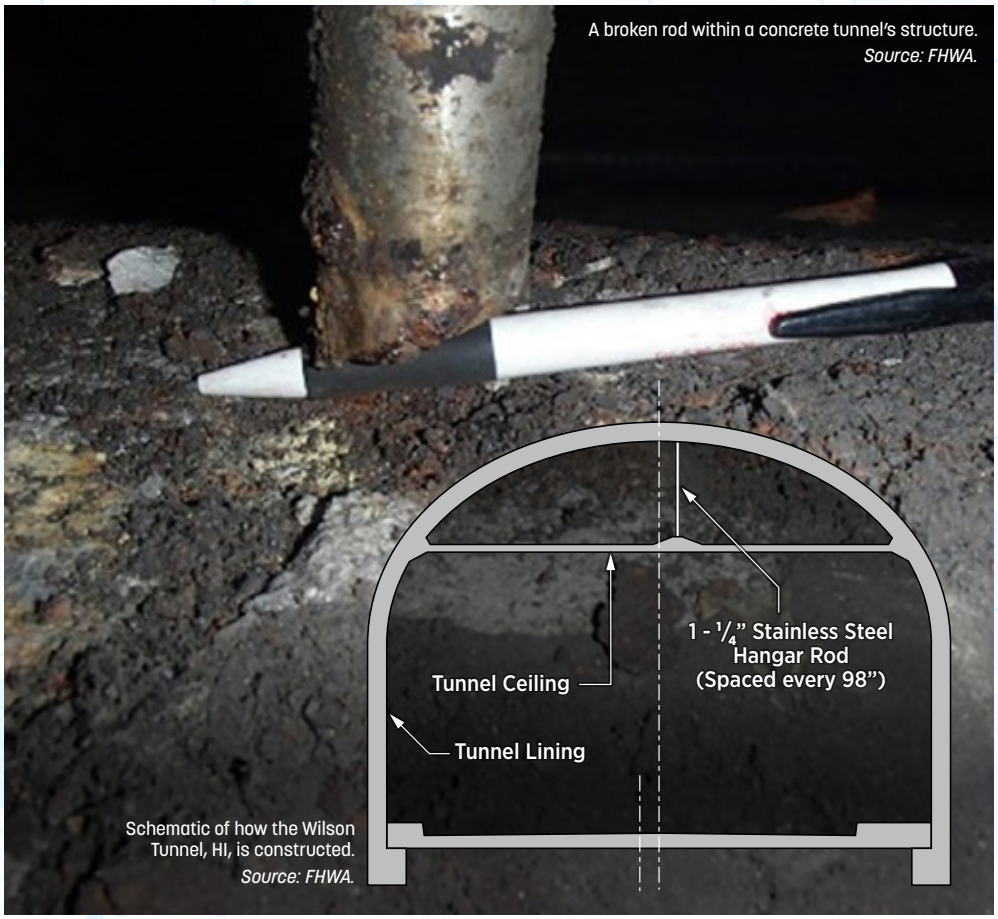
In visiting the site, researchers from the Chemistry Laboratory were able to gather a sample of the emulsion tack coat from an off-ramp to the Bypass. Forensic studies were performed and showed that it contained high levels of vanadium which is typical of asphalt from Venezuelan crude oil. The high level of vanadium present allowed researchers to identify the source of the asphalt used in the tack coat of the pavement and was key to solving why the asphalt bled to the surface. By extracting additional thin slices of the wearing course, recovering the binder, and analyzing for vanadium, researchers were able to see that the high vanadium content of the asphalt was bleeding up to the surface of the pavement. The researchers found that too much tack coat had been used.

Identifying Rod Failures in Wilson Tunnel, Hawaii

When it became federally mandated to test tunnels as well as bridges in the State, the Hawaii Department of Transportation (HDOT) inspected the John H. Wilson Tunnel—a pair of tunnels built in the 1950s—and found that some of the stainless-steel rods supporting the roof had broken and shifted next to the concrete. In this type of tunnel, rods extend from the very top, which is the actual boring, through the mountain, into the roof. Tunnels have a flat ceiling. Between the roof and the circular concrete of the tunnel itself there is an air space used for ventilation of the tunnel. The rods broke at the surface of the ceiling. Faced with the prospect of pouring another tunnel, HDOT was anxious to find what caused these rods to break.

Forensics performed on concrete taken from the tunnel's roof, via x-ray fluorescence (XRF), showed that the concrete contained both chlorine and bromine—two elements commonly found in seawater. Analysis showed the chloride content to be about 0.2 percent; this percentage was compared with the chloride content of sample concrete taken from the Arlington Memorial Bridge in Washington, D.C., which had salt placed on it every year since it was built in





A broken rod within a concrete tunnel's structure.
Source: FHWA.

Schematic of how the Wilson Tunnel, HI, is constructed.
Source: FHWA.

A law enforcement officer surveilles the area where a chartered bus lost traction on a wet slippery interstate highway. *Source: FHWA.*

What's Next?

The Chemistry Laboratory's staff is continually working to develop new testing standards, field procedures, and recommended practices for the safer design and construction of highways, bridges, and other transportation infrastructures. Currently, their research is delving further into the mechanism of ASR, with specific emphasis on the role of aluminum and identifying important parameters for a reliable test method to predict the reactivity of aggregates. The Chemistry Laboratory is also working to develop additional test methods for the use of handheld XRF, a Fourier transform infrared spectrometer, and Raman spectrometers for the field analysis of highway materials (versus their uses within a laboratory). For a look at the original Chemistry Laboratory article, visit the January/February 2012 issue of *Public Roads*: *https://highways.dot.gov/public-roads/januaryfebruary-2012/why-does-fhwa-have-chemistry-lab*.

TERRY ARNOLD is a manager at TFHRC's Chemistry Laboratory and a member of the pavement materials team. He is a Fellow of the Royal Society of Chemistry chartered chemist.

For more information, visit *https://highways.dot.gov/research/laboratories/chemistry-laboratory/chemistry-laboratory-overview* or contact Terry Arnold at 202-493-3305 or *terry.arnold@dot.gov*.

1932. Analysis returned a chloride level of only 0.03 percent, an amount far less than the concrete in Hawaii's tunnel. Originally, a reason for how chlorine and bromine penetrated the tunnel's concrete could not be found; though, many surmised it was due to absorption from atmospheric moisture. It was later discovered that concrete in Hawaii was made using beach sand through the 1970s.

Science Pinpoints Cause of Bus Crash

A chartered bus lost traction on a wet slippery interstate highway where the speed limit was 75 miles per hour (121 kilometers per hour). The bus skidded sideways, found traction in the grass, and turned over; nine passengers were killed.

Samples or cores from the pavement were provided to the Chemistry Laboratory to pinpoint a reason for the pavement's poor skid resistance. The Chemistry Laboratory found that the surface of the cores contained a layer of neat (or unmodified) asphalt. Infrared analysis also showed this asphalt contained a styrene-butadiene polymer—a hard rubber used for products like tire threads and soles of footwear. Though no polymer was found in the core itself, styrene-butadiene polymers are often added to strengthen asphalt tack coats, which are used as glue to bind stones to the surface in chip seal applications. The Chemistry Laboratory's researchers determined that the chip seal surfacing of the pavement was incomplete as the tack coat was applied but the stones were never actually added to the surface. This determination turned out to be the case. Unfortunately, due to poor recordkeeping by personnel working on the project, the chips were omitted; good recordkeeping would have indicated that stones had not been added onto the asphalt surface.

Note: *The above content provided for laboratory context only. Specific details of the bus incident, beyond what is shown, are not permitted to be released as directed by the investigating agency.*

Chemistry Laboratory Manager Terry Arnold collects a sample of dried tack coat from an off-ramp. *Source: FHWA.*

Virtual tours of several Turner-Fairbank Highway Research Center laboratories are available including the J. Sterling Jones Hydraulics Research Laboratory.
Source: FHWA.

Along the Road is the place to look for information about current and upcoming activities, developments, trends, and items of general interest to the highway community. This information comes from U.S. Department of Transportation sources unless otherwise indicated. Your suggestions and input are welcome. Let's meet along the road.

Public Information and Information Exchange

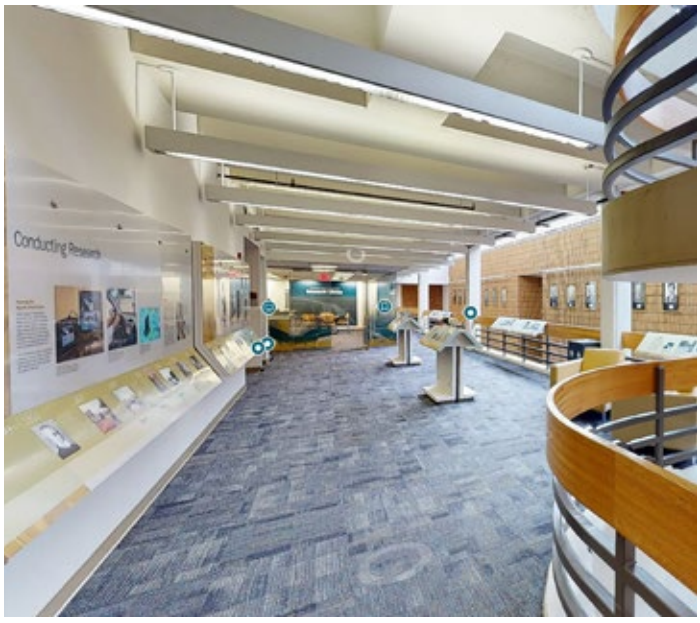
TFHRC Launches a Virtual Tour

A self-guided virtual tour of the Turner-Fairbank Highway Research Center (TFHRC) will soon be available on the Federal Highway Administration's website from a desktop or mobile device.

Launching in late 2023/early 2024, the virtual tour for this one-of-a-kind research center features close-up looks into 6 of the 15 laboratories that conduct the cutting-edge research and development activities for which TFHRC is known. With a click of the mouse, visitors can also virtually stroll through the TFHRC lobby filled with informational displays, learn about the center's state-of-the-art laboratory equipment, and participate in special activities created for elementary and secondary school students.

The tour explores the Chemistry Laboratory, the Federal Outdoor Impact Laboratory, the Human Factors Laboratory, the J. Sterling Jones Hydraulics Research Laboratory, the Saxton Transportation Operations Laboratory, and the Structures Laboratory. Similar to an in-person tour, FHWA researchers share information on the frequently used and unique high-tech equipment that enables their ground-breaking studies. This information is shared with visitors via clickable "touchpoints" highlighted throughout the rooms.

With special activities in Science, Technology, Engineering, and Mathematics (STEM), a visit to the STEM Activity Center will help inspire the next generation of transportation researchers and engineers; easy-to-follow videos illustrate activities—modeled after actual TFHRC research projects—that spark curiosity about infrastructure and the environment, road barriers and safety, communication among connected automated vehicles, and more.



The TFHRC virtual tours feature "touchpoints" that visitors can click on to learn about high-tech equipment, current research, and more.
Source: FHWA.

For more information, or to delve into the room-by-room tours of selected TFHRC laboratories, visit *https://highways.dot.gov/research*.

ODOT to Invest Record Dollar Amount in Construction

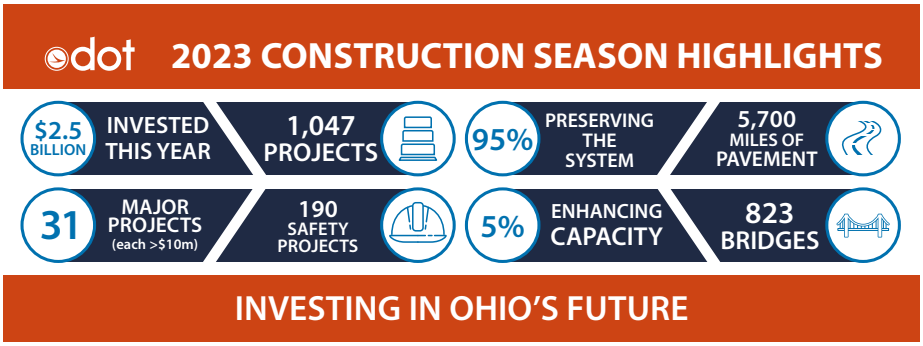
In March 2023, the Ohio Department of Transportation (ODOT) announced a plan to invest a record $2.5 billion during this year's construction season, the time of year when priorities shift from winter activities to springtime construction and maintenance. This season's projects center on safety and maintaining infrastructure in a state of good repair.

More than 1,000 construction projects are scheduled across Ohio this year, including 31 new projects and 190 projects to reduce serious or deadly crashes on roadways. More than 5,700 miles of pavement and 823 bridges will be improved through resurfacing; microsurfacing; culvert replacements; chip sealing; bridge repairs; bridge replacements; lighting improvements; intersection improvements; widening; slide repair; bridge re-decking; and/or pavement replacements.

ODOT's construction plans are grouped together by districts and outlined in guides (*https://www.transportation.ohio.gov/projects/construction-guides/construction-guides*) by counties. The guides provide a brief description of each project, estimated start and finished dates, project costs, and impacts to traffic.

With the number of construction projects planned, ODOT is encouraging motorists to abide by the "Move Over" law—to cautiously shift over one lane, or slow down, when driving by any vehicle with flashing lights—when traveling through work zones. In 2022, 133 ODOT crews (including workers, vehicles, and equipment) were struck by vehicles while operating along Ohio roadways.

For more information, visit *https://www.transportation.ohio.gov/about-us/news/statewide/2023-construction-kickoff*.



The Ohio Department of Transportation has launched their record-breaking construction season.
© ODOT.

Dust Storms Cause More Traffic Fatalities Than Previously Noted

A research study funded by the National Aeronautics and Space Administration's Health and Air Quality program and conducted by researchers at multiple institutions—including the National Oceanic and Atmospheric Administration's (NOAA) Air Resources Laboratory, George Mason University's College of Science and Center for Spatial Information Science and Systems, University of Texas at El Paso's Department of Earth, Environmental and Resource Sciences, and Freie Universität Berlin's (Germany) Institute of Meteorology—was published May 2023 in the Bulletin of the American Meteorological Society. The study revealed that dust storms contribute to a larger number of U.S. traffic fatalities than previously determined.

Dust storms, also referred to as sandstorms, can hurt a driver's visibility, causing a loss of control of the vehicle as strong winds lift large amounts of sand, dirt, and other debris off the ground and into the air. Research found that dust storms can also cause vehicles to lose traction and spin out of control.

Dust storms can occur in any place where loose soil and high wind is present, like Interstate–10 in San Simon Valley, AZ.
© Arizona Department of Transportation.

Though dust storms can occur at any place where loose soil and high wind is present (e.g., baseball fields, farmlands, and construction sites), dust storm-related fatalities occur most often in the Southwest region of the United States (e.g., Arizona, New Mexico, Southern California, and Texas), where winds from strong storms kick up dust and sand in desert landscapes. The Autumn 2021 issue of *Public Roads* features the article, "Confronting the Storm: Arizona's Innovative Dust Detection and Warning System" (*https://highways.dot.gov/public-roads/autumn-2021/03*) that details the impact of dust storms and a state-of-the-art, fully automated dust storm detection and warning system developed by the Arizona Department of Transportation. The system works to detect dust storm events as well as warn drivers to modify their behavior when they occur.

After examining records from 2007 to 2017 for dust storm-related events as well as two NOAA databases alongside the Fatality Analysis Reporting System, researchers pinpointed 232 deaths from dust storm-related traffic incidents. Their findings were greater than previous datasets that reported only 10 to 39 deaths. Hence, the researchers were motivated to create a method by which to gather and analyze storm data more accurately; their method involved running code to collect information on every severe weather event that mentioned "dust" in their published reporting, among other search strategies. Researchers then took the important measure of manually examining each resulting event to ensure it was representative of a dust storm. Their updated searches revealed the number of deaths from dust storms ranged from 14 to 32 per year, which was also more than what had been officially recorded over the same decade.

To view the research article in its entirety, visit: *https://journals.ametsoc.org/view/journals/bams/104/5/BAMS-D-22-0186.1.xml*.

Is Happiness the Next Transportation Metric?

There are several potential causes of unhappiness while driving—crowded roadways, running late due to traffic, or the driving behaviors of other motorists. A recent study, published April 2023 in the American Association of State Highway and Transportation Officials Journal, aimed to determine whether traveler happiness could be a key transportation metric for planning projects alongside others, such as vehicles' miles traveled (the distance that vehicles travel on a specific road or network of roads over a certain period of time); crash rates (the number of crashes, traffic volume, and road length); and transit accessibility (how easily residents of a community can access public transit services and how well those services meet their needs). How happiness—an emotional state characterized by feelings of joy, satisfaction, contentment, and fulfillment—is impacted by infrastructure could soon be tracked by State departments of transportation.

Happiness, categorized by feelings of joy, satisfaction, contentment, and fulfillment, may be utilized in the future as a transportation key performance indicator.
© Flamingo Images / AdobeStock.com.

For this study, researchers developed a GPS-based smartphone application (app) to capture commuters' routes and modes of transportation (e.g., car, bus, bike, rail, or walking) in Minneapolis-St. Paul (MN) metropolitan region. At the conclusion of their commute, travelers indicated, via the app, how they felt from a list of options: happy, meaningful, painful, sad, tired, or stressed. The data inputted into the app powers a map—dubbed the Minneapolis-St. Paul Transportation Happiness Map (*https://maps.umn.edu/transportation-happiness/*)—and produces a visualization that illustrates spatiotemporal differences in travelers' happiness ratings on the region's streets and roads. Users of the map can extract data by selecting among 10 travel-mode options, seven time-of-day options, eight emotion options, and two statistic options (mean and median) to visualize patterns of transportation happiness.

From the information collected during the study, people commuting along a scenic riverside route were the happiest, and bicycling was deemed the happiest mode of transportation. Although it may take additional research, there is hope that happiness will be used as a metric to guide the building of infrastructure—both the type and location.

After Two-Year Dramatic Rise, Flat Fatality Rate Projected

As the National Highway Traffic Safety Administration (NHTSA) continues to gather and finalize data on crash fatalities for 2021 and 2022, statistical projections for the fourth quarter of 2022 represents the third straight quarterly decline in roadway fatalities across the Nation. This decrease comes after seven consecutive quarters of year-to-year increases, beginning with the third quarter of 2020.

In 2021, NHTSA also created a methodology to generate State-level fatality estimations. Twenty-seven States—including Arkansas, Ohio, Pennsylvania, Puerto Rico, South Carolina, and West Virginia—are projected to have decreases in fatalities in 2022; 23 are projected to have experience increases. Fatality rates were also grouped by NHTSA region, with five of the 10 NHTSA regions experiencing decreases in 2022:

- NHTSA Region 3: Delaware, District of Columbia, Kentucky, Maryland, North Carolina, Virginia, and West Virginia.
- NHTSA Region 4: Alabama, Florida, Georgia, South Carolina, and Tennessee.
- NHTSA Region 5: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin.
- NHTSA Region 6: Louisiana, Mississippi, New Mexico, Oklahoma, and Texas.
- NHTSA Region 7: Arkansas, Iowa, Kansas, Missouri, and Nebraska.

However, these regional estimates are subject to change as annual reports are finalized and released.

In 2022, the U.S. Department of Transportation published the *Vulnerable Road User Safety Assessment* to guide States on required 2023 assessments. This guidance addresses schedule and frequency, statutory and regulatory requirements, potential funding opportunities, and the relationship between the *Vulnerable Road User Safety Assessment* and other vulnerable road user activities. USDOT has also advanced the *Manual on Uniform Traffic Control Devices* rulemaking effort and issued a Standing General Order to collect data about crashes in vehicles equipped with automated driving systems and advanced driver assistance systems. These efforts are among several implemented by the Department with the goal of not only decreasing but eliminating preventable fatalities.

MDOT Receives 2022 Keep America Beautiful Award

The Mississippi Department of Transportation (MDOT) and Keep Mississippi Beautiful—a nonprofit organization working to inspire Mississippians to end littering, improve recycling, and beautify their community—received the 2022 State Agency Partnership Award at the Keep America Beautiful National Conference held in February 2023. MDOT was one of 16 State agencies across the Nation to be honored at the annual forum in Washington, D.C.

State departments of transportation and other State agencies at this conference are awarded based on their support of Keep America Beautiful State affiliates. MDOT was selected for its litter prevention efforts and its Trash Bash events, held in partnership with Keep Mississippi Beautiful as an annual roadway clean-up initiative. These events are known to make a huge impact statewide by removing a large amount of litter and debris from State highways. In 2016, for example, MDOT employees in total spent 30,526 hours picking up trash on the side of the road, which is equivalent to almost three and a half years.

For more information on litter prevention in Mississippi, visit https://litter.mdot.ms.gov/.

2024 Federal Agency Uniform Act Conference

The Federal Highway Administration is planning a 2024 Uniform Act Conference scheduled for February 6–8, 2024. As a gathering for Federal agencies with real estate programs, the conference will promote Uniform Act stewardship, oversight, and state-of-the-practice through discussions and collaboration with Federal agency partners and stakeholders.

The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Uniform Act) provides important protections and assistance for people affected by federally funded projects. Congress enacted this law to ensure that people whose real property is acquired, or who move as a result of projects receiving Federal funds, are treated fairly and equitably and receive just compensation for—and assistance in moving from—the property they occupy. FHWA's Office of Real Estate Services, acting as Federal lead agency for the implementation of the Uniform Act, develops, issues, and maintains governmentwide regulations, provides advice and guidance to Federal agencies on the Uniform Act, and provides an annual report to Congress on the state of the governmentwide Uniform Act program.

FHWA leads many activities to advance Uniform Act state-of-the-practice including development and maintenance of Uniform Act Training courses, which are provided through the National Highway Institute (a description of each course offering is listed at https://www.fhwa.dot.gov/real_estate/training/trta200.cfm). FHWA also leads a research program on Uniform Act related issues and opportunities and hosts a biannual meeting with its Federal agency partners.

To register for the in-person and virtual 2024 Uniform Act Conference, visit: https://forms.office.com/pages/responsepage.aspx?id=WyTNxPBElUOhqjhI0lj3izjnWZnN3XtJrCgsjdEeb2ZUNkE0RzczSjAzTUxTMFBKQ0E4VDNCNjFVSC4u&wdLOR=cB9325838-2CD5-44D3-9AF7-46BEE1F861A4. Registration is open to Federal agencies and partners overseeing federally funded projects and programs subject to the requirements of the Uniform Act. For more information, contact FHWA's Arnold Feldman at arnold.feldman@dot.gov.

Hypothetical Strategies Address Actual Truck Emissions and Noise Concerns

The Federal Highway Administration published the report *Addressing Truck Emissions and Noise at Truck Freight Bottlenecks* (https://www.fhwa.dot.gov/environment/air_quality/research/addressing_truck_bottlenecks/fhwahep22026_final.pdf), which provides information on strategies to reduce truck emissions and noise at truck freight bottleneck areas across the Nation.

Truck freight bottlenecks—specific locations on highways where traffic congestion occurs—can have negative impacts on both the economy (e.g., delayed freight shipments and wasted fuel) and the environment (e.g., air pollution). The nearly 120-page report highlights three case studies, each representing a highway freight bottleneck and intermodal connector location in the country, along with hypothetical mitigation strategies.

The first case study, conducted on the Kennedy Expressway (also known as Interstate–90/94) in Chicago, IL, found that capacity and/or operational strategies to maintain higher peak period speeds could help reduce emissions. The study also found that truck replacement and clean truck strategies (e.g., congestion mitigation and idling reduction) could have large emissions benefits if applied to most trucks serving the region.

Strategies derived from the case study at Port of Houston's Barbours Cut Terminal in Texas—where most trucks serve local or regional destinations—include clean truck, drayage optimization, and rail drayage strategies, which can have significant emissions benefits. It was also found that noise-specific measures can provide larger truck noise reductions, and a substantial share of emissions came from idling at gates or in terminal operations, pointing to the benefits of terminal efficiency improvements.

Lastly, the case study focusing on Interstate–5 at the Port of Tacoma in the State of Washington—where most trucks on the interstate are through traffic—found that strategies that only affect local, port-serving traffic will produce modest benefits but more substantial benefits on local streets. Also, eliminating congestion for trucks (by establishing truck-only lanes on I–5) has significant peak period emissions benefits; truck replacement and clean truck strategies can have substantial benefits if applied to all traffic; and noise-specific measures (e.g., barriers) can provide larger truck noise reductions.

With each of the three case studies producing varied strategies, a "one-size-fits-all" strategy may not exist; the best solution may be a combination of strategies tailored to local needs, environment, and opportunities.

For more information, contact David Kall at david.kall@dot.gov or call (202) 366-6276.

Technical News

In transportation, artificial intelligence-enabled capabilities can lead to safer, cleaner, smarter, and more efficient processes in construction, surface automation, and intelligent transportation systems.
© Tierney / AdobeStock.com.

AI in Transportation: The Solutions and Challenges

The definition of artificial intelligence (AI) is continually evolving just like its number of applications. For one, AI consists of the "thoughts" and conclusions that computers make after receiving data inputs. The National Artificial Intelligence Act of 2020 defines AI as a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations, or decisions influencing real or virtual environments. In transportation, the predictions, recommendations, or decisions can range from advanced driver-assistance systems and predictive traffic modeling to safer, cleaner, smarter, and more efficient processes in construction, surface automation, and intelligent transportation systems (ITS).

In the construction industry, including roadway construction, nearly 350,000 unfilled positions exist. The construction industry is also where the second highest number of work-related severe injuries occur among the private industry sectors. AI, via AI-powered robots and collaborative robots (cobots), can serve as a viable solution to address these challenges. The use of AI and robotics can address the labor shortage and create jobsites that are safer and more productive. Cobots are equipped with advanced sensors and AI algorithms that allow them to perceive and adapt to their environment, interact with humans in a safe and efficient manner, and perform a wide range of tasks.

In surface transportation automation, including automated driving systems and smart infrastructure, AI enhances detection systems. It can be applied to a vehicle's detection system, where sensor input and map data are fused to detect all objects (static and dynamic) from the environment and enable a vehicle to plan its trajectory. Similarly, AI can enable infrastructure sensors to fuse data from multiple sources including connected and automated vehicles, traffic detectors, including radar and video, and other related data like environmental and contextual data.

In addition, AI applications can enhance ITS, including asset management, traveler support tools, commercial vehicle and freight operations, emergency management, and Transportation Systems Management and Operations (TSMO). For example, with TSMO, AI can be applied at the system, technical, and operational levels to optimize the performance of a multimodal infrastructure to preserve capacity, advance efficiency, and productivity, and improve the security, safety, and reliability of the U.S. transportation system.

For as much as AI can add to transportation, there are many challenges to its adoption, including stakeholder perception (e.g., the perceptions of users, developers, and researchers), ethics (e.g., privacy and surveillance), equity (i.e., producing equitable outcomes for everyone, including older people and people with disabilities), and bias (e.g., AI systems making decisions based on biased human decisions or those that reflect historical or social inequities). Other challenges include safety, cybersecurity, human behavior, weather impacts, public trust, and coworker trust (in working alongside AI-enabled teammates). A detailed listing of these challenges and more for AI in ITS can be found in the October 2022 report, *Artificial Intelligence (AI) for Intelligence Transportation Systems (ITS): Challenges and Potential Solutions, Insights, and Lessons Learned* (https://rosap.ntl.bts.gov/view/dot/66971).

For more information, contact Mubassira Khan (mubassira.khan@dot.gov), Robert Sheehan (robert.sheehan@dot.gov), or Reza Akhavian (rakhavian@sdsu.edu).

Policy, Regulations, and Grants

Accelerating the RIA Grant Program

In April 2023, the U.S. Department of Transportation announced that its Build America Bureau will add $24 million in grants to the Regional Infrastructure Accelerators (RIA) Program to further expedite the development of transportation infrastructure projects at local and regional levels.

RIA is a USDOT-funded grant program to help move transportation projects forward, assisting with project planning, development, and delivery. Accelerators also evaluate innovative financing, access technical assistance and best practices, and develop a pipeline of projects ready for investment.

In fall 2022, USDOT announced five additional accelerators to the RIA Program. One of those accelerators, the Resilient State Route (SR) 37 Program in California, will address congestion, flood protection, sea-level rising issues, and connections to transit and rail options along a 20-mile route of SR 37—a stretch of highway vital to both rural and disadvantaged communities in Sonoma and Napa counties. Another accelerator, in Dona Ana County, NM, will oversee the creation of the New Mexico TradePort. This tradeport, an integrated logistics hub, plans to build new infrastructure that accelerates the regional transition to a low-carbon economy and expands opportunities for allied trade and transportations service providers.

Complete Streets Course Series

by **BROOKE STRUVE** and **SABRINA SYLVESTER**

Source: NHI.

Pedestrians, bicyclists, and cars moving through a busy intersection on a city street.
Source: FHWA

The U.S. House and Senate Committee on Appropriations addressed their concerns about increases in cyclist and pedestrian fatalities and encouraged the Federal Highway Administration (FHWA) to review its policies, procedures, and rules. The committee directed FHWA to distribute best practices for the Complete Streets design model to State and local highway partners. FHWA shares the same concerns as the committee about the increase in roadway fatalities and established a Complete Streets initiative to work with State, Tribal, and local transportation agencies throughout the Nation to implement a Complete Streets design model. This model will assist with making roadways safer for all users, including bicyclists, motorists, pedestrians, and transit riders.

Complete Streets is a strategy to plan, design, build, operate, and maintain street networks that prioritize safety, comfort, and connectivity to destinations for every individual that uses the street system. This model will help to reduce fatalities and injuries on our Nation's highways.

FHWA's National Highway Institute (NHI) has developed a training series on how to use the Complete Streets design model to develop, plan, build, operate and maintain the Nation's highways to keep all street users safe in their community.

Achieving Successful Complete Streets with NHI

The *Complete Streets* (FHWA-NHI-380131A-F) course is a training that provides the participant with the opportunity to learn how Complete Streets is incorporated into the planning and designing process in the Safe System Approach. The learner has the option to take any of these courses as a Web-conference Training (WCT), which is taken virtually, or as an Instructor-led Training (ILT), which is held in-person.

Planning for Complete Streets (FHWA-NHI-380131A and FHWA-NHI-380131E)

Learners are introduced to the planning process for Complete Streets elements in a Safe System including the features, policies, and strategies that guide project development and result in measurable improvements.

Designing for Complete Streets (FHWA-NHI-380131B and FHWA-NHI-380131F)

Participants will be introduced to the process of designing and implementing Complete Streets and explore fundamental design principles that support Complete Streets elements, including design strategies that emphasize measurement improvements, connectivity, and quality of service.

Planning and Designing for Complete Streets (FHWA-NHI-380131C and FHWA-NHI-380131D)

The course emphasizes the importance of safe street access, including the safe journey for individuals that use multiple modes of transportation, including walking, cycling, driving, and public transportation.

For this series of training, all participants must complete the self-paced Web-based Training and homework portion of the course before taking the ILT or WCT version of the course.

This training series is designed for transportation professionals, traffic engineers, roadway designers, public health officials, public work officials, and project managers who want to learn more about the planning and designing process of the Complete Streets model to keep all streets users safe in our communities.

How to Attend or Host a Course

NHI invites all transportation professionals interested in a course to visit https://www.nhi.fhwa.dot.gov/ to learn more about registering or hosting a course. The course catalog lists over 350 courses in 18 program areas.

NHI is an approved Accredited Provider by the International Accreditors for Continuing Education and Training (IACET). As an IACET Accredited Provider, NHI offers continuing education units for its programs that qualify under the American National Standards Institute/IACET Standard.

BROOKE STRUVE is a senior safety and geometric design engineer for FHWA.

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For more information about the Safe System Approach, see the Winter 2022 special issue of *Public Roads*. https://highways.dot.gov/public-roads/winter-2022

For more information about Complete Streets, see the Winter 2023 issue of *Public Roads*. https://highways.dot.gov/public-roads/winter-2023

HSIS Excellence in Highway Safety Data Award Opens Soon!

Students, get ready to submit your 2024 papers!

Since 2016, the Federal Highway Administration's (FHWA) Highway Safety Information System (HSIS) program in partnership with the Institute of Transportation Engineers (ITE) has hosted a student research paper competition, the HSIS Excellence in Highway Safety Data Award.

HSIS is a highway safety database that contains crash, roadway inventory, and traffic volume data for a select group of States and cities, and it provides data to researchers including students.

The competition is open to undergraduate and graduate students in degree-granting programs that support highway safety.

Paper Submission Period Approaching

The data request period is open! Papers will be accepted from January 1–March 1, 2024. Winners will be announced at the end of summer 2024.

For more information and submission guidelines, contact Dr. Carol Tan at *carol.tan@dot.gov* or visit *https://www.hsisinfo.org/award.cfm*.

HSIS
HIGHWAY SAFETY INFORMATION SYSTEM

WRITE FOR PUBLICROADS

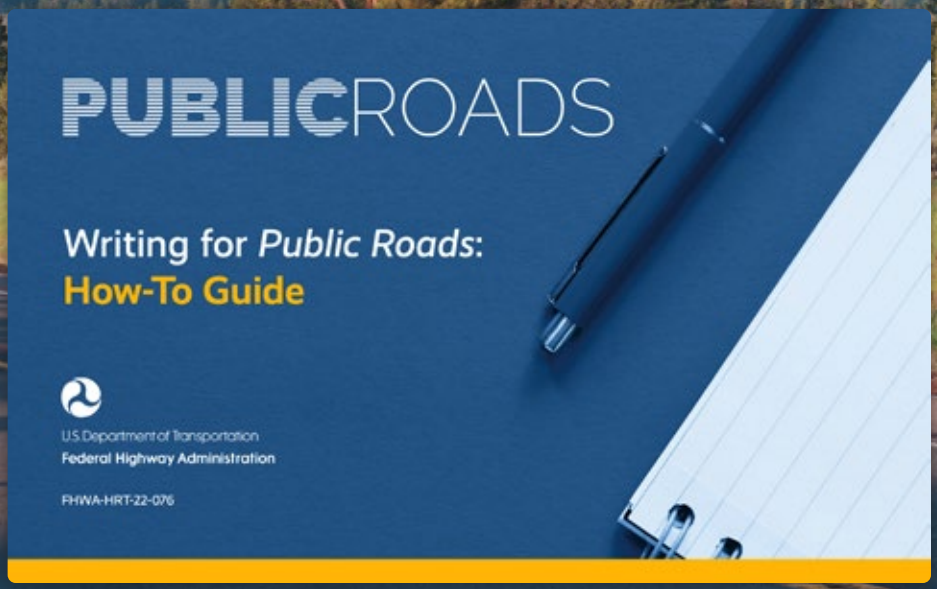
Public Roads offers FHWA and State department of transportation staff an avenue for communicating both technical and general-interest topics with peers (such as engineers, scientists, and economists) and other stakeholders across the highway industry.

Other Federal agencies, local and Tribal DOTs, field researchers and practitioners, and academia may also submit content for *Public Roads* but are encouraged to collaborate with FHWA and State DOTs.

Check out our **Writing for *Public Roads*: How-to Guide** to learn about the many ways you can contribute to *Public Roads*. From full-length feature articles to 200-word summaries, you can choose the option that best fits the information you want to share.

To access the guide and learn more about article types, submission deadlines, and requirements, visit ***https://highways.dot.gov/research/publications/public-roads/FHWA-HRT-22-076***.

Questions? Contact us at ***PublicRoads@dot.gov***.



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TaMara McCrae, Editor-in-Chief June 7, 2023

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