FHWA R&T Now

A news update of research, technology, and development from the U.S. Department of Transportation (USDOT), Federal Highway Administration (FHWA)

January/February 2018

POLICY & PARTNERSHIPS

FHWA Provides $6.5 Million to the U.S. Virgin Islands

The Federal Highway Administration (FHWA) recently announced the immediate availability of $6.5 million in "quick release" emergency relief funds for further repairs to roads and bridges throughout the U.S. Virgin Islands.

"The work continues to rebuild broken transportation links in the U.S. Virgin Islands in the aftermath of Hurricanes Irma and Maria," said Acting Federal Highway Administrator Brandye L. Hendrickson. "These additional funds will help ensure residents can travel safely."

The additional funding supplements $8 million in emergency relief funds previously made available to the U.S. Virgin Islands for Hurricanes Maria and Irma damage, bringing the total amount to $14.5 million for emergency work. The bulk of the additional $6.5 million in funds will be used to restore traffic signal service on the islands of St. Thomas and St. Croix and make repairs to damaged intersections critical to highway safety.

FHWA's Emergency Relief Program provides funding for highways and bridges damaged by natural disasters or catastrophic events. The "quick release" payments to U.S. Virgin Islands are considered as initial installments of funds used to restore essential traffic and limit further highway damage, which can help long-term repair work begin more quickly. Additional information about FHWA's Emergency Relief Program is available at https://www.fhwa.dot.gov/programadmin/erelief.cfm.

For more information, contact Nancy Singer, 202-366-0660, nancy.singer@dot.gov.

EXPLORATORY ADVANCED RESEARCH

EAR Program Funds Research for Guidance Assistance

Independent travel and active interactions with the surrounding environment present significant daily challenges for visually impaired individuals, which can lead to reduced quality of life and compromised safety. To begin to address these challenges, FHWA's Exploratory Advanced Research (EAR) Program funded research projects to examine new technology solutions to provide guidance assistance to visually impaired pedestrians navigating in large, unstructured environments.

Researchers demonstrated one of three different wayfinding technologies at the U.S. Department

U.S. Department of Transportation
Federal Highway Administration

of Transportation headquarters in Washington, DC. The Intelligent Situation Awareness and Navigation Aid (ISANA) provides a wearable technology that interprets the visual environment in real time and uses global position system-like voice guidance to assist the user. To see a video of the demonstration, visit https://www.youtube.com/watch?v=QdeF_o3RDs0&feature=youtu.be.

ISANA and two other wayfinding technologies funded through the EAR Program were conducted in coordination with the Volpe Center, the Federal Transit Administration, and the Intelligent Transportation Systems—Joint Program Office. Additional information about the Assistive Technologies for Visually Impaired Persons research projects is available at https://www.fhwa.dot.gov/advancedresearch/pubs/15040/index.cfm.

For more information, contact David Kuehn, 202-493-3414, david.kuehn@dot.gov.

INFRASTRUCTURE

FHWA Displays Sideway-Force Coefficient Routine Investigation Machine

At the 2018 Transportation Research Board (TRB) Annual Meeting in January, FHWA displayed the Sideway-Force Coefficient Routine Investigation Machine (SCRIM®), which will assist States in using the American Association of State Highway and Transportation Officials (AASHTO) Pavement Friction Management Guide. The machine's instrumentation is housed in an orange Volvo truck owned by FHWA.

The SCRIM can continuously measure friction, cross-slope, macro-texture, grade, temperature, and curvature while being driven up to 50 miles per hour. It is one of the ways FHWA is advancing its Pavement Friction Management (PFM) Support Program, which aims to reduce highway crashes and fatalities through:

- Assisting States in developing PFM programs by considering pavement friction, texture, and crash rates.
- Developing and demonstrating methods for establishing investigatory levels of friction and macro-texture for different demand categories in four States.
- Demonstrating proven continuous friction, and macro-texture measurement equipment.

About 4,000 miles of highways have been surveyed so far. Key findings in the first State include:

- The confirmation of a strong association between crashes and continuously measured frictional pavement properties (friction and macro-texture).
- A cross-sectional model was used to develop Safety Performance Functions. An Empirical Bayes analysis method (using continuous measurement of the pavement friction, macrotexture, and road geometry) proactively allowed the identification of sites with the highest potential payoff for pavement friction improvements.
- The network-level analysis from one State suggested potential crash reductions of about 25 percent on the sample network surveyed, if all recommend treatments were made.

FHWA is interested in helping agencies investigate the benefits of using continuous friction measurement equipment (CFME) such as the SCRIM, and the development and demonstration of proactive PFM programs. Such programs have the potential to significantly reduce the number and severity of crashes by decreasing pavement friction and texture related crashes.

For more information, contact Jim Sherwood, 202-493-3150, jim.sherwood@dot.gov.

FHWA Advances Fluorescence-Based Technology

FHWA recently published the technical brief, "Fly Ash AEA Adsorption Capacity Estimation as Measured by Fluorescence or Foam Index" (FHWA-HRT-17-118), which discusses a study aimed at examining the feasibility of using a fluorescence-based technology in place of the

traditionally used foam index for measuring adsorption capacity of fly ash.

Fly ash with high carbon content or powder activated carbon (PAC) when used as substitution for a portion of cement in concrete (typically 20 to 30 percent) has the tendency for adsorbing the air-entraining agents (AEAs), therefore hindering air bubbles' stabilization and potentially reducing the air content necessary to combat the detrimental effects of freezing and thawing. It is essential to adjust the dosage of AEAs to compensate for the portion that is adsorbed by fly ash. Foam index is the most prevalent method used by practitioners for this purpose.

In the foam index test, AEAs are applied drop by drop to a shaken slurry of cement and fly ash, the number of drops of AEAs that is required to form a complete layer of foam on the top of the sample is called a foam index number. Depending on the operator and the device used, this method is somewhat subjective and has a high degree of variability. AEAs fluoresce when excited by ultra-violet light. The fluorescence intensity is proportional to concentration of the AEAs remaining in solution. Consequently, a fluorescence-based technology once fully evolved could take the guesswork out of using AEAs.

FHWA's concrete laboratory in collaboration with Headwaters, Inc. has completed a study on the use of a fluorescence-based technology called Sorbsensor for measuring fly ash adsorption capacity. The preliminary investigation revealed a good correlation with foam index. Under the Small Business Innovation Research (SBIR) Program, an effort is underway to advance and commercialize the next generation of fluorescence-based technology.

This technical brief is available at https://www.fhwa.dot.gov/publications/research/infrastructure/pavements/17118/17118.pdf.

For more information, contact Ahmad A. Ardani, 202-493-3422, ahmad.ardani@dot.gov.

Concrete Beam Reduction Improves Safety and Handling

In December, FHWA published "Reducing the Specimen Size of Concrete Flexural Strength Test for Safety and Ease of Handling" (FHWA-HRT-17-119), a technical brief that covers a two-phased research study. In the first phase, researchers in FHWA's concrete laboratory examined the feasibility of miniaturizing modulus of rupture (MR) specimen size with the main goal of making the test safer and easier to conduct, simply through reduction in geometry and mass. The second phase of the study was a major collaboration with the American Society for Testing and Materials (ASTM) Interlaboratory Study Program (ILS) and 22 participating laboratories from State departments of transportation, Federal agencies, and commercial labs related to establishing the test precision for flexural strength.

Standard size concrete specimens cast in 6 by 6 by 21 inch molds weigh approximately 65 pounds (lbs.). When metal molds are used, the combined total mass of the beams could easily exceed 100 lbs. A specimen of this size and weight is hard to handle, cumbersome, and becomes a safety hazard, which potentially could inflict injuries to the testing personnel. To make the flexural strength testing of concrete safer and to streamline quality assurance testing, this study proposed the use of smaller, 4 by 4 by 14 inch beams. A 4 by 4 by 14 inch concrete beam weighs approximately 19 lbs. The combined mass of the concrete specimen and the mold is approximately 45 lbs. (i.e., less than 5o percent of the total mass of the standard size beam). This is a dramatic reduction in total mass and makes the smaller size specimens much lighter, easier, and safer to use.

ASTM and the American Association of State Highway and Transportation Officials (AASHTO) balloted and approved the results from both

phases of the study. The results proved that smaller size modulus of rupture beams are viable and can produce the same results as the much larger and heavier standard beams. Unmolded smaller size beams weigh only 19 lbs., compared to unmolded standard beams, which weigh 65 lbs.

This technical brief is available at https://www.fhwa.dot.gov/publications/research/infrastructure/pavements/17119/17119.pdf.

For more information, contact Ahmad A. Ardani, 202-493-3422, ahmad.ardani@dot.gov.

Student Award Winners Recognized at LTPP Program Session

For the past several years, the American Society of Civil Engineers (ASCE) and FHWA's Long-Term Pavement Performance (LTPP) program have partnered in the ASCE-LTPP International Data Analysis Contest. The contest is designed to encourage university students, professors, and highway agency engineers from around the world to use the LTPP database, and thereby contribute to a better understanding of pavement performance.

Joseph Lucey was recognized as the first place winner in the undergraduate category.

At the LTPP Program Session in January, several students received awards for exceptional papers submitted for the 2016-2017 contest year. These students were invited to attend TRB's annual meeting and present their work at the Workshop on Pavement Performance Data Analysis.

The first place undergraduate winners were Joseph Lucey and Rico Bubello of California State University Los Angeles for their study, *"Predicting Roughness as a Pavement Performance Indicator from Historical Data Using LTPP Database."* Leila Sadeghi of Purdue University placed first in the Graduate Category for her analysis *of "Using LTPP Monitoring Data to Predict Pothole Formation."*

Leila Sadeghi was recognized as the first place winner in the graduate category.

The Aramis López Challenge Category winner was Madeh Piryonesi of the University of Toronto for his paper entitled, *"Using Data Analytics for Cost-Effective Prediction of Road Conditions: The Case of Pavement Condition Index."* The students did an excellent job presenting their findings and the results of their work well received by practicing engineers and researchers.

The theme for the 2017–2018 contest is*: Use the LTPP Data to Evaluate a Question or Concern for Your Region or State.* This contest also includes a challenge topic: *Use the LTPP Data to Evaluate the Impact of Mix and Materials Properties on Individual Distress Types for Asphalt or Concrete Pavements.* Submissions are due by July 1, 2018. Winners will be recognized in January 2019 at the 98th Transportation Research Board Annual Meeting in Washington, DC.

To view the guidelines, visit https://www.fhwa.dot.gov/research/tfhrc/programs/infrastructure/pavements/ltpp/2017_2018_asce_ltpp_contest_guidelines.cfm.

For more information, contact Deborah Walker at 202–493–3068 or deborah.walker@dot.gov.

Researchers Instruct GMU Students at Turner-Fairbank

For the fourteenth consecutive year, FHWA's Office of Infrastructure Research and Development will be teaching a class titled "Civil Engineering Methods" to civil engineering students from George Mason University (GMU). During the 15-week semester, GMU students will receive lectures from researchers at Turner-Fairbank Highway Research Center in the areas Structures, Hydraulics, Geotechnical Engineering, and Asphalt and Concrete Pavement Engineering.

Each weekly 3-hour class will contain a laboratory experiment. The course goal is to advance students' professional development in areas such as laboratory testing, data collection, and technical report writing. The senior-level elective is one of several collaborative activities detailed in a Memorandum of Understanding signed in 2004 between GMU and FHWA.

For more information, contact Zach Haber, 202-493-3469, zachary.haber@dot.gov.

OPERATIONS

Fact Sheet Discusses Signing and Marking Strategies at Intersections

Increasing traffic demand is causing more severe congestion and bottlenecks in urban environments. Constrained budgets are spurring innovations that efficiently use existing intersection footprints. From a previously sponsored research effort by FHWA's Office of Operations Research and Development, dynamic reversible left turn lanes (DRLT) and contraflow left turn pockets (CLTP) treatments were identified as two cost-effective and innovative treatments to mitigate congestion attributed to heavy left-turn volumes at diamond interchanges and signalized intersections.

FHWA recently published the fact sheet, "Simulator Assessment of Contraflow Lanes at Signalized Intersections" (FHWA-HRT-18-016). This publication discusses a project aimed at conducting a series of human factors experiments to evaluate the most effective signing and marking strategies for real-world implementations of DRLT for diamond interchanges and contraflow left turn pockets CLTP for signalized intersections.

This fact sheet is available to download at www.fhwa.dot.gov/publications/research/operations/18016/index.cfm.

For more information, contact, Michelle Arnold, 202-493-3990, michelle.arnold@dot.gov.

SAFETY

FHWA Works with NHTSA SCI Team

As part of FHWA's Pilot In-Service Performance Evaluation (ISPE) of Guardrail End Terminals, FHWA has been working the National Highway Traffic Safety Administration (NHTSA) Special Crash Investigation (SCI) team, conducting crash investigations in several States.

The objective of this study is to evaluate the in-service crash performance of some of the most common W-beam guardrail end terminals currently installed throughout the United States.

For each device, the evaluation will address:

- Crash performance in terms of vehicle occupant risk.
- The sensitivity to varying effects, such as environmental conditions, site characteristics, and impact conditions.
- The degree of sensitivity to improper installation, maintenance, and repair.

Active partners in this effort include staff from NHTSA, FHWA divisions, and departments of transportation (DOTs) in four States where FHWA plans to collect data.

Ana Maria Eigen recently represented FHWA's Office of Safety R&D at an American Traffic Safety Services Association (ATSSA) gathering, where she met with the ATSSA Guardrail Committee to provide a high-level overview of FHWA's Pilot ISPE of Guardrail End Terminals. She also provided an update on this with Hugh McGee (co-founder of BMI-SG, Inc.), who presented the National Cooperative Highway Research Program ISPE findings.

For more information, contact Ana Maria Eigen, 202-493-3168, ana.eigen@dot.gov.

Students Receive 2017 HSIS Excellence in Highway Safety Data Award

In January, during the TRB Annual Meeting, students were presented with the 2017 Excellence in Highway Safety Data Award for using Highway Safety Information System (HSIS) data to investigate a topic that advances highway safety.

HSIS
HIGHWAY SAFETY INFORMATION SYSTEM

Jason Anderson and co-author Shangjia Dong from Oregon State University received first place for the paper, "Heavy Vehicle Driver Injury Severity Analysis by Time of Week: A Mixed Logit Approach Using HSIS Crash Data." Majbah Uddin and Fahim Ahmed from the University of South Carolina received second place for "Analysis of Pedestrian Injury Severity in Motor Vehicle Crashes in Ohio." Jin Wang from Auburn University received third place for "Evaluating the Effects of Intersection Balance on Wrong-way Movements at Partial Cloverleaf Interchanges Terminals to Improve Highway Safety."

Part of the Highway Data Analysis Excellence Awards Program, the HSIS Excellence in Highway Safety Data Award was created to introduce future highway safety professionals to HSIS safety data, to the application of appropriate research methods to derive recommendations, and to the practice of using data to make decisions. The competition is jointly administered by the FHWA and the Institute of Transportation Engineers (ITE), an association focused on improving mobility and safety in transportation and helping to build smart and livable communities.

Students were recognized for using HSIS data to investigate a topic that advances highway safety.

In July, the authors of the winning paper were recognized at the Joint ITE/Canadian ITE 2017 Annual Meeting and Exhibit in Toronto, Canada. Their paper was published in the September 2017 issue of ITE Journal, which is available at www.ite.org/itejournal.

"This year's winning paper focuses on heavy vehicle driver injuries and demonstrates an innovative use of HSIS data," said Michael Trentacoste, former FHWA Associate Administrator for Research, Development and Technology. "It exemplifies the goal of the awards program—to inspire university students to use HSIS data to investigate a topic that advances highway safety—and we hope these young researchers will continue exploring important transportation safety challenges."

Details about the 2018 HSIS Excellence in Highway Safety Data Award are now available at www.hsisinfo.org/contest.cfm.

For more information, contact Carol Tan, 202-493-3315, carol.tan@dot.gov.

Report Offers Guidance for Self-Enforcing Roadways

Each year, more than 13,000 people are killed in speeding-related crashes. Most speeding-related crashes occur on roads that are not part of the interstate system. Local streets and collector roads have the highest speeding-related fatality rate on the basis of miles driven per vehicle.

In January. FHWA published "Self-Enforcing Roadways: A Guidance Report" (FHWA-HRT-17-098), which is focused on providing guidance on how to produce self-enforcing roadways. A self-enforcing road (sometimes referred to as a "self-explaining roadway") is a roadway that is planned and designed to encourage drivers to select operating speeds in harmony with the posted speed limit. Properly designed self-enforcing roadways can be effective in producing speed compliance and may contribute to less severe crash outcomes. Six self-enforcing road concepts and the processes needed to implement the concepts when designing or evaluating existing two-lane rural highways are identified and described in this report.

Th document should be useful to transportation professionals, State departments of transportation, and researchers interested in designing and/or retrofitting roadways to induce drivers to drive at more appropriate speeds.

It is available at www.fhwa.dot.gov/publications/research/safety/17098/index.cfm.

For more information, contact Abdul Zineddin, 202-493-3288, abdul.zineddin@dot.gov.

RECENT PERIODICALS

***Public Roads*—Winter 2018**

This issue includes: Building Connections That Last; Refueling America; Ready for Takeoff; Smart Contracting; and Managing New Peaks at National Parks.

It is available online via www.fhwa.dot.gov/publications/publicroads/18winter/index.cfm.

For more information, contact Lisa Shuler, lisa.a.shuler@dot.gov.

***Innovator:* Accelerating Innovation for the American Driving Experience—January/February 2018**

This issue includes: Geosynthetic Reinforced Soil-Integrated Bridge System Technology Goes Mainstream; From Research to Deployment; Weather-Savvy Roads; Six Steps to a Traffic Incident Management Performance Measurement Program; FHWA Seeks Innovations for Every Day Counts Round Five; and States Innovate!

The issue is available online via https://www.fhwa.dot.gov/innovation/innovator/issue64/3dIssue/.

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LINKS

Turner-Fairbank Highway Research Center: www.fhwa.dot.gov/research/

Resource Center: www.fhwa.dot.gov/resourcecenter/

National Highway Institute: www.nhi.fhwa.dot.gov/home.aspx

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