IN MOTION

A semi-annual update on research and innovation at VTRC.

Virginia Transportation Research Council
September 2025

VTRC
Virginia Transportation
Research Council

A Note from Our Director

Each time a colleague retires or moves on, it offers a natural moment to reflect, not just on their individual journey, but on how much our organization and work have evolved during their time here. In recent months, we've said goodbye to a few longtime VDOT employees. Looking back over their careers, I realize that sometimes day-to-day accomplishments may be less apparent, but when you step back and see the full picture, the impact is impressive.

That same sense of progress is reflected in this issue of *In Motion*. Reviewing the work captured during this period—the breadth of recent publications and research projects— is striking. Topics range from practical applications such as chip seal performance and pavement rutting tests, to the more forward-looking, including big data applications in travel demand modeling and the use of mixed reality in bridge inspections. The diversity and complexity of this work reflect the varied needs of the VDOT customers we serve.

Our staff at VTRC are incredibly talented, and our customers throughout VDOT continue to play a critical role in shaping what we do. The research featured in this issue– both the recently completed studies and those just getting underway– exists because of their insight and collaboration. They help identify the right questions to ask, keep the work grounded in real-world needs and ultimately implement the findings. Their partnership is essential to the value and impact of our work.

I hope our readers enjoy the information provided in this newsletter.

Michael Fitch, Director, VTRC

New Happenings

VTRC Research Scientists Receive Prestigious Award for Research Paper on Assessing Test Methods to Evaluate Asphalt Rutting Potential

Virginia Transportation Research Council (VTRC) Pavements Research Scientists Ilker Boz and Stacey Diefenderfer were a part of an award-winning team that received the Walter J. Emmons Award from the Association of Asphalt Paving Technologists (AAPT) for the paper, "*Evaluating the Rutting Potential of Asphalt Mixtures with Simple and Practical Tests*" at the 2025 Annual AAPT meeting in March. VTRC was the leading research institution for the paper. Co-authors and partners on the project also receiving the award include Jhony Habbouche of the Asphalt Institute, Griffin Coffey of Dunbar Structural, Aksel Seitllari of the Virginia Military Institute and Osman Ozbulut of the University of Virginia.

L-R: Jhony Habbouche, Western U.S. Regional Engineer at the Asphalt Institute; Stacey Diefenderfer, Pavements Associate Principal Research Scientist, VTRC; and Bill Pine, President of AAPT and Quality Control Director of Asphalt Technology at Heritage Research Group. Habbouche and Diefenderfer receive the Walter J. Emmons Award at the AAPT annual meeting in March.

The Virginia Department of Transportation (VDOT) is currently implementing the balanced-mix design (BMD) concept as a way to improve asphalt mixture performance. The purpose of the research was to evaluate the feasibility of using simple and practical tests to assess the rutting potential of asphalt mixtures in Virginia. The asphalt pavement analyzer (APA) was used as a primary testing tool to evaluate rutting potential within VDOT's BMD specification, but there were several challenges with this test, including cost, time and availability of the equipment in VDOT and contractor laboratories. The award-winning paper describes the research project evaluating whether simple and practical tests— specifically the indirect tensile at high temperature (IDT-HT) test, the rapid rutting (RR) test and the Marshall stability and flow (MS) test— could be used as more effective alternatives for asphalt rutting testing. The results revealed that the IDT-HT test is the most viable alternative solution to test the rutting potential of asphalt mixtures.

"We're honored to have received this award from AAPT," said Ilker Boz, VTRC Pavements Senior Research Scientist and principal investigator of the study.

This story is continued. Read the full story on DOTi.

Research Updates

VTRC PUBLICATIONS

Supporting Transportation System Management and Operations Using Internet of Things Technology: Phase II Field Tests

Cetin, M., Ph.D.; Yang, H., Ph.D.; Shen, Y., Ph.D.; Yan, Z. and Wang, J.

This research examines the application of Low Power Wide Area Network (LPWAN) technologies in supporting transportation system operations and management and focused on the field test of the Long-Range Wide Area Network (LoRaWAN) and Narrowband Internet of Things (NB-IoT) communication solutions. Pedestrian counting solutions utilizing LoRaWAN and NB-IoT were tested in two locations to assess their feasibility, performance, cost and possible technical issues.

Operational and Safety Effects of the I-95 Variable Speed Limit System in Fredericksburg, Virginia

Cho, H.W., Ph.D., P.E.; Robartes, E., Ph.D. and Fontaine, M., Ph.D., P.E.

In June 2022, VDOT activated a Variable Speed Limit (VSL) system on I–95 northbound in the Fredericksburg, VA area where high traffic volumes and densities exist. This deployment intended to address traffic congestion and safety by encouraging more uniform speed selection and providing advance warning of congestion. Results showed that drivers responded to the VSLs and mean speeds and speed distributions changed during transitional flow states. A reduction in crash severity was also seen in early safety results and travel time and reliability showed mixed trends.

Supplemental Data Collection and Processing for Bridge Safety Inspection Utilizing Mixed Reality and Artificial Intelligence

Sarlo, R., Ph.D.; Gabbard J. Jr., Ph.D.; Smith, A. and Luksas, J.

This research evaluated both the technical and design elements necessary to perform augmented reality (AR) assisted bridge inspections. The inspection prototype developed by this project aimed to demonstrate the potential benefits and limitations of incorporating physical head-worn displays into the inspection workflow.

A Systematic Evaluation of Wrong Way Driving Crashes and Countermeasures on Virginia Roads

Cho, H.W., Ph.D., P.E.; Robartes, E., Ph.D. and Cottrell, B., P.E.

The purpose of this project was to evaluate wrong way driving (WWD) incident and crash risks and identify countermeasures for Virginia's roadways. This project assessed the magnitude of WWD crashes and WWD-related 911 calls in Virginia, investigating roadway features such as interchange type that could affect offramp entries to interstate highways and selected multi-lane divided highways. A list of WWD countermeasures and resources was developed and the project provided guidance and a plan to prioritize deployment of these countermeasures.

Evaluation of Recycled Plastic Modified Asphalt Mixtures and Pavements: Phase I - A Case Study in Virginia

Lloyd, L., P.E.; Habbouche, J., Ph.D., P.E. and Martinez, D., P.E.

The purpose of this study was to assess recycled plastic-modified (RPM) asphalt mixtures field trials constructed in Virginia. This study evaluated the constructability and laboratory performance of two plant-produced RPM mixtures compared with VDOT's typical D and E surface mixtures as reference mixtures. Moreover, this study attempted to detect and quantify the presence of microplastics in material generated from pavement wear that could potentially be mobilized via stormwater runoff. This objective includes the identification and development of appropriate laboratory analysis methods for microplastics. This effort is among the first and few to document findings and lessons learned regarding the incorporation of recycled plastic into asphalt mixtures through field trials.

Electric Vehicles and Socioeconomic Inequity in Access to the Charging Network on Virginia Roads

Yoo, D.K., Ph.D.

This study investigated the current state of Electric Vehicle (EV) charging infrastructure in Virginia, projects battery electric vehicle (BEV) adoption and future EV charging needs and proposed optimized solutions to tackle the shortage of direct current fast charging (DCFC) stations and address socioeconomic disparities.

Suitability of Using Crushed Concrete Adjacent to Geotextiles in Under-drain Systems Second Phase: Field Trial Before Implementation

Tanyu, B.F., Ph.D.; Abbaspour, A., Ph.D. and Sarak, S.

This study investigated the clogging potential of the geotextile used in highway edgedrains if crushed hydraulic cement concrete (CHCC) is placed adjacent to the drainage fabric geotextile. This project is the second phase of the laboratory study and involved constructing a full-scale field test site within VDOT's Harrisonburg facility.

Fiber-Reinforced Concrete Overlays for Bridge Structures

Ozyildirim, C.H., Ph.D., P.E. and Sharifi, M.

Common distresses in bridge decks are the loss of surface texture due to traffic and poor construction practices that result in cracks and spalls because of the reinforcement corroding. The common repair procedure for such distresses is removing the top surface of the deteriorated concrete and placing a low-permeability concrete overlay. Sometimes, these overlays exhibit cracks, diminishing the intended purpose of resisting the penetration of water and chloride solutions. This research emphasized the potential of using fiber reinforced concrete (FRC) as a versatile construction material, enabling tailored strength and durability properties to specific situations.

Interlaboratory Study for the Indirect Tensile at High Temperature Test and Ideal Rutting Test

Boz, I., Ph.D., P.E.; Diefenderfer, S., Ph.D., P.E.; Habbouche, J., Ph.D., P.E. and Seitllari, A., Ph.D., P.E.

The Indirect Tensile at High Temperature (IDT-HT) test and Ideal Rutting (IR) test were recommended for screening rut-susceptible asphalt mixtures in the Balanced Mix Design (BMD) process. VDOT is in the initial stages of implementing the IDT-HT test as part of the BMD initiative for dense-graded surface asphalt mixtures with unmodified asphalt binders. However, additional considerations such as fine-tuning the test procedure and determining precision estimates of the test method are necessary, and this study specifically addressed these aspects for the

IDT-HT and IR tests.

Increasing Regional Truck Freight Planning in Virginia

Miller, J., Ph.D., P.E.; Parambil, N.V. and Alsumait, K.

In response to increased truck travel, VDOT sought ways to elevate the importance of truck freight within the regional planning process. This study identified multiple practices that regional planners can initiate and piloted one such practice—incorporating truck parking needs into zoning. A key lesson is that these practices can potentially provide a cost savings (one estimate is $25,000 per year) and can enhance regional and statewide collaboration.

Evaluation of BMD Surface Mixtures with Conventional and High RAP Contents Under Laboratory-Scale and Full-Scale Accelerated Testing

Diefenderfer, B., Ph.D., P.E.; Diefenderfer, S., Ph.D., P.E.; Habbouche, J., Ph.D., P.E.; Tong, B., Ph.D.; Flintsch, G., Ph.D., P.E. and Perez, E.U.

This study evaluated the application of the BMD concept to design durable and longer lasting surface mixtures with A and D designations in Virginia, with a focus on relatively higher Reclaimed Asphalt Pavement (RAP) contents, or HRAP mixtures, (that is, greater than 30% RAP). The scope of work consisted of laboratory and accelerated pavement testing of six surface mixtures incorporating a range of RAP contents (conventional and high), two binder grades, one recycling agent, and one warm mix additive.

Laboratory Investigation of Concretes for Partial-Depth Link Slabs

Sharifi, M.; Ozyildirim, C.H., Ph.D., P.E. and Kassner, B.L., Ph.D., P.E.

VDOT has been using full-depth link slabs to eliminate existing deck joints on leaking bridge deck joints. However, this can be inefficient and disruptive to traffic. In this study, concrete mixtures, including fibers that exhibit ductility for crack control and high tensile strength for short splice lengths, were investigated to use in partial-depth link slabs as an alternate to full-depth link slabs. To ensure timely opening to traffic, concretes with high early strength were included. The project led to the development of two categories of fiber-reinforced concretes—one with conventional compressive strengths and the other with compressive and tensile strengths exceeding 10,000 psi and 1,400 psi, respectively.

Experimental and Analytical Evaluation of Residual Capacity of Corrosion-Damaged Prestressed Concrete Bridge Girders

Alfailakawi, A.; Roberts-Wollmann, C.L., Ph.D., P.E.; Hebdon, M., Ph.D., P.E. and Koutromanos, I., Ph.D.

The residual capacity of corrosion damaged pre-stressed I-beams and box beams needs to be accurately estimated to determine if damaged bridges need to be posted, and to help with making informed decisions related to repair, rehabilitation and replacement of damaged bridges. This report presents the results of testing of six corrosion-damaged pre-stressed beams removed from existing bridges during their demolition. The beams were tested in the lab to determine their flexural strength. The tested strengths of the beams were compared to calculated strengths using two methods for damage estimation and two different calculation approaches.

Field Evaluation of Reinforced Concrete Repairs Using Hydrodemolition, Galvanic Cathodic Protection, or Impressed Current Cathodic Protection

Ozyildirim, C.H., Ph.D., P.E.; Sharp, S.R., Ph.D., P.E. and Sprinkel, M.M., P.E.

The purpose of this project was to evaluate the feasibility of incorporating two large scale repair methods-- hydrodemolition or impressed current cathodic protection-- in substructure repairs of pier caps and columns. Where concrete was removed, low-permeability Self Consolidating Concrete (SCC) was placed. Repairs were performed on five bridges which included two bridges with conventional shotcrete repairs.

Behavior of the Expanded Polystyrene Elastic Inclusion at Integral Abutments

Hoppe, E., Ph.D., P.E.; Tanyu, B.F., Ph.D.; Guler, F.E., Ph.D. and Karakus, Y.

This report presents the findings of a laboratory study conducted by the Sustainable Geotransportation/Geoenvironmental Infrastructure (SGI) Research Group at George Mason University. The laboratory tests were divided into three tasks and investigated the ability of standard (S) and elasticized (E) expanded polystyrene (EPS) to provide elastic inclusion in integral abutments.

Evaluation Tool for Proposed Multi-Use Trails

Moruza, A.K. and Chen, T.D., Ph.D., P.E.

This report describes a Microsoft Excel-based screening tool for comparing multi-use trails (MUTs) that could compete for funding from VDOT or other state sources. The tool scores are based on nine factors such as the ability to serve commuters, access to points of interest, provision of exercise opportunities, and potential crash impacts and users can alter the weights as needed. The tool has been designed around an internal sample of trails provided to the researchers by VDOT. The report recommends that VDOT use the tool as a preliminary model for ranking the relative demand for specific trails, recognizing that the tool is only one of several inputs into the planning process.

Evaluation of a Truck In-Cab Alert System

Goodall, N.J., Ph.D., P.E. and Lan, C-L., Ph.D.

Transportation agencies communicate directly with truck drivers regarding weigh station compliance and parking availability, sometimes using applications provided by private third-party partners. One of these applications has expanded capabilities that allow agencies to transmit safety alerts directly to drivers through the in-cab electronic logging device systems. In 2022, VDOT partnered with one of these providers to issue emergency weather-related restrictions and congestion alerts directly to drivers via push notifications on the in-cab electronic logging devices (ELDs) or smartphone devices running the in-cab alert app. This project studied the characteristics of the in-cab alerts, including coverage and scope, estimated market penetration and observable effects on driver behavior from GPS traces.

EXTERNAL PUBLICATIONS

Evaluation of the Operational and Safety Effects of a Variable Speed Limit System in Virginia, Transportation Research Record
Cho, H.W., Ph.D., P.E.; Robartes, E., Ph.D. and Fontaine, M., Ph.D., P.E.

A Pilot Application of the Sliding Window Screening Method on Virginia Roadways, Advances in Transportation Studies
Cho, H.W., Ph.D., P.E. and Lan, C-L., Ph.D.

Comparability of Driving Automation Crash Databases, Journal of Safety Research
Goodall, N.J., Ph.D., P.E.

Innovative Approaches to Enhancing Safety and Efficiency in Work Zones, NCHRP Report 1142
(VTTI, VTRC [Fontaine, M.D., Ph.D., P.E. and Lan, C-L., Ph.D.] and Paul Pisano LLC. VTRC served as a subcontractor to VTTI.)

Machine Learning-Based Prediction and Optimization of Balanced Mixture Design Performance Indices, in Journal of Transportation Research Record
Tong, B., Ph.D.; Huang, W., Ph.D.; Habbouche, J., Ph.D., P.E.; Boz, I., Ph.D., P.E.; Guo, Q., Ph.D.; Diefenderfer, S., Ph.D., P.E. and Flintsch, G.W., Ph.D., P.E.

Large-Area Emergency Lockdowns with Automated Driving Systems, International Journal of Disaster Risk Management
Goodall, N.J., Ph.D., P.E.

Development of Precision Statements for the Asphalt Mixture Performance Tester Dynamic Modulus Test: A Framework for Small-Scale Specimens, Transportation Research Record
Kuchiishi, K., Ph.D., Castorena, C., Ph.D., Kim, Y. R., Ph.D., P.E., and Underwood, B. S., Ph.D.

INITIATED VTRC RESEARCH

Developing a Transportation Demand Management Tool for DRPT to Understand the Factors Affecting Transit Ridership
Ohlms, P.B., AICP and Hasnine, S.M.

Experimental Approaches for Integrating External Factors into P4P Traffic Volume Forecasting
Xu, Y., Ph.D.

Implementation of Multimodal Innovations: Crosswalk Lighting, RRFBs, LED-embedded Advance Warning Signs, and Passive Automated Detection
Dougald, L.E. and Ohlms, P.B., AICP

Resiliency Assessment of Flood Damage in Pavements
Bowers, B., Ph.D., P.E.; Biessan, D., Ph.D. and Hossain, M.S., Ph.D., P.E.

Verifying the Indirect Tensile at High Temperature (IDT-HT) Test Performance Criterion: A Multi-scale Investigation Integrating Laboratory, Full-Scale Accelerated Pavement Testing, and Field Evaluations
Kuchiishi, K., Ph.D.

Use of Carbonate Aggregates in Pavement Preservation Treatments
Boz, I., Ph.D., P.E.

Evaluation of Cement Treated Aggregate (CTA) and Full-Depth Reclamation (FDR) In-Service Performance and Pavement Design Inputs
Diefenderfer, B.K., Ph.D., P.E. and Hossain, M.S., Ph.D., P.E.

Utilizing Big Data to Verify and Enhance Route Choice Models in Travel Demand Modeling
Zhu, S., Ph.D. and Xiong, C., Ph.D.

Field Performance Assessment of Chip Seals with Updated Chip Seal Specification and Fog Seal Treatment
Boz, I., Ph.D., P.E.

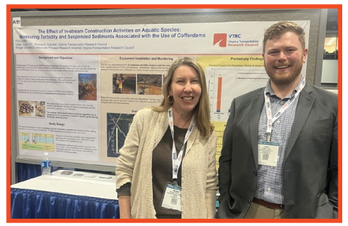
Improving Holiday Congestion Forecasting Using Advanced Methods
Belsol, G.D., Smith, B.L., and Appiah, J.

Developing a Framework for Large Animal-Vehicle Crash Risk: A Safe System Approach to Cost-Effective Safety Improvements
Hamilton, I., AICP and Donaldson, B.

Synthesis of VDOT Historic Bridge Survey, Review, and Management Information
Miller, A.

Other News

VTRC Attends 104th TRB Annual Meeting
VTRC participated in the 104th Annual Transportation Research Board (TRB) meeting in Washington, D.C. in January, where each VTRC team was represented and exchanged knowledge with industry partners, and showcased collaborative research efforts through seminars, meetings and presentations.



Bridget Donaldson and Lewis Lloyd represent their poster display at the 104th Annual TRB meeting.

VTRC Continues to Lead Lunch and Learns on Latest in Transportation
In partnership with the UVA Transportation Training Academy (VA Local Technical Assistance Program), VTRC staff led a variety of Lunch and Learn webinars during the first and second quarter on topics such as innovative concrete pavement applications in Virginia, plus many more. VDOT employees can register to attend these events on VDOTU. Contact us to learn more!

VTRC Administers Educational Activities at Summer Transportation Institute at VSU
The VTRC team visited the Summer Transportation Institute at Virginia State University in June where they participated in a morning of hands-on educational activities for high school students, including activities such as "Quick Fixes for High-Crash Highways," "How Much Does it Cost?" "This is the Roundabout," "Maglev Racing: Float Like a Butterfly, Sting Like a Bee," and a picture-heavy presentation on wildlife crossings.

OSI Highlights Starlink Pilot Project and GIS Efforts in April and June VDOT Voices Webinar's
In April, OSI Project Manager Brandon Young led a VDOT Voices webinar presentation on the Low-Earth Orbit Satellite Communication pilot project. In June, Program Analyst Christian Kagarise presented on innovative technologies being used for advanced GIS 3D data modeling and visualization dashboards, including potential future use-cases. Watch the webinars here.

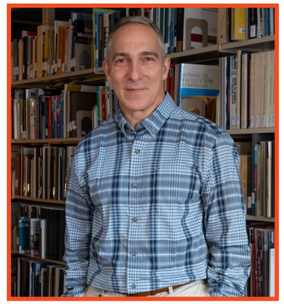
April VDOT Voices webinar opening.

OSI Speaks on Artificial Intelligence at ASCE Chapter Meetings
In May, OSI Director Hari Sripathi was a guest presenter at the Richmond and Norfolk American Society of Civil Engineers (ASCE) chapter meetings and spoke on Artificial Intelligence at VDOT, including current efforts and potential future use-cases.

OSI Continues Driving Innovation at VDOT
OSI continues to engage in the DRIVERS initiative to build and foster a culture of continuous improvement at VDOT. Stay up-to-date on DRIVERS efforts and activities through DRIVERS newsletters and other news. Visit the DRIVERS DOTi homepage to learn more!

VTRC Team

VTRC Team Updates



Ken Winter

In May, Ken Winter, VTRC's Associate Director of the VDOT Research Library retired after 23-years at VTRC. Ken was an integral part of the library operations and success. Among his many contributions, Ken modernized the VDOT library by implementing the first online catalog for VTRC and VDOT—a huge step to help us bring innovation to transportation. The VDOT Research Library is a deep repository of knowledge at the fingertips of all employees. Congratulations to Ken, and we wish him the best in his retirement!

Audrey Moruza

In June, Audrey Moruza, Senior Research Scientist, retired after 20-years at VTRC. Audrey was a true collaborator, bringing economics expertise to 15 different VTRC reports and seven legislative responses or reports on topics ranging from pavements, structures, wildlife composting, and rest area operations. Audrey worked tirelessly with others in these fields to ensure that when VDOT questions arose regarding cost impacts, those questions were answered with the best data and methodology available—and if there were gaps, Audrey sought to fill them. We will all miss her as she pursues new adventures!

VTRC Leadership Team

Michael Fitch
Director, VTRC

Hari Sripathi
Director, Office of Strategic Innovation

Michael Fontaine
Associate Director, Safety, Operations and Traffic Engineering

John Miller
Associate Director, Environment, Planning and Economics

Steve Sharp
Associate Director, Structures

Hari Nair
Associate Director, Pavements

Kevin Wright
Implementation Coordinator

Donna Cognata
Business Manager