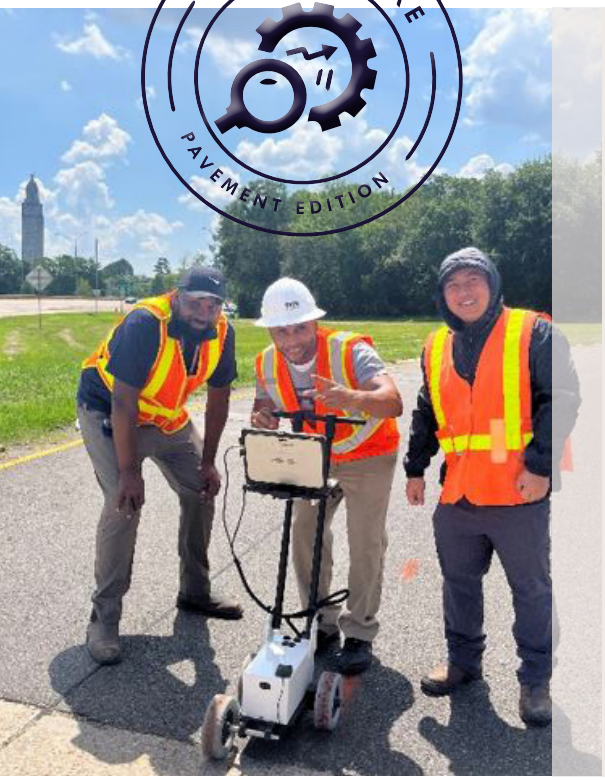
TECHNOLOGY TODAY

VOL 38 ISSUE 2 — *A publication of the Louisiana Transportation Research Center*



RESEARCH

Rolling Research: Getting to Know the Pavement Lab

Most LTRC labs operate within the center's walls, but the pavement lab takes its work on the road. With a lab-on-wheels, engineering technicians spend hours in the field gathering crucial data to support diverse research areas. Next, we explore the daily operations, essential equipment, and key contributions of LTRC's pavement lab. From planning and data collection to analysis, we reveal what it takes to keep our roads safe. With insights from experts Terrell Gorham (Engineering Technician DCL), Biyuan "Brandon" Zheng (Engineering Technician 5), and Ray Kimble (Engineering Technician 5), we highlight the passion, expertise, and cutting-edge technologies that

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TECH TRANSFER

2025 LTC Registration Underway

Planning for the 2025 Louisiana Transportation Conference (LTC) is fully underway! The theme for the conference is "Pathways to Progress: Shaping the Future of Transportation" and will be held March 16-19, 2025, at the Raising Cane's River Center in downtown Baton Rouge.

The LTC is held on a biennial basis to promote technology transfer and interchange of ideas among the transportation community's public and private sectors relative to policy, practice, and problems. Join us for LTC 2025, featuring more than 70 technical sessions, ethics, an opening general session, and more!

Register today at: *https://www.ltrc.lsu.edu/ltc_25/registration.html*

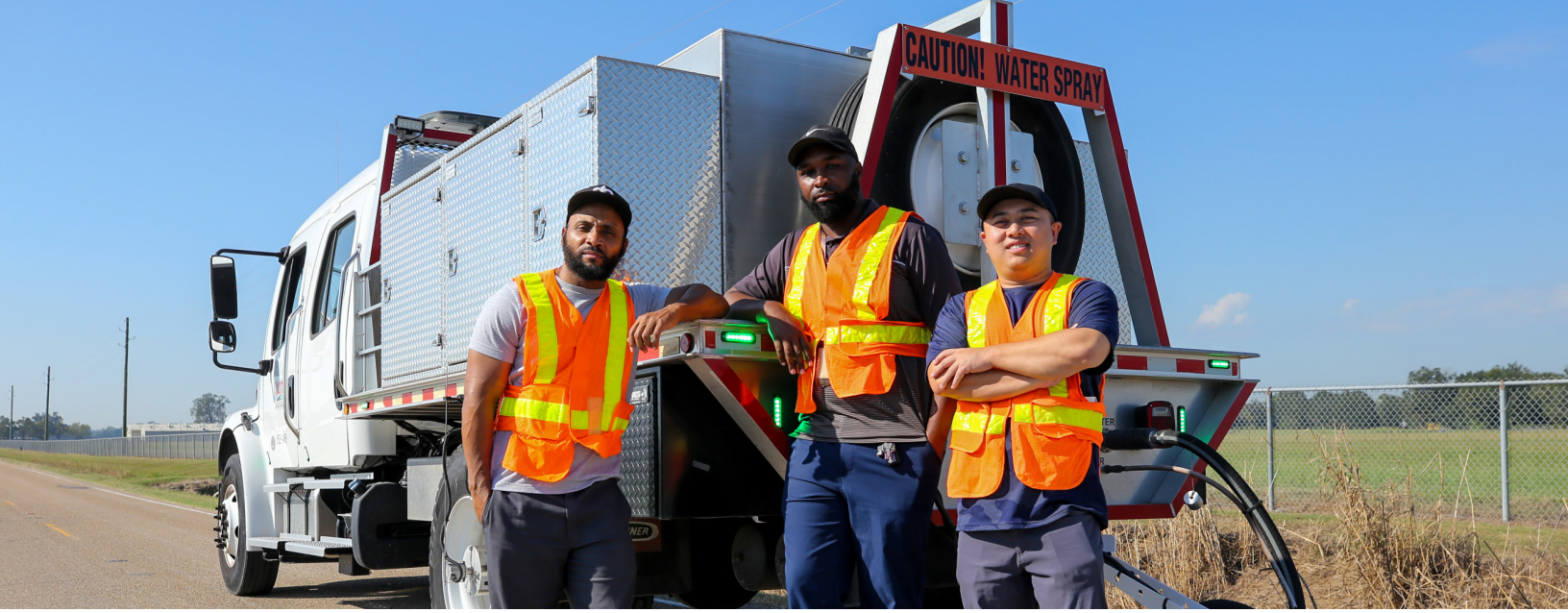
IN THIS ISSUE

UPCOMING EVENTS

NHI Course No. 130053—Bridge Inspection Refresher Training
January 21-23, TTEC 100

NHI Course No. 380120—Introducing Human Factors in Roadway Design and Operations
January 22-23, TTEC 175

To view more events, please visit www.ltrc.lsu.edu



drive this field, offering a comprehensive look into the heart of pavement research and its role in maintaining our infrastructure.

What does a typical week in the pavement lab look like?

In a typical week, we discuss with our team our plans and tasks for the rest of the week. We focus on what is to be done and what has been achieved. Once we take care of administrative tasks, we then crank all our equipment up and operate them to make sure everything is working properly. If no troubleshooting is needed, we then head to the field sites we discussed as a team earlier. It depends on the site location and what data needs to be collected on how long this will take. Typical site visits are at least 2 hours away. Then the collection process takes 1-2 hours. We do this for multiple sites statewide. Once all sites are collected, then we will process the data, organize, and report the data to our manager.

What types of equipment are primarily used?

We have three main pieces of equipment: Heavy Weight Deflectometer (HWD), High-Speed Road Profiler, and Lock-Wheel Friction Tester.

The HWD provides pavement structural condition, pavement moduli, and pavement joint load transfer. The High-Speed Road Profiler provides pavement roughness, pavement cracking, pavement rutting, and pavement joint faulting. The LockWheel Friction Tester provides pavement joint friction.

Is there a piece of equipment that is more popular?

The Heavy Weight Deflectometer is a favorite piece of equipment because it is user-friendly and easy to troubleshoot.

What do you wish people knew about the pavement lab and its capabilities?

Brandon: The pavement group can operate many types of equipment to conduct a variety of tests for different road conditions. Our specialization can provide accurate results to narrow down the issues for all types of pavement and help other groups fix and improve damaged roads. It increases productivity and research progress in many ways. Our research and duty is to monitor and improve the driving conditions for all citizens. Our goal is to help keep the road healthy and people safe.

What do you enjoy about what you do?

Ray: I enjoy experimental learning: being able to challenge your mind to think more critically or see beyond what is obvious. Pavement projects or research allows our department to gather evidence/data for various issues occurring within our roadways, so we can produce problem-solving results or implement improvements. Contributing to that work that betters our society is what intrigues me most and has me passionate about being in the engineering field.

What influenced you to get into this field?

Terrell: I have a bachelor's degree in Electrical Engineering Technology and a background in troubleshooting, operating, and repairing electronic devices, so working with different types of equipment to conduct our research is what drew me to this field. Each piece of equipment has a distinct design with multiple job purposes.

Brandon: All the research projects are unique and interesting, which gives me a chance to experience new technologies and learn or operate different equipment. Also, this area of research allows me to interact with people and work in different fields. It helps me to obtain new knowledge and understand the world from different angles.

How have you seen the effects of your lab or work?

Ray: As a team, the pavement section plays a major role in making sure our state's highways are maintained to the specifications and expectations of DOTD. From data collection, equipment use, and collectively having a team effort, we are frequently able to produce exceptional results.

RESEARCH

Rough Roads Have Got To Go: Roadway Performance in Determining Maintenance for Ramp, Acceleration Lanes, and Deceleration Lanes in Louisiana

Louisiana road maintenance is integral to creating a safe and efficient system for road users to thrive. One of the goals of DOTD is to enhance road maintenance strategies by assessing roadway conditions for performance. This is done using systems like performance indices (PI) and the International Roughness Index (IRI) to assess pavement conditions as they deteriorate due to wear and tear. While IRI is essential for assessing road ride quality, factors such as ramps, acceleration lanes, deceleration lanes, and profiler operating conditions (e.g., low speeds or stop-and-go) can affect the accuracy of IRI values on certain highway sections using a traditional high-speed profiler.

The study "Performance Index Rating and Maintenance Cost Assignment for Ramps, Acceleration Lanes, and Deceleration Lanes in Louisiana," led by Jun Liu of LTRC, sought to create guidelines for evaluating and measuring the ride quality of these specific highway sections. This research aims to enhance the evaluation accuracy of deteriorating pavement, thereby improving the performance and durability of Louisiana's roads.

The study's objective was to propose a methodology for measuring and characterizing IRI values for specific highway sections, such as ramps and acceleration/deceleration lanes. This framework establishes maintenance trigger values and

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RESEARCH

Drone Development: Highway Embankment Monitoring and Management

High plasticity soil in Louisiana's highway embankment infrastructure over time results in safety issues, such as surface sliding failures, causing heavy traffic disruptions for road users. These disruptions have drawn the attention of researchers to the need for a more proactive system for maintaining and managing highway embankment infrastructures, as well as early warning systems to ensure the safety of road users and reduce long-term expenses for taxpayers. Traditionally, site inspections for highway embankments have been extensive, time-consuming, laborious, and costly, requiring trained engineers and technicians to assess the condition of these sites. Due to the lack of proactive measures, the Louisiana Department of Transportation and Development (DOTD) can only respond to failures with costly remediation.

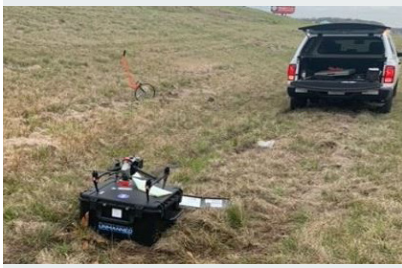
The research project "Exploration of Drone and Remote Sensing Technologies in Highway Embankment Monitoring and Management (Phase I)" explores the possibilities of using drones for transportation safety in highway embankments and dams. The principal investigators, Zhongjie Zhang, Ph.D., P.E., and Qiming Chen, Ph.D., P.E., emphasized the difficulties with traditional inspections, as the soil weakening process in the earth's embankment is nearly impossible to predict based on field observations by engineers. This unpredictability is what leads to slope failures across the state, as seen, for example, at the intersection of I-10 and Bluebonnet in Baton Rouge, Louisiana. The first slope slide occurred in 2000, after approximately 20 years of utilization, followed by a second slope slide in the same location in 2020. Therefore, field monitoring of embankment soil surface moisture conditions are vital for evaluating their stability. Prior to slope sliding, the soil requires stored moisture for a sustained period, which can serve as a quality indicator of slope surface stability.

The objective of this research was to evaluate the capabilities of drone-mounted remote sensors in estimating soil moisture and tracking changes over time in specific locations. By assessing the feasibility of using remote sensing technologies to evaluate the risk of slope failures in embankments and dams, a proactive safety system can be developed to aid engineers and technicians in assessing conditions in a practical, cost-efficient, and effective manner. This research serves as a roadmap to safety, or rather, a drone map to safety.

The study's findings show promising results in using drone-mounted thermal cameras to distinguish different moisture zones, thus identifying potential problematic areas in highway embankments and dam inspections. While the use of drone-based infrared thermography technology is not yet fully developed for independent use, experienced inspectors can utilize this technology to rapidly map the moisture conditions of highway embankments and dam slopes, providing full coverage over inspection sites. This approach can significantly reduce labor and costs by directing ground inspections to areas identified as potential concerns through drone-based thermal inspection. The study also provides insights into the image processing and analytical tools required for constructing maps and processing data from drone cameras. Overall, this research establishes a comprehensive framework for the management, maintenance, and proactive care of highway embankments and dams, ensuring the safety of Louisiana's road users, and contributing to the knowledge base for researchers worldwide.

"The study's findings show promising results in using drone-mounted thermal cameras to distinguish different moisture zones, thus identifying potential problematic areas in highway embankments and dam inspections."

—Dr. Chen



Read Final Report or Tech Summary 690 online: *www.ltrc.lsu.edu/publications.html*

Overlays Save the Day: Evaluating Carrying Capacity of Concrete Overlays over Asphalt Pavement

ATLaS30 is a heavy load simulation device located at LTRC's Pavement Research Facility, where pavement testing simulates 20 years of pavement trafficking in just a few months.

Due to the increasing costs of roadway materials, Portland cement concrete (PCC) overlays have been developed worldwide to enhance pavement durability in a cost-effective manner. There are two types of concrete overlays: bonded and unbonded. Bonded concrete overlays, as the name implies, are bonded to the existing pavement, whether it is concrete or asphalt. These overlays are typically 2 to 6 in. thick and are applied to reinforce existing pavement or for preventive maintenance. Conversely, unbonded concrete overlays are generally thicker and are used when the existing pavement is in poor condition, as they do not require bonding to the existing pavement.

In Louisiana, roadways feature medium- to high-volume traffic and consist of existing asphalt layers over a PCC or cement-stabilized soil base. The Louisiana Department of Transportation and Development (DOTD) was interested in studying thin-bonded concrete overlays as a cost-effective method for maintaining road standards in the state. Led by Accelerated Pavement Research Program Manager Zhong Wu, Ph.D., P.E., the study titled "Evaluation of Bonded Concrete Overlays over Asphalt under Accelerated Loading" aimed to determine the design, durability, and overall performance of bonded concrete overlay pavements for Louisiana's roads. To achieve this, accelerated pavement testing was conducted at the Pavement Research Facility (PRF) site in Port Allen, Louisiana.

The research evaluated both the structural performance and load-carrying capacity of bonded concrete overlays over asphalt (BCOA) pavements and characterized the influence of in-situ bond strength through accelerated pavement testing. Construction practices for PCC overlays were documented for DOTD. The experiment included three full-scale BCOA test sections with 6-in., 4-in., and 2-in. PCC overlays placed over aged asphalt pavement, subjected to accelerated loading using a heavy load simulation device called ATLaS30. Each section was loaded until cracking failure occurred, revealing a potential for longitudinal cracking across all test sections. It was determined that the 4-in. and 6-in. BCOA sections exhibited superior load-carrying capacity. In-situ non-destructive deflection measurements, crack-mapping surveys, a post-mortem trench cutting investigation, and pull-off tests (bond tests) of the BCOA slabs indicated that primary overlay pavement distresses, such as longitudinal and corner cracks, resulted from the debonding of the asphalt layer from the concrete overlay. A new concrete overlay design module available in the AASHTOWare© Pavement ME Design was investigated and used to predict and compare the performance with the tested BCOA pavements. The results recommended a new set of design failure criteria for Louisiana's roadway

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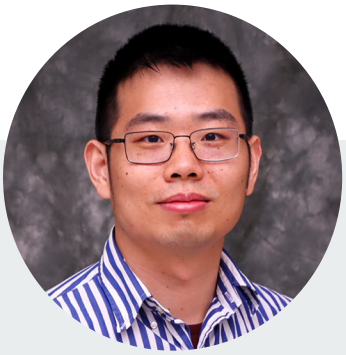
"The results recommended a new set of design failure criteria for Louisiana's roadway concrete overlay pavement design, including a higher percentage of slab cracking and a bond strength requirement."

—Dr. Wu



"The research builds a comprehensive understanding of how Louisiana's roads are impacted by usage and how DOTD can better allocate state resources to enhance road safety and smoothness."

—Jun Liu

treatment costs for all components of the highway system at both project and network levels. The research builds a comprehensive understanding of how Louisiana's roads are impacted by usage and how DOTD can better allocate state resources to enhance road safety and smoothness.

A specially designed profiling system was used in the study to measure IRI for specific highway sections and special operating conditions such as low speed and stop-and-go conditions. The specialized profiling system was calibrated, and a walking profiler system was utilized for ground truth calibration to verify the accuracy of the specialized profiling system. Various road sections with different pavement types and various operating conditions, including acceleration, deceleration, stop-and-go, and dead-stop scenarios, were considered in this study to assess pavement conditions. The study examined the repeatability and accuracy of the profiling system under different operating conditions and established a methodology of using the specially designed profiling system to characterize the ride quality of Louisiana's roads.

By evaluating and analyzing the roadway conditions using the specially designed profiling system, Dr. Liu explains that the methodology will help to determine if specific highway sections, such as ramps and acceleration/deceleration lanes, require additional treatment costs compared to travel lanes. This framework will assist DOTD engineers in selecting the most cost-effective treatment methods, optimizing the safety and efficiency of Louisiana's roads.

concrete overlay pavement design, including a higher percentage of slab cracking and a bond strength requirement.

By analyzing the construction cost savings and extended pavement life of BCOA pavements, the research results recommended using a 6-in. BCOA pavement for medium- to high-volume pavement design in Louisiana where heavy and over-loaded trucks are abundant, while a 4-in. BCOA could be suitable for pavement rehabilitation projects with medium-volume traffic. The findings provide valuable insights for DOTD to optimize the use of overlays in roadway maintenance. As the number of vehicles on the road increases and roadways become more congested, it is crucial for Louisiana's infrastructure to continuously test new cost-effective materials, such as concrete, to address the challenges posed by time-consuming work and rising costs.

Read Final Report or Tech Summary 622 online: *www.ltrc.lsu.edu/publications.html*

STAFF NEWS

Updates and Accomplishments

Rudynah "Dynah" Capone, LTAP Director, has been appointed a board member of the American Public Works Association (APWA) Louisiana Chapter and a member of the National Association of County Engineers (NACE).

Jesse Rauser, P.E., **Gavin Gautreau**, P.E., **Masoud Nabohar**, E.I., and **Tyson Rupnow**, P.E. recently co-authored a technical paper, "Forensic Investigation of a Cracked Highway Embankment Pavement in Louisiana: A Case Study," which was published in the *Transportation Infrastructure Geotechnology* journal.

PUBLICATIONS

Recently Published

Project Capsule 24-1C
Investigation of Piezoelectric and Other Advanced Sensors in Concrete
Tyson Rupnow, Ph.D., P.E.

Project Capsule 25-1B
Assessment of the PaveScan RDM for Continuous Density Measurements in Louisiana
Moses Akentuna, Ph.D., P.E.

Project Capsule 25-2B
Validation of SCB J_c Prediction Model and Aging Correction Factor
Moses Akentuna, Ph.D., P.E.

Final Report and Technical Summary 699 (21-1GT)
Internal Friction Angle of Sands with High Fines Content
Murad Abu-Farsakh, Ph.D., P.E., and Salman S. Abusalman

Final Report and Technical Summary 700 (20-1C)
Evaluation of the Miniature Concrete Prism Test (MCPT) for Use in LADOTD
Zhen Liu, Ph.D., P.E.; Jose Milla, Ph.D., P.E.; and William Saunders, E.I.

Final Report and Technical Summary 701 (22-2C)
Optimizing Aggregate Gradation to Reduce Concrete's Permeability
Zhen Liu, Ph.D., P.E.; Jose Milla, Ph.D., P.E.; and William Saunders, E.I.

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LTRC Administration and Publications Staff

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