TRAN-SET
QUARTERLY NEWSLETTER

SPRING **2021** • ISSUE **14**

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ABOUT TRAN-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across five states (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas). Tran-SET is led by LSU and was established in late-November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes."

LETTER FROM THE DIRECTOR

Spring is Such a Beautiful Time of Year!

Spring is a wonderful season filled with new growth, new promise, and new beginnings. In the South, spring is an especially beautiful time of year before the long, hot days of summer.

I am excited to report Tran-SET's continued progress. Recently, Tran-SET was granted a one-year extension to end in November 2023. I would like to take this opportunity to personally thank all Tran-SET staff, associate directors, program directors, and principal investigators. Your efforts are much appreciated and are directly responsible for the our success and achievements.

Tran-SET will be holding the 2021 Tran-SET Conference virtually on June 3-4, 2021, due to the current COVID-19 situation nationwide. The event is co-sponsored by the Judd Hill Foundation and e-hosted by Arkansas State University (A-State).

The start date of the conference's call for papers was December 7, 2020, and the due date for the drafted papers was February 5, 2021. A total of 42 papers were submitted for this year's conference, which is a great opportunity to learn how Tran-SET-sponsored research is solving regional transportation needs and to network, collaborate, and engage with professionals in a wide-range of transportation fields. For more information, please visit the **conference website**.

As part of our dedication to education and workforce development, on March 9, Tran-SET participated in this year's Oak Grove Science, Technology, Engineering, Arts, and Mathematics (STEAM) night drive-in. We presented a shout-out video on several innovative transportation materials, which was broadcast on a giant inflatable screen set up for the event so that students and their families could enjoy watching STEAM fun at school from the safety and comfort of their personal vehicles.

Proposals for our fifth cycle of funding have been received and are being reviewed by independent experts in each field. Tran-SET received 41 proposals in various areas of expertise within the transportation field. This shows the increasing interest in our research program! Selection of fifth-cycle projects and awards will be carried out in the upcoming months and sent out accordingly.

If you haven't done so already, I highly encourage everyone to follow us on **LinkedIn** and **Twitter**. You may also subscribe to our **mailing list**.

I invite you to read through our Spring 2021 newsletter and learn more about our research, technology transfer, educational, and workforce development activities.

Enjoy!

Marwa Hassan, PhD, PE, F.ASCE
CETF Distinguished Professor
College of Engineering, LSU

RESEARCH PROGRAM UPDATES

THIRD-CYCLE PROJECTS IMPLEMENTATION REPORTS

The implementation phase of most of Tran-SET's third-cycle projects ended on February 2021. In spite of the pandemic and LSU shutdown (March 2020- August 2020), Tran-SET worked efficiently with principal investigators to deliver projects on time. Tran-SET will circulate the implementation reports as soon as they are available. Third-cycle completed final reports and the corresponding datasets are now available through LSU Digital Commons.

FOURTH-CYCLE PROGRESS REPORTS AND TRACKERS

A total of 40 fourth-cycle projects were selected for award and started on August 1, 2020. Fact sheets describing the problem statement, objective, intended implementation, and other project information are now available on **Tran-SET's website**. The first progress report and tracker were due in December 2020. The second progress report and tracker are due on April 1, 2021.

PROBLEM STATEMENTS FOR FIFTH-CYCLE PROJECTS

Proposals for Tran-SET's fifth cycle of funding are currently under review and are being ranked by regional transportation leaders/experts. Tran-SET received a total of 41 proposals in various areas of expertise within the transportation field. A total of eight problem statements were collaborative, involving multiple partnering institutions. This shows the increasing interest in our research program! Selection of the fifth-cycle projects and awards will be carried out in the upcoming months and sent out accordingly. Please see **our website** for more information.

RESEARCH IN PROGRESS: HIGHLIGHTS

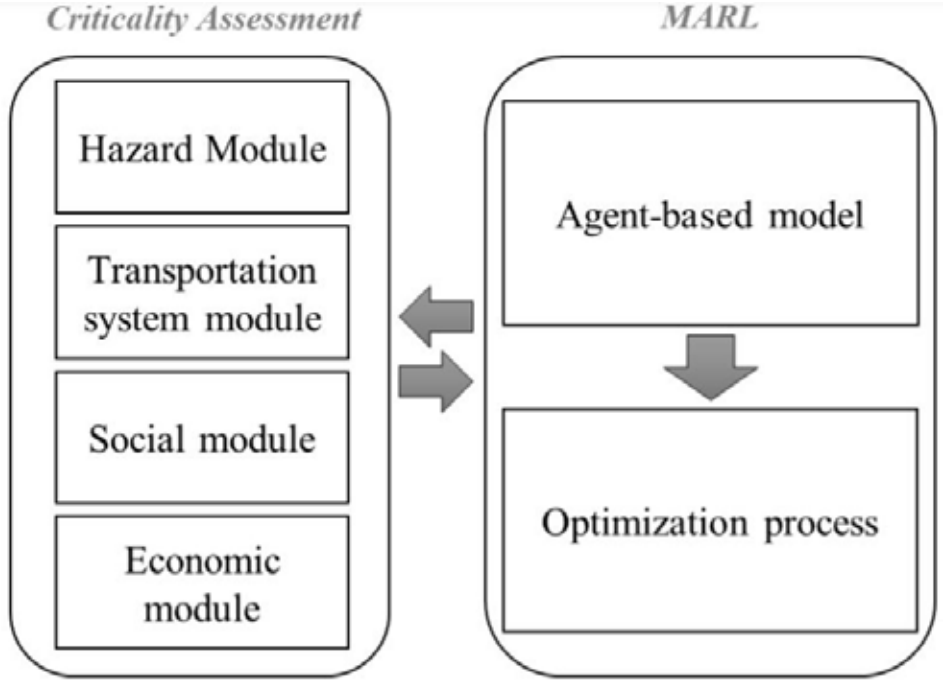
Please see below for a showcase of select, Tran-SET research projects. ***Is our research applicable to your technical area? Beneficial or a potential solution to your local transportation system? Can benefit from your efforts? Interesting?*** *Please contact us for ways to coordinate, be involved, and engaged! To learn more about the following projects (and the rest of our 35 active research projects), please visit* **our website**,

Deep Reinforcement Learning-based Project Prioritization for Rapid Post-Disaster Recovery of Transportation Infrastructure Systems

Dr. Yong-Cheol Lee–LSU, Dr. Kunhee Choi–Texas A&M University

After disasters hit, reconstruction and maintenance of damaged transportation infrastructure systems require DOTs to take long, costly processes. Additionally, planning and organizing post-disaster reconstruction and maintenance projects of transportation infrastructures are very challenging because they entail the considerable number of projects with various considerable factors and multi-objective issues including social, economic, political, and technical factors. Furthermore, decision makers deal with limited federal, state, and local resources in planning sequential and organized reconstruction of affected transportation systems. Since transportation networks are pivotal in disaster recovery, the recovery processes should include short- and long-term logistics and plan with underlying heterogeneous factors. Yet a comprehensive, integrated, data-driven approach for organizing and prioritizing post-disaster transportation reconstruction projects is elusive. In addition, Region 6 DOTs need to improve identifying and predicting the detailed factors and their impacts affecting post-disaster transportation recovery.

This project aims to develop a data-driven reinforcement learning-based project prioritization system for rapid post-disaster reconstruction and recovery of damaged transportation infrastructure systems. This project also aims to help Louisiana and Texas (eventually all Region 6 states) in the systematic optimization and prioritization of the post-disaster reconstruction and maintenance plan of transportation infrastructure by focusing on social, economic, and technical aspects. To accomplish this, researchers will examine all previously flood-affected roadways in Louisiana and Texas with the Louisiana Department of Transportation and Development (LaDOTD), as well as the Texas Department of Transportation (TxDOT). This project will first focus on two cities, Houma, Louisiana, and Houston, Texas. These areas provide historical recovery and maintenance data of transportation infrastructure systems.



Structure of prioritization model.

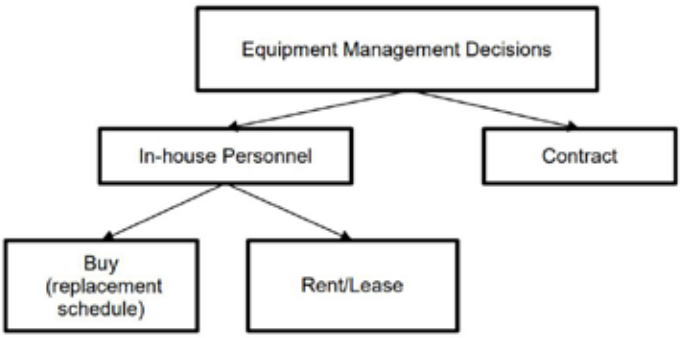
RESEARCH IN PROGRESS: HIGHLIGHTS

A Resource Guide for State DOT's Maintenance Equipment Fleet Management Decisions

Dr. Yongwei Shan, Dr. Samir Ahmed–
Oklahoma State University

The Oklahoma Department of Transportation (ODOT) has more than 4,000 pieces of equipment, with equipment-purchase-years ranging from 1964 to the present. Most of the equipment is beyond its useful life. Using equipment in suboptimal conditions increases operating costs due to equipment deterioration. The default equipment-useful-life specified by the ODOT lacks impartial, scientific reasoning. Equipment replacement decisions are purely dependent on fleet managers' experience. Furthermore, the ODOT primarily buys equipment. When it comes to equipment sourcing, strategies include own, rent, and lease. The ODOT may miss the opportunity of investigating other equipment sourcing methods.

The goal of this research is to aid the ODOT in strategically improving its equipment management practices using the data recorded in its equipment fleet management system. The specific objectives of this project are to assist ODOT in calculating ownership and operating costs of the selected types of equipment; to develop models for equipment management decisions (replacement and own, rent, or lease decisions); and to draft a resource guide to introduce ODOT management to the latest techniques and practices in equipment management.



The family tree of equipment management decisions.

Field Retrofit and Testing of a Corroded Metal Culvert Using Glass Fiber Reinforced Polymers

Dr. Mahmoud Reda Taha, Dr. Susan Bogue Halter–
University of New Mexico

In some parts of New Mexico, culverts go obsolete within three years of installation due to high corrosion. There is an urgent need to address the issue of metal culvert corrosion in the United States. Glass Fiber Reinforced Polymers (GFRPs) have become a desirable material for structural strengthening and rehabilitation. For the past two decades, corrosion-free and low-weight GFRP costs have also dropped considerably with production advances. In addition, GFRP material does not require additional protective coatings or maintenance. Recently, the team at the University of New Mexico finished an extensive experimental investigation conducted in the time of 2016-2019 examining the potential use of GFRP to retrofit corroded metal pipes. The investigation at UNM showed that slip-on GFRP profile liners can completely retrofit an existing metal culvert and provide a new culvert with significant structural capacity and excellent ductility.

The goal of this research project is to perform full-scale field implementation and testing of the field retrofit of CMP using GFRP slip liner and provide an implementation guidebook for future application. The technical phase objectives are the structural design of a GFRP liner retrofit for a field-corroded metal culvert; the field application of a GFRP profile liner to retrofit corroded metal culvert; and the recording of the behavior of the retrofitted CMP GFRP culvert subjected to traffic loads.

Experimental set-up for testing corroded CMP retrofitted with GFRP profile liner under three-point bending.

RESEARCH IN PROGRESS: HIGHLIGHTS

Combining Virtual Reality and Machine Learning for Enhancing the Resiliency of Transportation Infrastructure in Extreme Events

Dr. Supratik Mukhopadhyay, Dr. Yimin Zhu–LSU

Route-choice models are the spine of traffic management systems—high-fidelity models that are based on rapidly evolving contextual conditions that can greatly affect smart, energy efficient transportation. Current route-choice models are generic and are calibrated using static contextual data. These models do not consider dynamic contextual conditions such as dynamic travel time, accessibility to nearest freeways, traffic incidents, and emergency road closure. Consequently, they only predict at aggregate levels and for a generic set of contextual factors (even when predicting at disaggregate level). There is a clear need to develop route-choice models that consider local contexts and are closer to reality to allow government agencies to make informed, model-based decisions and policies.

The goal of this study is to develop a novel, context-aware framework that combines virtual reality (VR) with causal machine learning to enhance understanding about drivers' decision making in relation to route selection and prediction of roadway congestion in extreme events. For this, researchers will develop a robust computations/analytic framework that integrates causal machine learning-based models with VR to improve the predictions of existing models for traffic routing, resource allocation, and deployment of resources (sensors and personnel) by considering contextual variables regarding human interaction with highway infrastructure. The proposal brings together a multidisciplinary team that will capture time- and context-sensitive traffic data and use it to develop and field test new context-aware parameterized models for smarter, efficient traffic management.

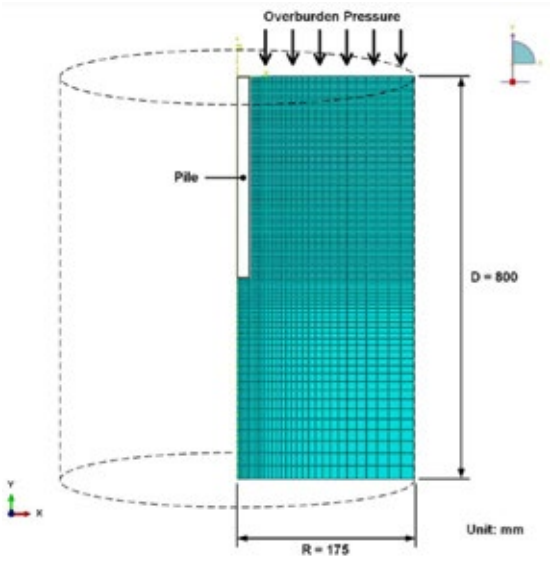
Driving simulator.

Calculating Pile Downdrag: Experimental and Numerical Investigations

Dr. Hai Lin, Dr. Shengli Chen–LSU

Deep foundation axial resistance falls into two categories—shaft resistance and tip resistance. The direction of the shaft resistance depends on the relative movement between the deep foundation and the adjacent soil. If the pile moves downward relative to the soil, positive shaft resistance is developed (i.e., shaft resistance acting upward). Conversely, if soil flows downward relative to the pile, negative shaft resistance (drag load) is developed (i.e., shaft resistance acting downward). The drag load is defined as the axial compressive load induced along the length of the pile due to the accumulated negative skin friction. Downdrag is defined by downward movement of piles resulting from the ground settlement. The neutral plane location is where the transition from negative to positive shear direction occurs.

This project aims to explore pile downdrag in consolidating ground using fully instrumented lab-scale pile tests and finite-element numerical modeling. To achieve this, the following tasks will be performed: literature review related to the calculation of pile downdrag; analysis of force-displacement relationships at the soil-pile interface using the interface direct shear tests; investigation of the drag load and downdrag along the pile length using fully instrumented lab-scale tests with advanced sensors; analysis of the results and comparison with the available design methods of downdrag; and development of a numerical modeling tool and parametric analysis to accurately predict pile downdrag and drag load.



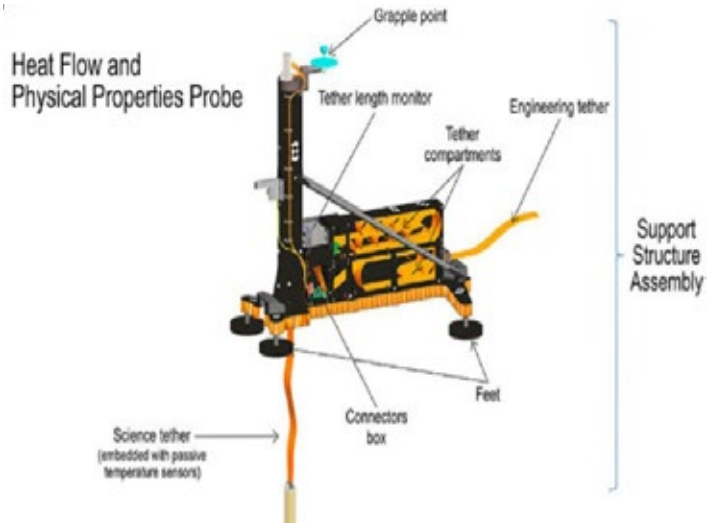
Finite element meshing for pile downdrag laboratory test.

RESEARCH IN PROGRESS: HIGHLIGHTS

Compaction Multimeter

Dr. Douglas D. Corte –New Mexico State University

The successful implementation of a non-nuclear, in-situ, mechanical performance evaluation device requires satisfying the information needs in a system-wide context. The device must provide reliable density and moisture content measurements to fit within the fixed construction control regulatory framework. Non-nuclear devices that measure density and moisture content efficiently and portably, like an NDG, will encounter doubt but would likely replace the NDG. However, limiting such devices to the determination of these two parameters will not advance the state of the practice in the in-situ mechanical characterization of compacted aggregates. Thus, developing transitional devices that measure density, moisture content, strength, and stiffness is vital. Providing side-by-side measurements of all properties, such a device could adapt to current construction specifications without maintenance. Inspectors and contractors would have access to real-time density and moisture content data in the field so that they still use the pass-fail criteria with which they are familiar, and strength and stiffness data can also be recorded and made available to engineers and designers. Over time, the compiled data set could be used to develop adjustments to the regulatory framework, effectively eliminating density and moisture content evaluation criteria for mechanical performance standards. The research team hypothesizes a prototype compaction multimeter device can be made by combining feasible compatible sensors and technologies. Furthermore, the introduction of redundancy in the measurement (i.e., multiple sensors measuring one physical parameter) can greatly boost the accuracy of the device. This study aims to develop a compaction multimeter prototype. This device would be capable of directly measuring the density, water content, strength, and stiffness of a compacted soil and require minimal material specific calibration.



Heat flow and physical properties probe (HP3).

TECHNOLOGY TRANSFER ACTIVITIES

Tran-SET has two objectives that guide its technology transfer (T2) activities: to ensure that scientific and technological developments are: (1) accessible, disseminated, and transferred to a wide range of users including state agencies, universities, and industries and (2) have long-term research value and significant impact to the transportation industry. Please see below for a showcase of select, T2 activities sponsored by or involving Tran-SET. Please stay up-to-date with our activities by following us on ***LinkedIn*** *and* ***Twitter****, visiting our* ***website****, and subscribing to our* ***mailing list****!*

2021 Tran-SET Conference

Tran-SET will be holding the 2021 Tran-SET Conference virtually on June 3–4, 2021, due to the current COVID-19 situation nationwide. The event is co-sponsored by the Judd Hill Foundation and e-hosted by Arkansas State University (A-State). The start date of the call for papers for the conference was December 7, 2020, and the due date for the draft papers was February 5, 2021. A total of 42 papers were submitted for this year's conference. The conference is a great opportunity to learn how Tran-SET-sponsored research is solving regional transportation needs and to network, collaborate, and engage with professionals in a wide-range of transportation fields. For more information, please visit the **conference website**. Accepted papers will be published by the ASCE. For any questions, please contact transet2021@astate.edu.

Transportation Research Board Annual Meeting

Tran-SET had a strong presence at the 2021 TRB Annual Meeting, which was held virtually in January 2021. About eight Tran-SET-related lectern presentations and nine poster presentations were conducted, and more than 35 Tran-SET-related researchers and students attended. The TRB Annual Meeting is one of the largest transportation research conferences in the world, covering all transportation modes and addressing topics of interest to policymakers, administrators, practitioners, researchers, governments, industry, and academic institutions. More than 13,000 transportation professionals were in attendance.

Joint Tran-SET Webinar Series

Our latest webinar in the Joint Tran-SET Webinar Series, *"Advances in the Ultra-High Performance Concrete (UHPC),"* was held on March 9, 2021. In this webinar, Dr. Kyle Riding (University of Florida) discussed the *"Ultra-High Performance Concrete Quality Control Testing;"* Dr. Royce Floyd (University of Oklahoma) presented *"Ultra-High Performance Concrete and Innovative Concrete Materials for Pre-stressed Concrete Girder Repair;"* and Dr. Brad Weldon (The University of Notre Dame) presented the *"Field Implementation and Monitoring of an Ultra-High Performance Concrete Bridge Deck Overlay."* The recording of this webinar is available on **Tran-SET's website** or directly on **Tran-SET's YouTube page**.

Tran-SET would like to sincerely thank the webinar presenters (please see below):

Kent Seminar Spring 2021

Dr. Marwa Hassan (Tran-SET director) gave an overview of Tran-SET at this year's Kent Seminar, which was organized by the Illinois Center for Transportation. She also provided an introduction to innovative pavement material advancements developed by Tran-SET—including low-cost ECC, EGC, and self-healing pavement materials—and shared a detailed overview of self-healing/self-rejuvenating asphalt technologies. The recording of this seminar can be found on **YouTube**.

EDUCATIONAL & WORKFORCE DEVELOPMENT

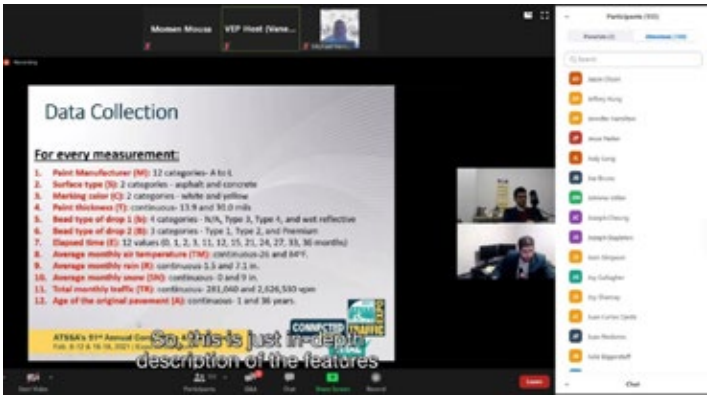
Tran-SET has a firm initiative to advance the transportation workforce and develop its next generation of leaders by: (1) attracting and supporting diverse, promising individuals to the transportation field through internships/research assistantships; (2) providing experiences through education and cutting-edge research to more properly prepare these individuals as they enter the workforce; and (3) incorporating and disseminating knowledge generated from sponsored research into educational and training products/activities. The following is a showcase of select, educational and workforce development activities sponsored by or involving Tran-SET:

STEAM Night at Oak Grove

Oak Grove Primary held the Science, Technology, Engineering, Arts, and Mathematics (STEAM) Night on March 9, 2021, to generate interest and enthusiasm for STEAM education among students and their families by giving them a chance to explore science in action at their school in Prairieville, Louisiana. Due to COVID-19, this year's event took place outdoors as a STEAM Night Drive-In. Tran-SET participated in this event by presenting a shout out video on innovative pavement materials, which was broadcast on a giant inflatable screen set up for the event so that attendees could enjoy watching STEAM fun at school from the safety and comfort of their personal vehicles.

American Traffic Safety Services Association (ATSSA)'s Annual Convention & Traffic EXPO 2021

Dr. Momen Mousa (Tran-SET PI and program manager) provided a one-hour educational session with Dr. Saleh Mousa (TxDOT) in February 2021 in front of 130 attendees at the American Traffic Safety Services Association (ATSSA)'s Annual Convention & Traffic EXPO 2021. In this session, emerging machine learning techniques were presented as promising techniques to predict the performance of pavement markings. For more information, please visit the event website.



Dr. Momen Mousa's Presentation at the American Traffic Safety Services Association (ATSSA)'s Annual Convention & Traffic EXPO 2021.