



# TRAN-SET

## QUARTERLY NEWSLETTER

FALL 2020 • ISSUE 12

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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

Wishing You All a Wonderful Fall!

I am delighted to report Tran-SET's continued progress. As you all know, due to the current COVID-19 situation worldwide and the changing restrictions and guidelines states and individual organizations have undertaken, Tran-SET held the 2020 Tran-SET conference virtually on September 1-2, 2020. The conference was organized by the University of New Mexico and New Mexico State University and co-sponsored by ASCE Construction Institute. The conference included 56 interesting presentations, which will be uploaded on our [YouTube channel](#) soon. During the conference, Tran-SET also conducted its business meeting with our Center Advisory Board (CAB) members, associate directors, and program directors to solicit feedback/guidance from the CAB. Thank you to all Tran-SET staff, associate directors, CAB members, and program directors for their efforts in these unprecedented times and for making the Tran-SET conference a big success.

Tran-SET has finalized selection and award of its fourth-cycle projects. A total of 41 research projects were awarded, and their start date was set on August 1, 2020. Also, the call for problem statements for our fifth cycle of funding has come to an end. Problem statements will be evaluated based on their potential benefits, and funding priority will be given to projects addressing the impacts/challenges of COVID-19 on the transportation industry.

The next webinar in the Tran-SET Webinar Series will be held September 15, 2020. Three transportation experts will discuss Innovative Techniques in Detecting, Motioning, and Planning for Flooding. Visit [Tran-SET's website](#), for more information. Registration is free!

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 [here](#).

I invite you to read through our Fall 2020 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 RESEARCH REPORT

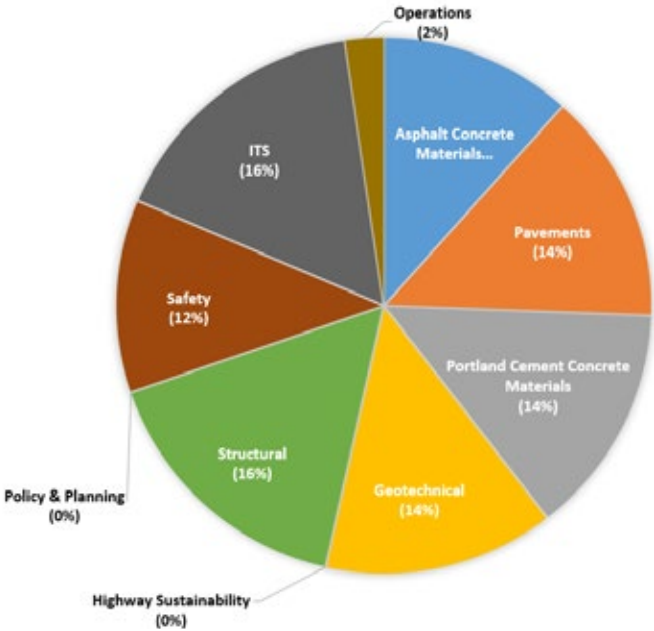
Tran-SET’s third-cycle projects ended their technical phase in mid-August 2020. The projects’ third progress reports and trackers, as well as their final research reports, were submitted on August 25, 2020. Tran-SET will circulate these reports as soon as they are ready. Dr. Husam Sadek (Tran-SET Research and T2 Program coordinator) is currently organizing and facilitating TRL assessments for each third-cycle project. The process has been a tremendously useful experience: (1) providing an opportunity for the research team to directly communicate to stakeholders, (2) gathering critical feedback from the panel to better inform/improve activities during the implementation (technology transfer) phase, (3) ensuring more informed and engaged stakeholders, and (4) educating research teams and panel members on the use of the TRL scale and assessment processes.

## AWARD OF FOURTH-CYCLE PROPOSALS

Tran-SET has finalized the selection and award of its fourth-cycle projects. A total of 41 projects were awarded, and their start date was set on August 1, 2020. The projects totaled \$4.5 million (grant and matching funds) and are categorized below by topic area.

## PROBLEM STATEMENTS FOR FIFTH-CYCLE PROJECTS

The deadline for the submission of problem statements for Tran-SET’s fifth cycle of funding was August 30, 2020. Problem statements will be ranked by their potential benefits and eventual impacts on workforce development and educational activities that focus on the evaluation and implementation of advanced technologies in the transportation industry. Priority will be given to projects addressing the impacts/challenges of COVID-19 on the transportation industry.



Projects categorized by topical area.

# RESEARCH IN PROGRESS: HIGHLIGHTS

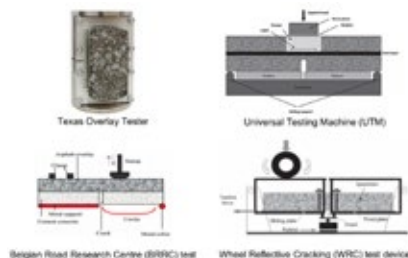
Please see below for a showcase of select, Tran-SET research projects. *Is our research applicable to your technical area? Beneficial or a potential solution to your local transportation system? Can benefit from your efforts? Interesting?* Please contact us for ways to coordinate, be involved, and engaged!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

## EVALUATION OF ASPHALT MIXTURES' RESISTANCE TO CEMENT-TREATED BASE REFLECTIVE CRACKING IN THE LABORATORY

DR. HUSAM SADEK, DR. MARWA HASSAN,  
DR. CHARLES BERRYMAN—LSU

Reflective cracking is one of the main forms of pavement deterioration. When an asphalt overlay is paved on top of a cement-treated base (CTB) or a cracked base, cracks from the base tend to propagate to the surface in a short period of time. For this reason, asphalt mixtures produced to be constructed over a CTB or a cracked base should be evaluated against reflective cracking. The main reasons behind the propagation of reflective cracking are mainly due to traffic loads and horizontal movements resulting from temperature variations. Also, the initiation of reflective cracking can be avoided by controlling the amount of cement used in the CTB, as well as the mixing and curing process.

This project aims to simulate the propagation mechanism of reflective cracking in pavements by performing a variety of laboratory tests that evaluate the effects of traffic and temperature, both separately and simultaneously, through the application of vertical loads and horizontal opening displacement. The results from this study will broaden the knowledge of the effect of reflective cracking on asphalt mixtures, help predict the performance of asphalt mixtures against reflective cracking, encourage constructors and designers to include CTB layers in their design when reflective cracking is more controlled, and enhance knowledge about the CTB material and laboratory testing used to evaluate reflective cracking resistance.



Example of available laboratory test for reflective cracking resistance evaluation.

## FIELD IMPLEMENTATION AND MONITORING OF AN ULTRA-HIGH-PERFORMANCE CONCRETE BRIDGE DECK OVERLAY

DR. CRAIG NEWTON, DR. BRAD WELDON—NEW MEXICO STATE UNIVERSITY

Overlays are placed on existing concrete bridge decks as a way to increase the cover for the deck-reinforcing steel, improve rideability, and skid resistance. Ultra-high-performance concrete (UHPC) has proven to have the potential to increase the service life of bridge deck overlays, thus protecting the underlying concrete deck. This is due to its exceptional durability and silica fume component that facilitates a bond to substrate concrete. Previous research has shown that UHPC produced with local materials has presented great durability, with its cost being decreased 30-70%, and a small reduction in compressive strength of UHPC when compared to commercial mixtures.

The goal of this project is to monitor and evaluate the field implementation of UHPC produced with local materials on a bridge in Socorro, New Mexico. Best practices for UHPC technologies and overlay construction methods will be studied and implemented, and the short- and long-term performance of the overlay will be monitored using a variety of mechanical, physical, and non-destructive testing. The results from this study could encourage state agencies to consider using UHPC for bridge deck overlays. It was previously identified as a promising technology in a 2017 Tran-SET-funded project, which demonstrated that UHPC produced with local materials was able to achieve adequate bond strength when used as an overlay material in the laboratory.



Bridge in Socorro, New Mexico, where the UHPC overlay will be implemented.

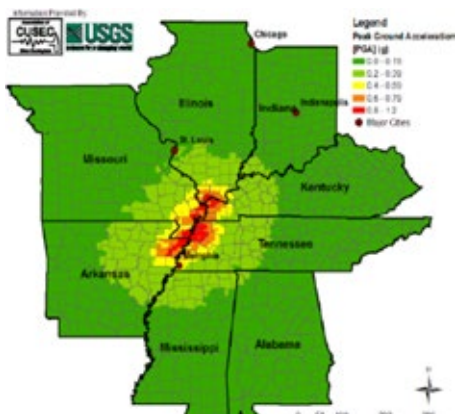
# RESEARCH IN PROGRESS: HIGHLIGHTS

## SITE-SPECIFIC SEISMIC GROUND MOTION ANALYSES FOR NORTHEAST ARKANSAS

DR. ZAHID HOSSAIN, DR. ASHRAF ELSAYED—ARKANSAS STATE UNIVERSITY

Liquefaction resistance and shear velocities are main elements in the estimation of potential earthquake damage of new and existing construction projects. In the efforts to estimate the aforementioned elements, Arkansas Department of Transportation (ArDOT) and other agencies in the region surveyed 15 construction sites in the past three years. However, these sites are not enough to cover the entire region. Since the specific ground motion response analysis (GMRA) is expensive and time consuming, the proposed study will use the available data from these sites and develop neural network models to predict earthquake resistance parameters of other locations in the region. Historical data such as standard penetration test (SPT) results will be used to predict parameters like liquefaction resistance, peak ground acceleration, and spectrum velocity.

The main objective of this study is to predict shear-wave velocity profiles and seismic site coefficients for various locations in Northeast Arkansas (NEA). In order to do this, seismic site coefficients for developing the design response spectrum of different sites will be estimated using stochastic simulation; liquefaction potential will be estimated using neural network modeling; and Bayesian analysis-based risk assessment will be used for the uncertainty analysis. The project results will help ArDOT and industries in the region use findings on seismic hazards and liquefaction maps of different types of soils and is expected to save agencies a lot of funds.



Peak ground acceleration map in the North East Arkansas (NEA) area.

## COUPLING NOVEL SOIL MOISTURE-SUCTION SENSORS AND UAV PHOTOGRAMMETRY TECHNOLOGY TO THE PERFORMANCE OF HIGHWAY EMBANKMENTS

DR. NAVID JAFARI—LSU; DR. XINBAO YU, DR. ANAND PUPPALA, DR. SURYA CONGRESS—UNIVERSITY OF TEXAS AT ARLINGTON

Many highway embankments all over the United States, specifically in the South Central region, have decayed at a faster rate than they were originally intended to due to high-plasticity clays used in the construction process softening significantly with time. Also, rainwater infiltrating the embankments increase pore-water pressure, leading to slope instability. For this reason, highway embankments in this region require maintenance more often, resulting in the use of more funds to keep them in working condition.

The main goal of this study is to help understand how long-term wetting-drying cycles change the mechanical properties of high-plasticity clays by developing a predictive design and rehabilitation tool for highway embankments while addressing previous research questions on the topic. A highway embankment with a history of shallow slides will be studied to gather undisturbed shear strength, soil moisture, and pore-water conditions. In-situ suction and moisture content will be measured using a novel-TOR sensor; geometry and slope changes will be assessed using unmanned aerial vehicles (UAVs); and a numerical tool will be developed to predict fully softened shear strengths and possible slope failures. The anticipated impacts of this study include promoting more resilient geotechnical infrastructure and the use of emerging technologies to repair and extend the service life of highway embankments.



Unmanned aerial vehicle (UAV) during infrastructure monitoring.

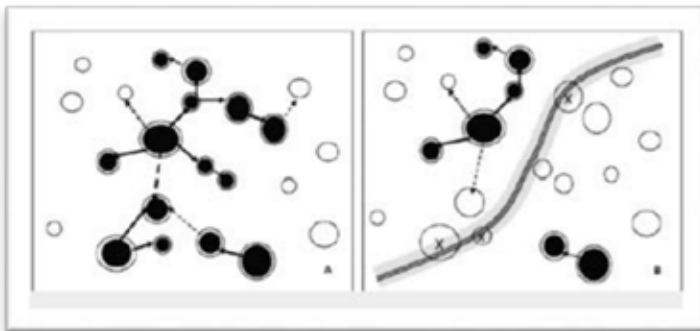


# RESEARCH IN PROGRESS: HIGHLIGHTS

## ENHANCING EVALUATION OF WILDLIFE DETECTION SYSTEMS

DR. NICK FERENCHAK—UNIVERSITY OF NEW MEXICO

Every year in the United States, wildlife-vehicle collisions (WVCs) account for 200 human fatalities, 26,000 human injuries, considerable material damage, and a significant harm to wildlife populations, resulting in about \$8.4 billion in total costs. For some rural highways in the country, WVCs are the most common type of collision. To address this issue, different methods have been implemented. One of the methods used to prevent WVCs is the use of wildlife crossing structures. But how effective these structures are, and how to improve their efficiency is still being studied. Novel wildlife detection technologies can be used to determine how much and what type of wildlife are using the crossings, as well as how to improve crossings to better channel animals into using them. This project aims to develop a cost-effective solution to WVCs by studying current WVC avoidance strategies, wildlife-crossing structures, game-fencing practices, and wildlife detection methods. Novel detection technologies and crossing treatments will be analyzed in the field to assess their performance and give guidance and best practice recommendations based on the results. The anticipated impact of these projects is to develop guidelines that can be used right away by DOTs to reduce wildlife-vehicle collisions, decrease maintenance, save human lives, reduce human injuries, decrease material damage, preserve wildlife population, and improve technology development.



*Wildlife populations are linked to each other through movements along migratory corridors (left). Figure B: When a roadway is installed, populations' natural habitats and movements are disrupted, putting them at risk of extinction (right).*

## DEVELOPMENT OF CORROSION-INHIBITING GEOPOLYMER-BASED CEMENT FOR TRANSPORTATION INFRASTRUCTURE

DR. HOMERO CASTANEDA, DR. MILADIN RADOVIC—TEXAS A&M UNIVERSITY

Geopolymers have been gaining attention as an affordable, sustainable, and eco-friendly alternative for ordinary Portland cement (OPC) in civil infrastructure. Geopolymer-based cement (GPC) can be processed at room temperatures from aqueous solutions of waste material or abundant natural resources, thus reducing CO<sub>2</sub> production. The use of GPC as a replacement for OPC can reduce CO<sub>2</sub> emissions by 44-64%. GPC also has the potential to prevent extensive corrosion damage of the steel bar reinforcement of concrete structures. Previous research has been undertaken on mechanical properties of GPC, however, very few studies have been done on the effects of GPC concrete on steel rebar reinforcement. The objective of this study is to develop an innovative, sustainable, eco-friendly, and durable GPC for reinforced concrete infrastructure by evaluating the long-term durability of GPC concrete against chloride-induced corrosion. Reinforced GPC concrete will be tested under simulated marine environment over long periods of time to assess its durability. Also, in order to improve the service life of transportation infrastructure, a procedure will be developed to manage corrosion in reinforced GPC bridges, taking into account preliminary and in-depth corrosion condition evaluations. Finally, recommendations on how to optimize GPC composition for maximum corrosion protection of steel rebar will be given, and the corrosion mechanism and kinetics of the reinforcement steel in GPC concrete will be explained.



*Bridge and pavement construction using GPC concrete at Brisbane West Camp Airport, Australia.*

# 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](#)!

## 2020 TRAN-SET VIRTUAL CONFERENCE WAS A SUCCESS!



Due to the current COVID-19 situation worldwide, Tran-SET held the 2020 Tran-SET Conference virtually on **September 1–2, 2020**. The conference was organized by the University of New Mexico and New Mexico State University and co-sponsored by the ASCE Construction Institute. The event included 56 interesting presentations, which will be uploaded on our [YouTube channel](#) soon. During the conference, Tran-SET also conducted its business meeting with our Center Advisory Board (CAB) members, associate directors, and program directors to solicit feedback/guidance from the CAB. Thank you to all Tran-SET staff, associate directors, CAB members, and program directors for their efforts in these unprecedented times, and for making the Tran-SET Conference a big success.

## PRESENTATIONS AT 5TH ANNUAL AIRWORKS CONFERENCE AND COMMERCIAL UAV EXPO AMERICAS 2020



Dr. Surya Congress (Tran-SET PI) virtually presented case studies that demonstrated the feasibility of using unmanned aerial vehicles close-range photogrammetry (UAV-CRP) technology in the inspection of transportation infrastructure assets like pavements, bridges, and railroads at the 5th Annual AirWorks Conference, August 25–28, 2020. On September 15–17, 2020, he will also be a guest speaker at the Commercial UAV Expo Americas 2020 to discuss the use of drones and artificial intelligence technology in addressing critical infrastructure inspections and how their use has been proven to save both time and money. We encourage you to join the upcoming virtual conference at the [UAV Expo website](#). For more information on the Annual AirWorks Conference, please visit its [website](#).

## DECISION-SUPPORT MODELS FOR OPTIMAL WORK-ZONE LENGTH

Dr. Kunhee Choi is leading a Tran-SET research team at Texas A&M (in collaboration with LSU) to develop decision-support models that determine the optimal work-zone length in a balanced trade-off between motorists' inconvenience due to traffic disruption and their opportunity cost using traffic-schedule simulations. As the first of its kind, this study will help state transportation agencies devise sounder construction phasing plans by providing a point of reference when establishing work-zone length in a viable way to minimize traffic disruption during construction. Stay tuned for interesting results!



## STRIPING FIELD TESTING IN LSU

As part of the Tran-SET funded project, *Maintenance and Restriping Strategies for Pavement Markings on Asphalt Pavements in Louisiana*, Dr. Momen Mousa (PI) coordinated with Stripe-A-Zone to conduct striping field testing at LSU on August 28–30, 2020. Six different marking materials were applied, including four waterborne paints and two thermoplastic materials. Retroreflectivity measurements will be conducted using handheld retroreflectometers every two to three months over the project period.



# TECHNOLOGY TRANSFER ACTIVITIES

## RECORDING OF WEBINAR ON FUTURE IMPACTS OF CONNECTED AND AUTOMATED VEHICLES APPLICATIONS IS NOW AVAILABLE

The recording of Tran-SET's latest webinar, *Future Impacts of Connected and Automated Vehicle (CAV) Applications*, is now available online! It was conducted on June 10, 2020. Dr. Hany Hassan (LSU), Dr. Samer Dessouky (University of Texas at San Antonio), and Dr. Sabya Mishra (University of Memphis) discussed the potential impacts of the implementation of CAVs in the transportation industry and how truck platooning will impact the environment and existing pavements. We invite you to view the recording of the webinar 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):



Joint Tran-SET Webinar Series "Future Impacts of Connected and Automated Vehicle (CAV) Applications."

## JOINT TRAN-SET WEBINAR SERIES

Our upcoming webinar in the Joint Tran-SET Webinar Series, *Innovative Techniques in Detecting, Monitoring, and Planning for Flooding*, will be held on September 15, 2020. In this webinar, Drs. Gabriel Villarini and Witold F. Krajewski (The University of Iowa) will discuss the projected changes in flooding across Iowa; David Heimann (U.S. Geological Survey) will present geological survey streamflow and precipitation-based flood warning tools in communities in Missouri; and Dr. Suyun Ham (The University of Texas at Arlington) will present a real-time early detection of flooding using low-cost, high-sensitivity ultrasonic sensing of water level. We encourage you to join this webinar on [Tran-SET's website](#). Registration is free!

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



Joint Tran-SET Webinar Series on Innovative Techniques in Detecting, Monitoring and Planning for Flooding.



# 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:*

## PARTICIPATION IN REHAMS AND HALLIBURTON XCITE SUMMER CAMPS

As a part of Tran-SET's initiative to advance the transportation workforce and develop its next generation of leaders, Dr. Momen Mousa (program manager) provided an Introduction to Civil Engineering virtual lecture for future female engineers (Halliburton XCITE Summer Camp) and for multicultural students (REHAMS summer camp). After the presentation, the students were given engineering activities they could perform at home while being coached by LSU engineering students virtually. These real-time programs give high school students the chance to discover how engineers solve problems and, at the same time, allow them to explore multiple engineering disciplines.



## STEM RESOURCES



Tran-SET launched a new [webpage](#) to provide STEM (science, technology, engineering, and mathematics) resources to students, parents, and teachers. These resources include at-home STEM events, training for educators, STEM contests, educational videos, transportation/engineering events, and others.

## PRAIRIE VIEW A&M UNIVERSITY'S CENTER FOR ENERGY AND ENVIRONMENTAL SUSTAINABILITY GRANT AWARDS

Prairie View A&M University's Center for Energy and Environmental Sustainability (CEES), led by Dr. Raghava Kommalapati (Tran-SET associate director), has received grants in excess of \$3.7 million, in addition to the \$5 million award from the National Science Foundation (NSF) in October 2019. The center focuses on addressing challenging interdisciplinary problems, paving the way for scientific and technological breakthroughs in energy engineering to meet short- and long-term national needs. To develop its education and workforce, the center has a strong education component known as the Energy Engineering Research Learning Initiative (EERLI). The objectives of EERLI are to expand the energy curriculum and recruitment, coordinate student-centered professional development activities, increase K-12 and community engagement efforts, and develop a network of industry partners and research collaborators. For more information on the center, please visit the [CEES website](#).



*CEES team.*