

# **TRAN-SET** QUARTERLY NEWSLETTER

# SUMMER **2020** • ISSUE **10**

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# **ABOUT TRAN-SET**

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions across five states (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas) and is led by LSU. It 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

Warm Summer Greetings from Tran-SET!

I want to wish everyone a happy and safe Summer season. I would also like to take this opportunity to personally thank all Tran-SET staff, associate directors, program directors, and principal directors for their efforts in these unprecedented times. Your work is much appreciated and is directly responsible for Tran-SET's achievements throughout 2020.

In this newsletter, I am happy to report Tran-SET's continued progress. I am especially excited about our response to COVID-19, including hosting a webinar earlier this month highlighting the impacts of the pandemic on transportation and logistics. However, I would like to dedicate my forum to informing you of two important announcements.

Tran-SET will hold the 2020 Tran-SET Conference virtually due to the current COVID-19 situation nationwide and the continued restrictions and guidelines states and individual organizations have implemented. The event is e-hosted by the University of New Mexico and New Mexico State University and co-sponsored by the ASCE Construction Institute (CI). The purpose of this annual conference is to educate, engage, and work with varied stakeholders (academics, industry professionals, state DOTs, and other government agencies) to solve transportation challenges facing the South-Central United States.

Tran-SET is currently soliciting research problem statements for its fifth cycle of funding. Principal investigators/researchers, Center Advisory Board members, and other community/agency leaders are encouraged to participate. Problem statements for the fifth cycle of funding are due by August 30, 2020. For more information, please visit <u>Tran-SET's website</u>.

I invite you to read through our Summer 2020 newsletter and learn more about our research, technology transfer, educational, and workforce development activities. If you haven't done so already, I highly encourage everyone to follow us on <u>LinkedIn</u> and <u>Twitter</u>. You may also subscribe to our mailing list <u>here</u>.

Enjoy!

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





# CALL FOR FIFTH-CYCLE PROBLEM STATEMENTS NOW OPEN!

Tran-SET is currently soliciting research problem statements for its fifth-cycle of funding. Any and all principal investigators/ researchers are welcomed to submit problem statements, including those not part of Tran-SET or not located within Region 6. However, problem statements selected after review/ranking that were submitted by institutions not part of Tran-SET (including those in Region 6), will move forward as an open request for proposal (RFP). Only institutions within Region 6 (including those not part of Tran-SET) will be able to apply to an open RFP. Any and all Center Advisory Board (CAB) members and other community/agency leaders are also welcomed to submit problem statements. Problem statements for the fifth cycle of funding are due by **August 30, 2020**. For more information please visit **Tran-SET's website**.

# UPDATE ON FOURTH-CYCLE PROPOSALS

Tran-SET issued a call for problem statements (July 2019) for its fourth-cycle of research projects. A total of 96 problem statements were received (August 2019), and they were reviewed and ranked by regional leaders (October 2019). Submitters of the chosen problem statements were contacted (November 2019), and 43 project proposals were received (February 2020). Proposals were reviewed by subject matter experts (April 2020) and revised accordingly by the submitted research teams (May 2020). Tran-SET is currently in the process of making award decisions and finalizing the fourth-cycle funding program. **All fourth-cycle projects are anticipated to start August 2020**.

# THIRD-CYCLE PROJECTS RESEARCH REPORTS

Tran-SET's third-cycle projects are in progress and their second progress reports and trackers were submitted on April 2020. Tran-SET's third-cycle projects will end their technical phase on August 2020. Please stay tuned as we will disseminate these reports when available. Don't miss a report by subscribing to our <u>mailing list!</u>

# THIRD-CYCLE TECHNOLOGY READINESS LEVEL (TRL) ASSESSMENTS

As part of our Technology Transfer (T2) Plan, within two months of the technical (research) phase ending, Tran-SET will organize and conduct TRL assessments for each project. This includes working with each principal investigator to define a panel comprised of the PRC and at least one other member considered to be a potential adopter. The assessment involves a webinar (or in-person meeting) where the panel assesses: (1) the level in which the research product (technology) is ready for implementation, (2) which elements the technology currently lacks regarding implementation, and (3) the next step(s) required to further ready the technology for implementation. 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 proven to be 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) better informing and engaging stakeholders, and (4) educating research teams and panel members on the use of the TRL scale and assessment processes.

# **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 <u>our website</u>.

### CORROSION MANAGEMENT SYSTEM OF REGIONAL REINFORCED CONCRETE (RC) BRIDGES

Dr. Homero Castaneda-Lopez – Texas A&M University, Dr. Ayman Okeil – LSU

The deterioration of concrete infrastructure due to reinforcing steel corrosion has been recognized as a major technical and economic challenge in the United States. One aspect is the natural degradation of the materials forming the reinforced concrete element while in service and under natural conditions. This rebar/concrete system has been extensively studied in laboratory but has rarely been inspected in the field. The use of new, quantitative, meaningful parameters in the characterization and inspection of concrete bridges should inform the development of procedures for corrosion management of the concrete/rebar system.

This project aims to develop a comprehensive, effective management system of corrosion-damaged RC structural elements. The system will encompass many components like modeling, characterization, and development of methodologies for conducting preliminary corrosion assessment; as well as an in-depth corrosion mechanism for both uniform and pitting corrosion, for selecting the most suitable repair/ inspection and corrosion control methods based on modeling to meet a qualitative/quantitative index, for monitoring component performance following repairs or control action, and finally, for creating experiment-based and data-driven probabilistic models of corroding RC structures. The result will be an integrated tool that merges materials, structures, and management systems for corrosion management.

# Side View

Reinforced concrete samples designed for corrosion index in the laboratory

# ADVANCED MODELING AND DESIGN METHODOLOGY FOR PAVEMENTS USING PLASTICITY-BASED SHAKEDOWN THEORY

Dr. Shengli Chen, Dr. Chao Sun – LSU

Pavement design is a process intended to find the most economical combination of layer thickness and material type for the pavement, considering the properties of the subgrade soil and the traffic to be carried during the service life of the road. Current methods of pavement analysis and design are more or less empirical in the United States (AASHTO, 1993), and have many shortcomings, like the inability to effectively consider the accumulation of plastic/permanent deformations. This makes it hard to achieve accurate and economical pavement designs.

The goal of this research is to develop an advanced model for the pavement performance assessment using the shakedown concept based on the plasticity theory, which will be a great improvement over the existing design methodologies, such as the empirical method and mechanistic-empirical method. It will result in a vehicle-road coupling model for more accurately estimating the additional dynamic vehicle load induced by pavement roughness considering time-variant traveling speed. This will, in turn, help develop a design approach capable of preventing rutting failure, as well as some other types of plastic failure of flexible pavements. Furthermore, the outcomes of the proposed project will help evaluate pavement damage development to make optimized maintenance plans during its lifespan and has the potential to significantly reduce the huge costs of pavement maintenance in the United States.



Pavement system under moving vehicle load

# **RESEARCH IN PROGRESS: HIGHLIGHTS**

# LIFE CYCLE ENVIRONMENTAL IMPACT OF HOUSTON METRO SYSTEM – EVALUATION OF ELECTRIC ALTERNATIVES

### Dr. Raghava R. Kommalapati, Dr. Hongbo Du, Dr. Doeun Choe – Prairie View A&M University

Urban mass transit systems alleviate road traffic congestion and reduce the total greenhouse gas emissions (GHG) from the transportation sector. Houston METRO operates buses along 86 routes in the Greater Houston area and three light rail lines that have an average daily ridership of 61,000 passengers as of June 2018. A comprehensive energy and environmental life cycle assessment (LCA) study is necessary to quantify the improvements and identify any potential systemic modifications that could further lower environmental impact.

The objective of this study is to estimate the energy and environmental impacts from the total life cycle of the Houston METRO System and provide cost-benefit analysis for an electrification alternative. The objectives in realizing the overall goal are estimating the total GHG and CAP emissions from the current operational routes of the bus and light rail fleet of the Houston METRO system; quantifying the total energy and environmental impact resulting from Houston METRO; evaluating the net change in energy and environmental impact in transitioning from METRO fleet to electric vehicle; determining the impact of electrification and expansion of Houston METRO system on regional air quality and global warming potential; comparing the improvement in sustainability resulting from varying degrees of traffic migration/passenger adoption from automobiles; and finally, providing guidance to stakeholders and community leaders within Houston on the adoption of electric vehicles and expansion of METRO ridership.

# HOLISTIC NETWORK-LEVEL ASSESSMENT OF PAVEMENT FLOOD DAMAGES USING FEMA'S HAZUS FLOOD MODELS AND MAINTENANCE COST PREDICTION

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

Due to catastrophic disasters, roadways in the South-Central Region suffer not only from flood inundation but also from many long-term recovery processes that result in high maintenance costs. Current methods for evaluating roadway damages are inefficient and labor-intensive because they involve a large number of visits to damaged sites, as well as physical analyses. In addition, even though existing methods provide a detailed damage analysis of pavement in a particular location for a particular time, there is still a sizable knowledge gap in understanding network-level roadway functional/ structural damages before-and-after historic flooding, as well as assessing flooding effects on roadways over time. Also, a lack of long-term investigation on roadway damages caused by floods has resulted in the absence of accurate maintenance cost prediction.

The main objective of this study is to develop a holistic roadway damage assessment method using FEMA's Hazus flood models and the pavement condition data collected over many years. This research project aims to provide a means for Louisiana and Texas (eventually to all Region 6 states) to intuitively identify roadway damage patterns at the network level caused by flooding over time, as well as accurately predict roadway maintenance cost. The anticipated benefit is to predict the long-term maintenance cost by identifying flood impact on roadways over time.



System boundary and unit processes for the LCA study of HSR system in Texas



Hurricane Harvey Simulation for State of Louisiana and Baton Rouge in HAZUS

# **RESEARCH IN PROGRESS: HIGHLIGHTS**

### INVESTIGATING THE IMPACTS OF TRUCK PLATOONING ON TRANSPORTATION INFRASTRUCTURE IN THE SOUTH-CENTRAL REGION

Dr. Hany Hassan – LSU,

Dr. Samer Dessouky – University of Texas at San Antonio, Dr. Alireza Talebpour – Texas A&M University

Freight and the efficient movement of freight is a critical component to the economy of the southern United States, especially to states in Region 6 (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas). Truck platooning is a connected and automated vehicle (CAV) application of interest to the freight industry due to its potential energy savings, safety benefits, and ability to reduce highway congestion. However, the short distances maintained between vehicles and more precise lane-keeping lead to a higher concentration of load being placed on the transportation infrastructure. Self-driving truck technology is continually being developed



Various truck platooning demonstrations: (a) joint demonstration by FHWA; FMCSA; and Volvo, (b) joint testing by FHWA; TxDOT; TTI; and several private companies, (c) demonstration by Peloton, and (d) demonstration by Volvo and FedEx and will grow increasingly more available on public roadways. Even though this technology is not available to the public, it is envisioned to include short following distances and accurate lateral positioning.

The main goals of this study are to quantify the operational and environmental impacts of diverse truck platooning configurations at both the corridor- and network-level through a series of modeling case

studies. Resulting impacts to the structural pavement from truck platooning implementations will be analyzed using finite element (FE) modeling. Finally, a feasibility study for implementation will be developed comparing the benefits of truck platooning with the potential costs associated with the increase in pavement loads. Results from the case studies may be taken into account for CAV-related policy, planning, and integration strategies.

# SELECTING THE MOST FEASIBLE CONSTRUCTION PHASING PLANS FOR URBAN HIGHWAY REHABILITATION PROJECTS

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

Approximately 20% of the U.S. highway system is under construction, resulting in more than 3,000 construction work zones (CWZ) across cities and states. Delays and rerouting due to U.S. highway rehabilitation projects account for the average driver wasting 67 hours on the road and 32 gallons of fuel annually and 97,000 crashes each year due to sudden speed drops and mandatory lane changes. For this reason, daily commuters and businesses are facing a growing need to improve mobility around work zones. The main concern is the lack of methods to evaluate the level of mobility disruption caused by construction work zones.

This project aims to create a unified data-driven model for autonomously predicting the levels of mobility disruption caused by the presence of a critical work zone under arbitrary and user-defined rehabilitation scenarios. The proposed project will result in a significant step forward in the ability of DOT planners and engineers to efficiently assess the impacts of pursued highway rehabilitation alternatives, select the most feasible construction phasing/staging scenarios, and thus, significantly improve mobility and reduce the amount of safety incidents involving work zones. This research will greatly benefit researchers and industry practitioners, the traveling public, and overall society by significantly improving mobility and safety in and between CWZs and positively affecting regional development.



CWZ impacts of various "what-if" construction scenarios assessed in terms of delayed minute and user delay cost at a much higher level of prediction through learning and generalization.

# **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 CONFERENCE



Tran-SET will hold the 2020 Tran-SET Conference virtually, due to the current COVID-19 situation nationwide and the continued restrictions and guidelines states and individual organizations have implemented. The event is e-hosted by the University of New Mexico and New Mexico State

University and is co-sponsored by the ASCE Construction Institute (CI). The purpose of this annual conference is to educate, engage, and work with varied stakeholders (academics, industry professionals, state DOTs, and other government agencies) to solve transportation challenges facing the South-Central United States. For more information about the conference, please visit <u>our website</u>.

# RECORDING OF WEBINAR ON IMPACTS OF COVID-19 ON TRANSPORTATION NOW AVAILABLE

The recording of the latest episode in the Joint Tran-SET Webinar Series, Impacts of COVID-19 on Transportation and Logistics, is now available online. In this webinar, Laura Perrotta (American Highway Users Alliance), Brandon Orr (Stantec), and Herby Lissade (Caltrans, Haiti Engineering Inc.) discussed how the transportation industry and its policies have adapted to the pandemic so far, as well as the main impacts of COVID-19 on the future of transportation and freight movement.

We invite you to view the recording of the webinar on <u>Tran-</u> <u>SET's website</u> or directly on <u>Tran-SET's YouTube page</u>.

We would also like to sincerely thank the webinar presenters listed below:



# **TECHNOLOGY TRANSFER ACTIVITIES**

### UPCOMING JOINT TRAN-SET WEBINAR

Our next episode of the Joint Tran-SET Webinar Series will be held on June 10, 2020, and is titled, Future Impacts of Connected and Automated Vehicle (CAV) Applications: Truck Platooning." In this webinar, Dr. Hany Hassan (LSU), Dr. Samer Dessouky (University of Texas at San Antonio), and Dr. Sabya Mishra (University of Memphis) will discuss the impacts of truck platooning on highway infrastructure, the role of platooning on vehicle electrification, and the pros and cons of the adoption of highly automated vehicles, as well as its anticipated implementation barriers and concerns.

We invite you to view the recording of the webinar on <u>Tran-</u> <u>SET's website</u> or directly on <u>Tran-SET's YouTube page</u>.

We would also like to sincerely thank the webinar presenters listed below:



# FIRST NON-PROPRIETARY, ULTRA-HIGH PERFORMANCE CONCRETE OVERLAY IMPLEMENTATION IN THE U.S.

Dr. Craig Newtson is leading a Tran-SET project in which the bridge off Exit 150 in Socorro, New Mexico, will be overlaid with a non-proprietary, ultra-high performance concrete (UHPC). This will be the first non-proprietary UHPC overlay constructed in the country. NMDOT has approved the project and a contractor has been selected, as well as the subcontractor that will actually perform the overlay work.





Bridge off Exit 150 in Socorro, New Mexico.

Lateral view - Bridge off Exit 150 in Socorro, New Mexico.

# HUMAN INTERACTION WITH AUTOMATED VEHICLES (AVS) USING VIRTUAL REALITY (VR)

Autonomous vehicles are a promising solution to most of today's transportation challenges, such as efficiency, safety, equity, and environmental impacts. Nevertheless, there will be a transition period in which both AVs and human-driven vehicles share the road, which means there is a need to study the interaction between both. Dr. Nick Ferenchak, from the University of New Mexico, is leading a project that implements VR as a tool of interaction between AVs and humans. The bicycle and driving virtual reality simulators are now up and running. Stay tuned for interesting results!



Bicycle virtual reality simulator



Driving virtual reality simulator

# **EDUCATIONAL & WORKFORCE DEVELOPMENT**

Tran-SET has a firm initiative to advance the transportation workforce and to 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. Below, you'll find a showcase of select, educational and workforce development activities sponsored by or involving Tran-SET.

# TRAN-SET TRANSPORTATION VETERAN SCHOLARSHIP



As part of Tran-SET's initiative to advance the transportation workforce and to develop its next generation of leaders, we recently offered a scholarship to two veterans over a period of two years.

One student has been accepted and is currently working on Tran-SET-funded research projects. Please visit our website for further detail on the Internship and its activities.

### LSU HIGH SCHOOL STUDENT RESEARCH (HSSR) INTERN PROGRAM

LSU

Drs. Momen Mousa, Husam Sadek, Hai Lin, and Yongcheol Lee (principal investigators) are participating in the LSU High

School Student Research (HSSR) Intern program organized by LSU to include four high school students in their Tran-SET research projects this summer. Due to COVID-19, all of the meetings are held online, and the program might be extended through Fall 2020, if needed.

### **U.S ROAD ASSESSMENT PROGRAM**



Dr. Momen Mousa (Tran-SET program manager) discussed with Laura Perrotta (president and chief executive officer) possible future collaboration opportunities with the American Highway Users Alliance in May 2020. Tran-SET was also introduced to

AHUA's sister foundation organization, the Roadway Safety Foundation (RSF). As a part of this collaboration, RSF offered Tran-SET access to its U.S. ROAD ASSESSMENT PROGRAM (usRAP), a free online training program that offers highway engineers, safety planners, and transportation officials unique and user-friendly tools for evaluating the safety of their road networks and limited resources for improvements to the areas where they will have the most impact. Future collaboration will also include joint webinars, Tran-SET researchers participating in RSF's regular broadcasts, site visits, etc. Please stay upto-date with these activities by following us on LinkedIn and Twitter, visiting our website, and subscribing to our mailing list! [RS\_Foundation]

[RS\_Foundation; Logo of Roadway Safety Foundation]

### 2020 CREATE@STATE SYMPOSIUM



Five students from Dr. Zahid Hossain's (Tran-SET principal investigator) research

team presented their findings at the 2020 Create@State symposium held on April 22-24, 2020. in Jonesboro, Arkansas. The students virtually presented their posters and made oral presentations (via voice thread). One of the five students received the first-place prize in the Graduate Category of the College of Engineering and Computer Science.