TRAN-SET
QUARTERLY NEWSLETTER

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INSIDE THE ISSUE

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!

As with each quarterly newsletter, I am proud to report Tran-SET's continued progress. We are organizing our 2022 Tran-SET Conference to be held in Austin, Texas, August 31-September 2, 2022. The conference is co-sponsored by the ASCE Construction Institute and hosted by the University of Texas at San Antonio. This 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**.

The call for problem statements for our sixth cycle of funding has ended, and Tran-SET received 68 problem statements! We finalized the review and selection of the sixth-cycle problem statements and sent out requests for proposals accordingly.

Tran-SET has also been awarded the Council of University Transportation Centers (CUTC) Workforce Development Leadership Award, which recognizes outstanding leadership in designing and delivering workforce development programs. Dr. Momen Mousa (Tran-SET program manager) received the award during the 2022 TRB Annual Meeting in Washington, D.C. He has also been awarded a grant from the CUTC New Initiatives Program to develop a workforce development program that will educate transportation professionals on emerging transportation topics. For more information, please visit the CUTC **website**.

If you haven't done so already, follow us on **LinkedIn** and **Twitter**. You may also subscribe to our mailing list **here**. I invite you to read through our Winter 2022 newsletter and learn more about our other research, technology transfer, educational, and workforce development activities.

Enjoy!

Dr. Marwa Hassan

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

RESEARCH PROGRAM UPDATES

FOURTH-CYCLE PROJECTS FINAL RESEARCH REPORTS

The technical phase of Tran-SET's 40 fourth-cycle projects ended on August 2021. The projects' third progress reports/trackers and final reports were submitted in mid-August 2021. Tran-SET staff is currently conducting a review of the submitted final reports and datasets. The next deliverable is the implementation report, which is due at the end of the project implementation phase in February 2022. Tran-SET will circulate the implementation reports as soon as they are available. Fourth-cycle research reports and corresponding datasets will be available soon through **LSU Digital Commons**.

FIFTH-CYCLE PROGRESS REPORTS AND TRACKERS

Tran-SET's fifth-cycle projects started on August 1, 2021. The first PRC meeting for the awarded fifth-cycle projects was held in September, and their first progress reports and trackers were due on December 1, 2021. Two-page fact sheets, describing the problem statement, objective, intended implementation, and other project information, have been developed for all awarded projects and are available on Tran-SET's **website**.

PROBLEM STATEMENTS FOR SIXTH-CYCLE PROJECTS

The call for problem statements for Tran-SET's sixth-cycle of funding has ended. In total, Tran-SET received 68 problem statements from various institutions. Six were collaborative, involving multiple partnering institutions. Problem statements were carefully reviewed and selected, and requests for proposals have been sent to the respective institutions. Please see our **website** for more information.

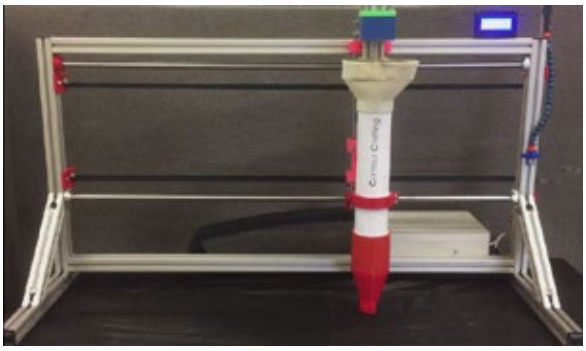
RESEARCH IN PROGRESS: HIGHLIGHTS

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**,

Resilient 3D-Printed Civil Infrastructure With Ultra-High-Performance Engineered Cementitious Composites (UHP-ECCs)

Dr. Gabriel Arce – LSU

The advent of construction 3D printing (3DP) technology has opened the possibility of revolutionizing construction productivity worldwide. However, one important barrier to broader adoption of construction 3DP in civil infrastructure is the difficulty in providing printed structural components with reinforcement to achieve sound structural performance under different loading conditions. As such, the implementation of intrinsically reinforced cementitious materials has the potential to address this barrier and yield significant benefits, such as enhanced structural capacity, durability, and resiliency. For this reason, novel, ultra-high strength, highly ductile cementitious composites like Ultra-High-Performance Engineered Cementitious Composites (UHP-ECCs) are excellent candidates for the 3DP of structurally sound civil infrastructure. This project proposes the development



Linear 3DP System.

of UHP-ECC materials with rheological characteristics tailored specifically for construction 3DP application. Furthermore, this project aims to conduct a comprehensive evaluation of the hardened properties of printed UHP-ECC.

The aim of the proposed study is to develop and evaluate UHP-ECC materials for 3DP application. To this end, rheological characteristics of UHP-ECC will be specifically tailored to allow for 3DP functionality. Furthermore, this project aims to conduct a comprehensive evaluation of the hardened properties of 3DP UHP-ECC specimens compared to those of UHP-ECC specimens cast using conventional techniques.

Investigation of the Impact of Rainfall Patterns on Highway Slope Instability

Dr. Md Jobair Bin Alam – Prairie View A&M University

Highway embankments are one of the most crucial elements of the transportation infrastructure system in the United States. Therefore, keeping the integrity of the highway slopes is of utmost importance for economic sustainability of the country. However, the variation of environmental conditions and the presence of unsuitable soil that constitutes many highway embankments often pose serious threat to these infrastructures' stability and cause property damages and casualties. Highway embankments constructed with unsuitable soil, especially expansive clay soil, are susceptible to reduction in their shear strength properties and eventually cause failure. The southern Texas (greater Houston region) has experienced multiple natural disasters and subsequent deterioration of the transportation infrastructures (e.g., pavement distress, slope failure, etc.). Among these, the variable rainfall pattern is one of the major causes of slope instability. Additionally, substantial heterogeneities of geological composition have been observed in this region.

The overall goal of this study is to develop the rainfall patterns for south Texas (Houston) and numerically evaluate their impact on the slope performance. The typical measurement of rainfall is executed by rain gauge network, which is straightforward to estimate the surface precipitation and has significant spatial variation. To achieve greater resolution in rainfall measurement, this proposed research will incorporate weather radar networks. Furthermore, the aim is to develop a geotechnical database containing information such as sub-soil characteristics (e.g., physical, hydraulic, strength), slope geometrical configuration, and other pertinent highway slope information for this region to synthesize the hydro-geotechnical analysis.

Highway embankment.

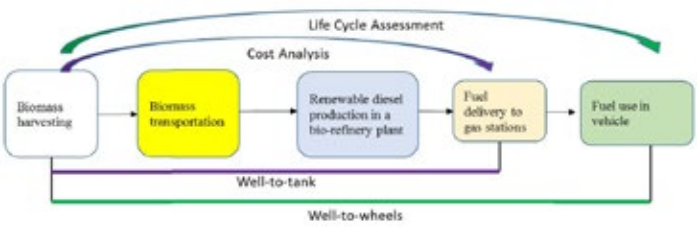
RESEARCH IN PROGRESS: HIGHLIGHTS

Potential Use of Renewable Diesel for Transportation in Texas and its Environmental Impacts Under Uncertainties Caused by COVID-19

Dr. Raghava R. Kommalapati – Prairie View A&M University

Compared to biodiesel, renewable diesel is a relatively new biofuel that can also be used for diesel vehicles. Some advantages of renewable diesel over biodiesel are no special requirements for the vehicle, cold startup, and fuel storage. There is no renewable diesel plant in Texas, and no action is being considered on renewable diesel application for Texas' transportation. Additionally, the COVID-19 pandemic has been an enormous disruption, with immense economic impacts in the US. It also caused a sharp drop in fuel prices, as economic activities plummeted during the lockdown.

The proposed project would address this critical gap and develop an environmental life cycle and cost assessments to produce renewable diesel in Texas and its local applications in transportation. A novel and key component of this work would be the development of a decision-making tool that would help determine where the renewable diesel processing plant should be built. The analysis will also explore the long-term impacts of the COVID-19 pandemic on life-cycle cost analysis (LCCA) of renewable diesel production in Texas. A new LCCA model will be designed with consideration for uncertainties, such as resources, transportation, and fuel production, caused by the COVID-19 pandemic. The decision-making tool developed in this study would help the biofuel industry to make the decision on the development of renewable diesel in Texas.



The system boundary and key stages of renewable diesel used in transportation.

Data Driven Identification of COVID-19 Impacts on E-Commerce and Freight Movement

Dr. Kate Hyun – The University of Texas at Arlington

E-commerce freight truck.

Online shopping has grown rapidly worldwide for the past two decades. In the US, the share of online retail sales grew from 4% in 2009 to 9.8% for the third quarter in 2018. This growth generates significant freight movement demand. The American Transportation Research Institute (ATRI) reports a 17.7% increase in urban truck VMT (vehicle miles traveled) in the US from 2011 to 2016, which is drastically higher than rural truck VMT (2.2 % increase) for the same time period. The recent pandemic significantly accelerates this trend. Walmart grocery e-commerce increased more than 74% during the pandemic, and consumer spending on Amazon between May and July 2020 increased by 60% from the same time in 2019. Researchers expect that e-commerce sales will reach $6.5 trillion by 2023, a nearly 20% growth from 2020. Studies report that people have developed their new habit of online shopping in their daily routine, which substitutes and complements their shopping trips and activities, permanently.

This research will comprehensively explore the current trends of online and offline shopping activities by utilizing data fusion and analytics to gain insight into how e-commerce might influence future passenger travel and freight movements. Furthermore, it will investigate how last mile operations have impacted network disruptions, air quality, and safety. Understanding freight movements at micro levels will provide valuable knowledge on effectively allocating resources and developing policy and planning strategies, such as adjusting parking policy, promoting off-peak delivery, and adjusting the capacities of roadway infrastructure to properly control and manage increased shipment movements to preserve existing infrastructure, reduce congestion and air quality impacts, and enhance road safety.

RESEARCH IN PROGRESS: HIGHLIGHTS

Permeable Curb and Gutters for Storm Water Control

Dr. Drew Johnson – University of Texas at San Antonio

Rendering of testing apparatus.

Storm water pollution is a pressing problem and a variety of low-impact development-stormwater control measures (LID-SCMs) have been studied for reducing pollutant loadings to receiving waters. However, no measures have been widely adopted at levels necessary to fully mitigate stormwater pollution in high-density urban environments.

The main goal of this project is to develop a proof of concept for how new linear LID-SCM permeable materials could be installed along curb and gutters to treat non-point source pollution for regular streets. The configuration will entail hollow-core permeable curbs that collect filtered water to be conveyed as storm drainage. Pollutants are removed prior to entering receiving waters. Required permeability, porosity, and associated material pollutant removal efficiencies and cleaning options need to be characterized for this stormwater collection configuration to identify best form and function when utilized in urban environments. An experimental test apparatus will be constructed to simulate a typical street profile and water depths expected to occur during typical storm events. This apparatus will be used to determine—the fraction of water, for a typical design rain event, that can be treated by the permeable curb; the amount of solids that may be removed from the water treated; the potential for clogging and fouling of the permeable curb; the ability to recover lost performance through vacuum cleaning of the porous curb; and training of students, outreach to the public, and dissemination of research findings to the broader scientific community.

Increasing Bridge Durability and Service Life With LIDAR-Enhanced Unmanned Aerial Systems (UAS)

Dr. Fernando Moreu - University of New Mexico

Conventional inspection of bridge constructions, in general, is rather time-consuming and often cost-expensive due to traffic closures and the need for special heavy vehicles, such as under-bridge inspection units or other large-lifting platforms. Visual inspection of the bridge construction process based on the non-equipped eye is the most commonly used method of reinforced concrete construction inspection. However, this method is subjective, costly, time-consuming, and may cause safety risks, such as falling or trying to reach far components. LiDAR-based methods are highly accurate and able to collect point clouds and enable measurements to be collected with non-contact means. It is also faster. Bridge durability and service life depend heavily on the construction means and methods being closely monitored and tracked so that they are accounted for and known for future decisions of the agency. This requires a highly up-to-date and effective monitoring system for all critical constructions of bridges. A flexible and valuable tool, such as unmanned aerial systems (UAS) with special sensors like a LiDAR scanner, can be precious for carrying out the monitoring tasks.

The proposed research project will expand the positive results obtained in the past related to collecting rebar spacing in bridge construction using LiDAR. Capabilities will be built up and adapted to the technical demands imposed by COVID-19 of limited interaction by automatizing the LiDAR scanning using unmanned aerial systems (UAS). This new technology is also called LiDAR-equipped UAS technology. The goal of this project is to use LiDAR-equipped UAS and build the appropriate software/hardware tools that will help enable the construction inspector of the future.

LiDAR-equipped UAS.

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****!*

2022 Tran-SET Conference

The 2022 Tran-SET Conference will be held in Austin, Texas, tentatively on August 31–September 2, 2022. The conference is co-sponsored by the ASCE Construction Institute and hosted by the University of Texas at San Antonio. This 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 ASCE and will provide bibliographic information for each proceeding paper to abstracting and indexing (A&I) services (e.g., Elsevier Engineering Index (EI), National Academies, ExLibris Primo, etc.). For any additional information, please contact **transet@lsu.edu** with any questions.

UTSA
The University of Texas at San Antonio™

CUTC Workforce Development Leadership Award

Tran-SET was selected to receive this year's CUTC Workforce Development Leadership Award on behalf of the Council of University Transportation Centers (CUTC). This award is given to an institution that demonstrates outstanding leadership in designing and delivering workforce development programs. For substantial and impactful contributions to workforce development, CUTC was very pleased to make this award to Tran-SET. The award was presented to Dr. Momen Mousa (Tran-SET program manager) at the 2022 CUTC Awards Banquet.

Council of University Transportation Centers

Friday Transportation Seminar Series

"Friday Transportation Seminar Series" organized by CUTR.

Dr. Marwa Hassan presented on December 3, 2021, at the "Friday Transportation Seminar Series," organized by the Center for Urban Transportation Research (CUTR) at the University of South Florida. This presentation was an overview of the regional UTC Tran-SET, followed by an introduction of some innovative pavement material advancements that were developed by Tran-SET funding, including low-cost ECC, EGC, self-healing concrete pavement materials, and a detailed overview of self-healing/self-rejuvenating asphalt technologies. For more information on the seminar series, visit the **CUTR website**.

Joint Tran-SET Webinar Series: Recording Now Available

Tran-SET organized a webinar on December 9, 2021, on "Improving Safety and Reliability of Rails." Transportation experts discussed the effects on traffic safety and vulnerable road users of rail transit, as well as multimodal linkages to and opportunities for proposed stations for future passenger rail service between Baton Rouge and New Orleans. The webinar was jointly hosted by LSU and Oklahoma State University. The recording of the webinar is now available on Tran-SET's **website** or directly on Tran-SET's **YouTube page**.

Webinar: "Improving Safety and Reliability of Rails."

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:

Tran-SET Seminar Series

As a part of Tran-SET's seminar series, "ITS Applications to Support Smart Cities," Herbert Moore, state transportation leader at Gresham Smith, discussed the current and past ITS-related projects that Gresham Smith has worked on and why and how ITS elements are applied to the projects. Moore is a licensed Professional Engineer in eight states, Professional Land Surveyor, and a Professional Traffic Operations Engineer. He worked as a traffic engineering consultant in private industry for more than 10 years before leaving to become the District 61 traffic operations engineer for LADOTD. In 2014, he joined Gresham Smith to lead and develop Louisiana operations.

Tran-SET Seminar Series,
"ITS Applications to Support Smart Cities."

Back-to-School STEM Festival

On November 20, 2021, Tran-SET participated in the Back-to-School STEM Festival, which took place at the Southeastern Louisiana University campus in Hammond, Louisiana. Topics such as engineered cementitious composites, engineered geopolymer composites, and bioconcrete were presented using hands-on materials. Fact sheets about all projects were handed out to interested students and staff. For more information, visit the **STEM Fest website**.

Tran-SET's STEM fest presenters.

Augmented Reality for Design and Maintenance of Infrastructure

Researchers from the Smart Management of Infrastructure Laboratory at the University of New Mexico in Albuquerque are advancing research in augmented reality (AR) for design and maintenance of critical infrastructure, with an emphasis on the use of artificial intelligence for crack detection of structures. UNM is developing several new AR applications and interfaces that will transform the future of work inspectors. Collaborations include, but are not limited to, the Organization, Information, and Learning Sciences (OILS) program of the UNM, NCHRP, the University of Kansas, Air Force Research Laboratory, National Academy of Sciences, Federal Railroad Administration, New Mexico Consortium, Office of Naval Research, and New Mexico Space Grant Consortium. For more information, visit the **SMILAB's website**.

Inspector with AG headset analyzing crack on pavement.