TRAN-SET
QUARTERLY NEWSLETTER

Spring **2022** • ISSUE **18**

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

Spring is Such a Beautiful Time of the Year!

As seasons change, I am happy to report Tran-SET's continued progress. Tran-SET has finalized selection and award of its sixth-cycle projects. A total of 39 research projects were awarded, and their start date was set on April 1, 2022. If you are interested in learning more about them, two-page fact sheets will be available on Tran-SET's website soon.

We will hold the 2022 Tran-SET Conference in Austin, Texas, 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. We encourage you to join the 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 a part of Tran-SET's dedication to education and workforce development, on March 18, Tran-SET participated in this spring's Southeastern Louisiana University Chemistry and Physics Seminar. We presented on several innovative transportation materials, such as engineered cementitious composites, engineered geopolymer composites, and bio-concrete using hands-on materials. The seminar took place at the SLU campus in Hammond, Louisiana. Attendees, including staff and students, were handed out project fact sheets.

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

Enjoy!

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

Dr. Marwa Hassan

RESEARCH PROGRAM UPDATES

FOURTH-CYCLE PROJECT IMPLEMENTATION REPORTS

The implementation phase of Tran-SET's fourth-cycle projects ended in February 2021. Tran-SET will circulate the implementation reports as soon as they are available. Fourth-cycle completed final reports and the corresponding datasets are now available through **LSU Digital Commons**.

FIFTH-CYCLE PROGRESS REPORTS AND TRACKERS

A total of 35 fifth-cycle projects were selected for award and started on August 1, 2021. Fact sheets describing the problem statement, objective, intended implementation, and other project information are now available on Tran-SET's **website**.

PROBLEM STATEMENTS FOR SIXTH-CYCLE PROJECTS

Proposals for Tran-SET's sixth cycle of funding have been reviewed and ranked by regional transportation leaders/experts. Tran-SET received a total of 40 proposals in various areas of expertise within the transportation field. A total of two proposals were collaborative, involving multiple partnering institutions. This shows the increasing interest in our research program! Selection of the sixth-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**,

A New Generation of Dense-Graded Asphalt Mixtures With Superior Performance Against Stripping and Moisture Damage

Dr. Mostafa Elseifi – LSU, Dr. Zahid Hossain – Arkansas State University

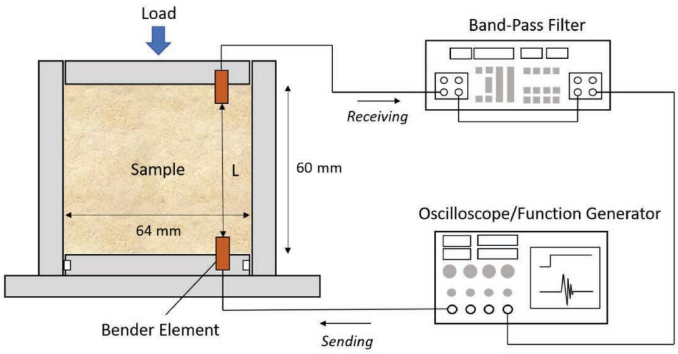
The presence of moisture beneath the pavement surface is a matter of great concern, as it is responsible for significant distresses such as stripping, fatigue cracking, rutting, and poor durability of asphalt mixes. Asphalt concrete (AC) stripping, which is a chronic problem in flexible pavements in Louisiana and Arkansas, refers to the loss of bond between the aggregate and asphalt binder usually caused by the accumulation of moisture underneath the pavement surface. In Louisiana, a shallow groundwater table (GWT) and heavy rainfall conditions (average annual rainfall of 60 inches) throughout the year make the pavement highly vulnerable to water entrapment and moisture damage. The effect of AC stripping is manifested in the roadway through poor durability of the mixes and shorter service life. These pavement distresses greatly affect user safety, pavement performance, and cost-effectiveness of maintenance and rehabilitation activities.

This project aims to develop a new generation of dense-graded asphalt mixtures that would provide superior performance against AC stripping and moisture damage. To develop this improved asphalt mixture, the current state of practice, including aggregate type and gradation and additives, will be reviewed and comprehensively evaluated. Furthermore, innovative ideas will be evaluated in the laboratory, including the use of hydrophobic nanomaterials and emerging anti-stripping agents such as Evotherm and vegetable-based oils, recycled products such as crumb-rubber, warm-mix asphalt technologies, and adhesion promotors.

AC Stripping Damage in Flexible Pavement in Louisiana

Development of Soil-Biochar Mixtures as a Sustainable and Multifunctional Roadway Fill Material

Dr. Hai Lin – LSU



Experimental setup of the 1D consolidation test

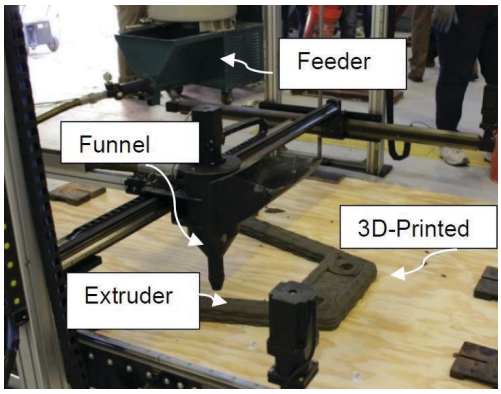
Many lightweight fill materials have limited applications due to their high costs and energy-intensive manufacturing processes. Biochar is an environmentally friendly and economical carbon-rich product formed by combusting waste biomass (e.g., forestry and agricultural residues) in an oxygen-limited environment through a process known as pyrolysis. Since biochar has a much lower density than typical soils, biochar is suitable for roadway applications as a lightweight fill material. Furthermore, biochar has a high surface area and porosity and excellent ability to adsorb a variety of contaminants, which have been amended in the soil to increase soil-water retention, reduce potentials of soil cracking and erosion, adsorb contaminants, and enhance soil aggregation. Due to these favorable properties of biochar, soil-biochar mixtures have high potential to serve as a multifunctional lightweight fill material for roadway embankment applications that decrease the applied load to foundation soil, enhance the factor of safety against slope stability failure, reduce the soil erosion and cracking potential, and remediate the stormwater runoff.

This research project investigates the mechanical and hydraulic properties of sand-biochar mixtures as a sustainable and multifunctional fill material for roadway embankment applications. The goal of this research is to develop soil-biochar mixtures as a sustainable, economical, and multifunctional lightweight fill material for roadway embankment applications.

RESEARCH IN PROGRESS: HIGHLIGHTS

Evaluation of Fresh and Hardened Properties of 3D-Printed Engineered Cementitious Composites (ECC) Designed for Sustainable and Resilient Infrastructure Systems

Dr. Maryam Hojati – University of New Mexico



UNM Materials and Structures Lab 3D-Printing Systems

Additive manufacturing (AM) is revolutionizing many manufacturing fields, worldwide. AM enables the fabrication of 3D-objects by extruding filaments following a designed pattern. There are some challenges in applying AM to 3D printing of concrete structural elements. These limitations are mainly associated with the fresh properties of concrete mixtures, the possibility of cold joint formation between different layers, and the incorporation of reinforcing components (i.e., steel bars). Because of these limitations, conventional concrete mixtures cannot be used for the 3D-printing application. One of the crucial challenges against the broader adoption of concrete 3D printing is reinforcing 3D-printed components to reach acceptable structural performance under different loading configurations. Therefore, we should design a concrete mixture that can be utilized as a rebar-free material but address both strength and ductility requirements. Recently, the development of Engineered Cementitious Composites (ECC) has neared the possibility to obtain both criteria (i.e., strength and ductility) in the concrete structures without embedding steel reinforcement. Hence, ECC can be used as an intrinsically reinforced cementitious material for the 3D printing of concrete components.

This project proposes ECC mixtures' design by mostly using the available local materials and admixtures in Region 6 and then studying the fresh and hardened properties of these 3D-printed mixtures as a function of mixture proportions. The ECC mixtures' properties, which will be evaluated, include the extrudability and buildability as the fresh properties and compressive, flexural, and tensile strength of 3D-printed ECC elements as hardened properties.

Impact of Truck Drivers and Transportation Infrastructure Characteristics on Large Truck Crashes

Dr. Hatim Sharif – University of Texas at San Antonio

For the past three decades, Texas has had the highest number of fatal crashes involving large trucks in the United States. Other states in Regions 6 also have high rates of large truck crashes. Due to the size and weight of large trucks, their crashes usually are very destructive. Although they have a significant impact on traffic safety in Region 6, very little analysis has been conducted on the risk factors associated with crashes involving large trucks, especially the roadway-related risk factors.

The purpose of this research is to perform a comprehensive evaluation of crash and operational data to identify the root causes of crashes involving large trucks in Texas. This includes the development of a database of large truck crash reports in the target area, calculation of crash counts and rates, and identifying road segments and intersections with highly concentrated large truck crashes and the unsafe actions that are contributing factors. The crash data analysis will include a detailed review of the crash narratives and diagrams as part of the database-building process to help elucidate the true causes. The evaluation will include operational and physical characteristics of the crash locations, severity of injuries, environmental conditions, characteristics of truck drivers, and road users' behaviors, as well as the common characteristics of the built environment that contribute to unsafe actions and conditions.

Large truck.

RESEARCH IN PROGRESS: HIGHLIGHTS

Development of Robotics & Automation Roadmap for Road Construction/ Maintenance Projects

Dr. Changbum Ryan Ahn - Texas A&M University,
Dr. Chao Wang – LSU

Examples of construction robots for road construction and maintenance

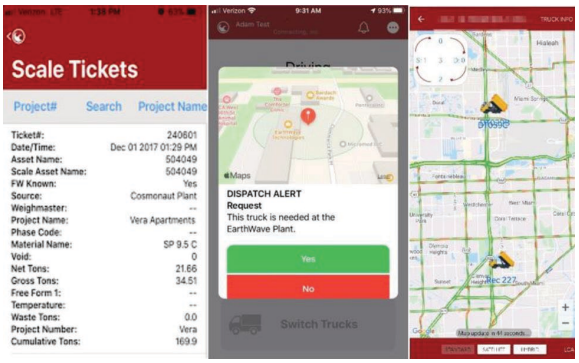
Over the past decades, the construction industry has seen a growing momentum to develop and implement innovative technologies driven by the market pressure to improve productivity, efficiency, safety, and quality. One of the most noteworthy emerging technologies, which has demonstrated its great potential to abate the high-labor intensity, is construction robotic technologies. Effectiveness and availability of robots motivate an imperative research question—how can the civil infrastructure industry utilize the robotic solutions in the construction and maintenance process? To answer this question, it is essential to explore not only what robotic technologies are appropriate to adopt but also how these technologies can be seamlessly integrated into the current practices to form an effective human-robot team.

Although the demand for new technologies and innovation is growing, the civil infrastructure industry lacks a decision-making mechanism, and as a result, the actual implementation is still very limited. To address this gap in practice, the goal of this study is to develop a decision-supporting framework to deploy robots with specific designs for certain construction and maintenance work. Considering the complex nature of civil infrastructure projects, as well as human-robot collaborative interaction, whether a technology is useful is affected by a number of factors such as organization, individuals within the organization, project constraints, the limitation of technologies, and so on. Therefore, in order to establish a decision-supporting framework to determine the most effective robotic technologies to implement, it is necessary to explore and evaluate such aspects of the task and the corresponding environment. Thus, this study proposes a hierarchical decision-supporting framework which first identifies key factors from previous literature and domain experts' knowledge that influence the robot adoption decision-making process. Given the identified multicriteria, it provides an evaluation method to support the decision of whether or not to adopt robotic technologies for a target task and subsequently, to determine detailed design of human-robot collaborative teaming.

Effectiveness Assessment of E-Ticketing Technology Adopted to Mitigate Covid-19 Challenges for Inspectors and Field Engineers in Transportation Projects: Guidebook Development for E-Ticketing (Electronic Track of Material Delivery) Implementation

Dr. Sharareh (Sherri) Kermanshachi – University of Texas at Arlington

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.



Screen captures of e-Ticketing technology

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.

TECHNOLOGY TRANSFER ACTIVITIES

Tran-SET has two objectives that guide its technology transfer (T2) activities - (1) to ensure that scientific and technological developments are: 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, hosted by the University of Texas at San Antonio, will be held in Austin, Texas, on August 31–September 2, 2022, and is co-sponsored by the ASCE Construction Institute. The start date of the call for papers for the conference was May 2022. This event is a great opportunity to learn about the efforts made by Tran-SET to solve regional transportation needs through sponsored research 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. For any questions, please contact **transet@lsu.edu**.

UTSA
The University of Texas at San Antonio™

UTSA Logo

Transportation Research Board Annual Meeting

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 8,000 transportation professionals are usually in attendance.

Tran-SET had a strong presence at the 2022 TRB Annual Meeting, which was held in Washington, D.C., in January 2022. Several Tran-SET-related lectern and poster presentations were conducted, and more than 35 Tran-SET researchers and students attended the meeting.

TRB
Transportation Research Board

Joint Tran-SET Webinar Series: Recording Now Available

Our latest webinar in the Joint Tran-SET Webinar Series, Warm Mix Asphalt to Improve Pavement Sustainability, was held on March 24, 2022. In this webinar, Dr. Zahid Hossain (Arkansas State University) discussed the Feasibility Assessment of Warm Mix Asphalt in Arkansas; Dr. Louay N. Mohammad (LSU) presented Long-Term Field Performance of WMA in Louisiana; and Dr. Debakanta Mishra (Oklahoma State University) presented the Warm Mix Asphalt: A Logical Choice in Our Drive Towards Net Zero Emissions. The recording of this webinar is available on Tran-SET's **website** and on Tran-SET's **YouTube page**.

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

Webinar: Warm Mix Asphalt to Improve Pavement Sustainability

TECHNOLOGY TRANSFER ACTIVITIES

Kent Seminar Fall 2021 and Spring 2022

Dr. Samer Dessouky (Tran-SET associate director) gave an overview on energy harvesting at the last Kent Seminar, which was organized by the Illinois Center for Transportation. He also provided an introduction to several energy-harvesting approaches using piezoelectric transducers, thermoelectric generators, electromagnetic systems, and solar films. He shared a detailed overview of prototypes currently developed at the University of Texas at San Antonio, including laboratory and field implementation. The recording of this seminar can be found on **YouTube**. Additionally, on April 7, 2022, Dr. Mostafa Elseifi (Tran-SET PI), Occidental Chemical Corporation Distinguished Professor in LSU's Department of Civil and Environmental Engineering, discussed optimizing the durability and functionality of open-graded friction course asphalt mixtures.

Logo of the Illinois Center for Transportation

LSU/CUTC/TRF Summit

Summit participants

A Joint Tran-SET Workforce Development Summit was conducted in partnership with the Council of University Transportation Centers (CUTC) and Transportation Research Forum (TRF) on April 25, 2022, in the LSU Foundation Building. Six different speakers presented their work and viewpoints on the topic of Climate Change Adaptation Strategies to Enhance Coastal Resilience. The speaker panel included Bren Haase (executive director, Coastal Protection and Restoration Authority), Christopher F. D'Elia (professor and dean, LSU College of the Coast and Environment), Harry Vorhoff (deputy director of coastal activities, Office of the Governor), Jay Grymes (WAFB TV chief meteorologist/LSU adjunct faculty), Patrick Banks (assistant secretary, LA Department of Wildlife and Fisheries), and Colette Pichon Battle (co-executive director, Gulf Coast Center for Law and Policy). A recording of the summit is available on Tran-SET's YouTube page. After the summit, a student competition was conducted in which the winner was awarded a one-month, fully paid internship that allows the student to travel to any of the Tran-SET partnering universities and work on-site on a research project related to climate change.

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:

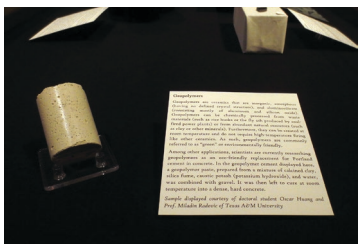
SLU Chemistry and Physics Seminar

On March 18, 2022, Tran-SET participated in this spring's Southeastern Louisiana University Chemistry and Physics Seminar. Tran-SET presented its research on several innovative transportation materials, such as engineered cementitious composites, engineered geopolymer composites, and bio-concrete using hands-on materials. The seminar took place at the SLU campus in Hammond, Louisiana. Attendees, including staff and students, were handed out project fact sheets.

Seminar

FIRE & EARTH: The Story of Ceramics Exhibit

Dr. Miladin Radovic (Tran-SET PI), along with a team of engineers from Texas A&M, helped organize the exhibit, FIRE & EARTH: The Story of Ceramics, in the Brazos Valley Museum of Natural History by preparing geopolymer samples for it with Tran-SET funding. The exhibit was on display from January 29, 2022 - May 28, 2022. Exhibit highlights included the ancient origins of ceramics, current uses, and the cutting-edge future of this remarkable material. In addition, visitors had the rare opportunity to explore advanced ceramic materials developed by Texas A&M.



Geopolymer sample in the FIRE & EARTH: The Story of Ceramics exhibit

ECC 3D Printing at UNM Lab

Dr. Maryam Hojati and her research team (Amir Bakhshi, Muhammad Saeed Zafar, and Reza Sedghi) at the University of New Mexico (UNM) are working on 3D-printable Engineer Cementitious Composites (ECC). The main aim is to address the problem of reinforcement in 3D-concrete-printing by enhancing the ductility of 3D-printed ECC. The UNM team has developed the 3D-printable ECC using local materials in Region 6 as part of a Tran-SET funded project. The experimental work mainly comprises investigating the rheological evolution, extrudability, buildability, shape retention, and mechanical performance such as compressive, tensile, and flexural strength of the cast and printed specimens. The project findings were presented at the 2021 Tran-SET conference and the 2021 TriDurLE symposium.

3D printing of ECC material