TRAN-SET
QUARTERLY NEWSLETTER

Fall **2022** • ISSUE **20**

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 Autumn!

I am delighted to report Tran-SET's continued progress. Tran-SET held its fifth annual conference in Austin, Texas, on August 31 – September 2, 2022. The conference was organized by the University of Texas at San Antonio (UTSA) and co-sponsored by the ASCE Construction Institute. The event included two keynote speakers, seven additional guest speakers, 40 lectern presentations, and 13 student posters. 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. Thank you to all Tran-SET staff, associate directors, CAB members, and program directors for making the Tran-SET conference a big success.

Tran-SET 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 are now available on Tran-SET's website. Funding priority was given to projects addressing materials, preservation, climate resilience, reconnecting communities following infrastructure reconstruction, broadband in rural areas and its impact on future traffic, impact of carpooling on greenhouse gases, impact of automated vehicles on future traffic, impact of working from home on future traffic, and underserved/underinvested communities.

Tran-SET also held its last webinar in the Tran-SET Webinar Series on September 23, 2022, on "Use of Wireless Technologies for Transportation Infrastructure Management." Three transportation experts discussed wireless technologies that are transforming the transportation industry, as well as the next steps towards implementation. A recording of the webinar is now available on our **Tran-SET YouTube Channel** and the **Tran-SET website**.

I invite you to read through our Fall 2022 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 **LinkedIn** and **Twitter**. You may also subscribe to our mailing list **here.**

Enjoy!

Dr. Marwa Hassan

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

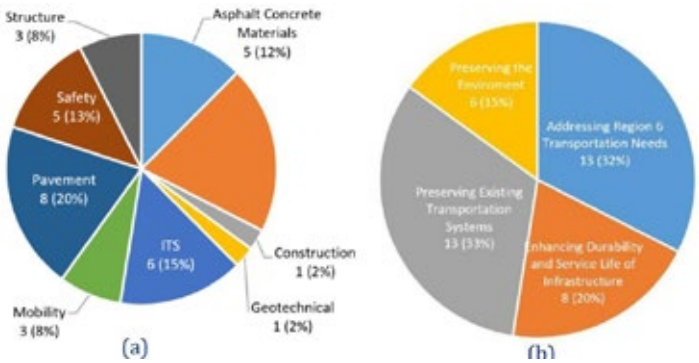
RESEARCH PROGRAM UPDATES

FIFTH-CYCLE PROJECTS FINAL RESEARCH REPORTS

Tran-SET's fifth-cycle projects ended their technical phase in August 2022. The projects' third progress reports and trackers, as well as their final research reports, were submitted in mid-August 2022. We will circulate these as soon as they are available. Dr. Hassan Noorvand, research associate and Tran-SET T2 coordinator, is currently organizing and facilitating Technology Readiness Level (TRL) assessments for each fifth-cycle project. The TRL process has been a tremendously useful experience by: (1) providing an opportunity for the research team to directly communicate with stakeholders, (2) gathering critical feedback from the panel to better inform/improve activities during the implementation (technology transfer) phase, and (3) educating research teams and panel members on the use of the TRL scale and assessment processes.

AWARD OF SIXTH-CYCLE PROJECTS

Tran-SET has finalized the selection and award of its sixth-cycle projects. A total of 68 problem statements were submitted for the sixth-cycle of funding and ranked by regional transportation leaders/experts. Requests for proposals (RFPs) were solicited for 40 projects. A total of 40 proposals were received, and 39 projects were awarded with a start date of April 1, 2022. The projects totaled $4.3 million in grants and matching funds and are categorized below by topic area and research objective.



Sixth-cycle topics. Projects are categorized by topical area and research objective.

STAFF UPDATE: DR. HEENA DHASMANA'S ARRIVAL

Dr. Heena Dhasmana joined Tran-SET in April 2022 as the assistant professor of research (with a focus on asphalt material and pavement research) and program manager of Tran-SET. She will be in charge of further developing Tran-SET's main management processes and procedures; conducting Tran-SET's webinar series; developing Tran-SET's Technology Transfer (T2) Plan (and corresponding T2 processes); and overseeing Tran-SET's main research, T2, educational, and workforce development activities.

Welcome to the team, Dr. Dhasmana!

Dr. Heena Dhasmana

RESEARCH IN PROGRESS: HIGHLIGHTS

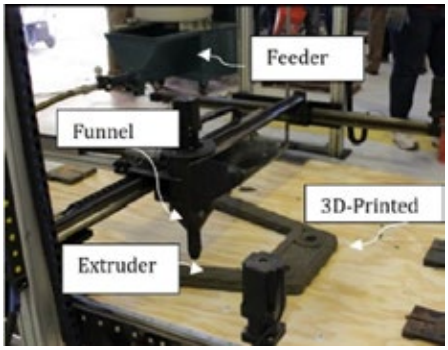
Please see below for a showcase of select, Tran-SET research projects. ***Is our research applicable to your technical area? Beneficial or a potential solution to your local transportation system? Can benefit from your efforts? Interesting?*** *Please contact us for ways to coordinate, be involved, and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

Design of 3D Printable Eco-Concrete by Utilizing Rheology Modifiers for Sustainable Infrastructure

Dr. Maryam Hojati – University of New Mexico

3D-printing technology has become more common in diverse industries in recent years. The popularity of this technology in the construction industry has been increasing; however, there are some challenges related to designing 3D-printable construction materials and adjusting their fresh properties for the 3D-printing process. Rheological properties—including viscosity, yield stress, and thixotropy—are the fundamental parameters to be considered for 3D-printing applications. They significantly influence the key properties of 3D-printed concrete in the fresh and hardened states, including buildability, extrudability, and mechanical characteristics. Several researchers have utilized chemical admixtures (retarders/accelerators/superplasticizers/rheology modifiers) to achieve critical rheological demands. However, these are non-renewable, oil-based products containing many undesirable toxic materials, which pose a prospective danger towards the environment and can cause the reinforcement's corrosion.

On the other hand, organic admixtures have the potential to replace chemical admixtures as an alternative, and they are abundantly available renewable materials. This study utilizes self-degradable additives (corn starch and cassava starch), supplementary cementitious materials (silica fume, nano-clay), and viscosity modifying admixture (methylcellulose). These admixtures will be used individually and in different combinations to evaluate their potential effects on the rheology, green strength, printability, and mechanical characteristics of the 3D-printable concrete. Fresh properties will be measured using a flow-table test. A rheometer will be used to study the plastic viscosity, yield stress, and thixotropy evolution over different intervals. The green strength will be examined using the direct shear and uniaxial compressive strength tests for different ages. The printability of the selected mixes will be assessed in terms of extrudability and buildability.



UNM Dana C. Wood Materials and Structures Lab 3D-printing systems: 3D-printing of concrete.

SMARTP3M: Smart Pavement Monitoring, Management, and Maintenance

Dr. Mena Souliman – University of Texas at Tyler; Dr. Samer Dessouky – University of Texas at San Antonio

Overall framework of the proposed project.

As an efficient pavement management practice, South-Central State DOTs, as well as many other state DOTs and local highway agencies across the nation, perform daily surveys to verify pavement roughness and the presence of potholes/distresses. The traditional testing methods for this purpose, however, are extremely expensive and beyond the technical and financial capabilities of different state DOTs. Conversely, smartphones and advanced on-board computers recording information related to the pavement condition, traffic data, and weather are utilizing advanced sensors and stereo cameras in almost every vehicle traveling on the roads. This technology is reliable, affordable, and experiencing a fast and continuous development, and much more can be expected in the future, as they are generating a massive amount of data ("big data") that can and should be utilized to shift the pavement management process to a new and higher paradigm. Also, unlike the traditional surveys that are done at most once a year, fresh data can be collected and analyzed to verify the pavement condition and the required actions on a daily basis, or even real-time, at an extremely low cost approaching zero in the long run.

The proposed project will lead to the development of a smartphone application that, when utilized, can be beneficial not only in the South-Central State DOT's, but essentially every state DOT and local transportation municipality. The successful completion of this project will result in achieving the Tran-SET goals of promoting sustainability and resiliency of the transportation infrastructure in renewing, upgrading, and implementing the most cost-effective solutions.

RESEARCH IN PROGRESS: HIGHLIGHTS

Eco-Driving of Connected and Autonomous Vehicles Approaching and Departing Signalized Intersections

Dr. Xiangyu Meng – LSU

CAVs and HDVs approaching a signalized intersection with V2I and V2V communications.

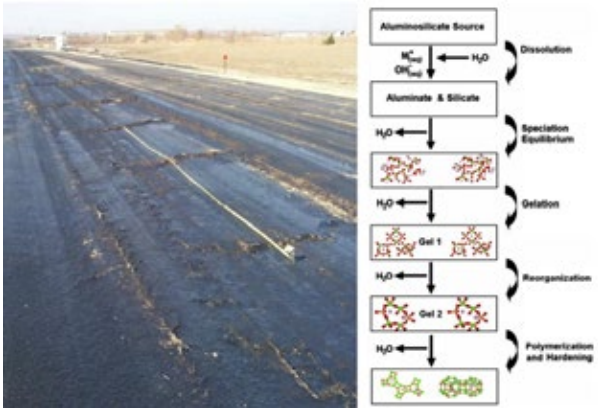
Autonomous vehicles (AVs), commonly known as self-driving vehicles, have captured the attention of the public for decades and continue to be the center of attention of academic and industrial research activities worldwide. Their proliferation has rapidly grown, largely because of Vehicle-to-X (or V2X) technology, which refers to an intelligent transportation system where all vehicles and infrastructure components are interconnected with each other. Therefore, the term "CAV," which is short for connected and autonomous vehicles, was coined. The connected here not only refers to the connections to infrastructures, such as traffic signals and GPS information, but also the communication among vehicles in the same vicinity. Connected and autonomous vehicles (CAVs) will have a profound impact on various aspects of urban mobility, such as safety, energy usage, and environmental sustainability, which are considered as the driving changes for smart cities. The CAV technology provides an intriguing opportunity to better monitor transportation network conditions, which in turn helps optimize traffic flows, enhance safety, reduce congestion, and minimize emissions.

Recent developments in artificial intelligence would make this once science fiction-sounding idea into reality. The project's overall objective is to apply the emerging artificial intelligence (AI) technology to solve the eco-driving problem of CAVs approaching and departing signalized intersections in a cohabitation environment of CAVs and human-driven vehicles (HDVs).

Stabilization of Expansive Soils Using Geopolymers Prepared From Locally Available Resources

Dr. Anand Puppala – Texas A&M University

The stabilization of soft and highly compressible soils is essential to construct transportation infrastructure using local geomaterials, which typically contain a high amount of clay and therefore, lack desired mechanical properties in their native state. Typically, traditional calcium-based compounds (i.e., Portland cement, lime) and organic polymers are used to improve the mechanical properties of those geomaterials. However, traditional calcium-based stabilizers have a high carbon footprint, while organic polymers have durability issues. Geopolymers are a family of inorganic polymers that have recently received much attention as an alternative to ordinary Portland cement in various transportation infrastructure applications due to its good and comparable mechanical properties. In addition, geopolymers can be synthesized from various sources of waste materials (e.g., fly ash, steel slag) and natural materials (e.g., rice husk, volcanic ash, clay), which lowers its impact on the environment and carbon footprint. Although there have already been many studies in the past decade or so on stabilized clay soils with geopolymers, there are only a limited number of studies that utilize locally available resources.



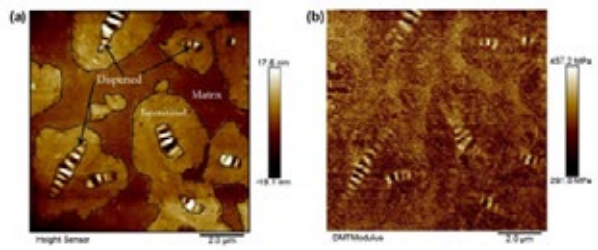
(left) Vertical heaves generated during the construction of U.S. 67 near Midlothian, Texas and (right) conceptual model of geopolymerization.

The objective of this research project is to synthesize innovative, sustainable, and eco-friendly geopolymers suitable for stabilizing expansive soils for transportation infrastructure by using calcined clays that are locally available in the region. The geopolymer stabilizer synthesized in this research is expected to be effective in enhancing the mechanical properties of problematic expansive soils and reducing the distresses on pavement infrastructure.

RESEARCH IN PROGRESS: HIGHLIGHTS

Prediction of Moisture Resistance of Polymeric Asphalt Binders Through the Atomic Force Microscopy (AFM) Technique

Dr. Zahid Hossain – Arkansas State University



Typical images of AFM images of a polymeric binder—(a) morphology showing three distinct phases and (b) DMT modulus.

Moisture susceptibility has been recognized as a major pavement distress since the early 1990s. Great effort has been given in this field to come up with effective test methods to quantify the moisture susceptibility of asphalt concrete and take remedial action for the longevity of the structures. The most popular forms of moisture resistance tests of asphalt mixtures are the Boiling, Indirect Tensile Strength, and Hamburg Wheel test methods, which are followed by more than 80% of agencies. However, none of these techniques consider the adhesion phenomena at the interface level. Also, there does not exist an approach to predict the interfacial behavior considering the chemical composition of contact surfaces at the molecular level. The adhesiveness of a bitumen-aggregate system is one of the fundamental properties that affect asphalt pavements' performance. Low adhesion causes bitumen detachment from the aggregate surface, leading to severe distresses that include moisture damage and cracking in asphalt mixture.

The proposed study will investigate the interaction between asphalt binder and aggregates at the interface level by measuring adhesion forces between asphalt binder samples and minerals of different chemical compositions using an Atomic Force Microscope (AFM). The tips of the AFM will be modified with comparable aggregate minerals; thus, the adhesion force between asphalt and minerals will be measured. The adhesion force will then be used to estimate the work of adhesion between asphalt binders and materials. The findings of the proposed study are expected to give pavement professionals and researchers a better understanding of moisture-related damage in asphalts at the molecular level. Implementation of the learned knowledge will assist transportation agencies in avoiding premature pavement distresses and save taxpayers' money.

Countermeasures to Improve Pedestrian Safety on Arterials

Dr. Nicholas N. Ferenchak – University of New Mexico

The timing of this project is opportune as the US finds itself in the midst of a pedestrian safety crisis. Between 2009 and 2019, pedestrian fatalities in the US increased 51% while all other traffic fatalities increased 0.4%. Unfortunately, New Mexico has had especially poor outcomes. For the fifth year in a row, in 2021, the Governors Highway Safety Association (GHSA) identified New Mexico as having the highest pedestrian fatality rate in the nation (GHSA, 2021). Thanks to recent research by the proposed PI, it became known that more than 81.8% of the additional pedestrian fatalities in the US occurred on arterials and 99.7% occurred in urban areas. Similarly, despite the fact that New Mexico is the fifth largest state in the US, an astonishing 18.7% of all pedestrian-involved collisions in the state occur within a quarter mile of a single arterial corridor—Albuquerque's Central Avenue. About a dozen pedestrians are typically killed on the corridor each year and countless others injured. If we can understand how to improve safety on this 15-mile-long east/west corridor, not only will we make significant progress at improving possibly one of the worst roads in the country, but we can extrapolate those results to improve other similar arterials across the state, region, and country.

Similar arterial roadways in cities across New Mexico. (clockwise from top left: Central Avenue in Albuquerque, US 285 in Roswell, US 180 in Silver City, US 64 in Farmington).

This project will explore the impacts of several traffic safety countermeasures and roadway design changes on pedestrian safety along the Central Avenue corridor of Albuquerque, New Mexico, and extrapolate those results to other locations. This will allow for results to not only improve traffic safety in Albuquerque, but in other municipalities across the state, region, and country. The research will have a specific focus on pedestrian safety, but will also address traffic safety outcomes for motor vehicle users and bicyclists.

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 and Workforce Development Summit on Electric Vehicles

University of Texas at San Antonio hosted the fifth annual Tran-SET conference in Austin, Texas, on August 31 – September 2, 2022. The conference was co-sponsored by the ASCE Construction Institute. There were 40 lectern presentations and 13 student posters in a student poster competition. In the student poster competition, Mohammad Najmsuh Sakib Oyan (1st and 3rd place), Rupesh Mahat (2nd place), and Fares Tarhuni (4th place) from Arkansas State University were the winners. Congratulations!!

During the Tran-SET conference, a CUTC summit on "Electric Vehicles and Challenges in its Large-Scale Implementation in the US" was also organized. The speaker panel included Ms. Beverly West (from TxDOT), Jason JonMichael (Austin Transportation), Laura Morrison (Texas Electric Transportation Resources Alliance), Harley Hubbard (City of San Antonio), George Liang (Infineon Technology American Corporation), and Jason Jankowsky (Intel). The speakers presented their ideas on the topic and answered questions from the audience. The detailed conference recording will be posted on the Tran-SET website soon.

Tran-SET summit on electric vehicles at the Tran-SET conference in Austin, Texas.

Recording of the Webinar on Wireless Technologies for Transportation Infrastructure Management is Now Available

The recording of Tran-SET's latest webinar, "Wireless Technologies for Transportation Infrastructure Management," is now available online! The webinar was conducted on September 23, 2022. Dr. Husain Aziz (Kansas State University), Dr. Shinae Jang (University of Connecticut), and Dr. Chun-Hsing Ho (University of Nebraska-Lincoln) discussed the role of wireless technologies in transforming the transportation industry. We invite you to view the recording of the webinar on the Tran-SET **website** or on the **Tran-SET YouTube page.**

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

Joint Tran-SET Webinar Series "Wireless Technologies for Transportation Infrastructure Management."

TECHNOLOGY TRANSFER ACTIVITIES

Tran-SET Summit on Transportation Materials–Innovation and Durability

Our upcoming summit on “Transportation Materials–Innovation and Durability“ will be held on November 1, 2022, in Little Rock, Arkansas, and will be hosted by Arkansas State University. The purpose of this summit is to brainstorm, educate, and engage transportation professionals and administrators (academics, industry professionals, state DOTs, and other government agencies) to solve transportation material challenges and problems in terms of durability through innovation and research. Speakers on topics related to paving asphalt, concrete, and foundation materials from a diverse group of scholars and practicing engineers representing FHWA, DOTs, private sectors, and/or academia will discuss challenges, issues, and possible solutions. We encourage you to register for this summit on Tran-SET’s **website.**

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:

2022 Arkansas Engineering Forum & Southeast Symposium on Contemporary Engineering Topics (SSCET)

Presenters at 2022 Arkansas Engineering Forum & Southeast Symposium on Contemporary Engineering Topics (SSCET)

A team of researchers led by Dr. Zahid Hossain (Tran-SET principal investigator) from Arkansas State University delivered five Tran-SET-funded research presentations at the 2022 Arkansas Engineering Forum held in Little Rock, Arkansas, on September 16, 2022. The students, Fares Tarhuni (soil stabilization with rice husk ash and lime) and Rupesh Mahat (seismic hazard analysis), won first and second place awards in the poster presentation contest. For more information, visit **https://lnkd.in/gFffDxXH**

The 2022 Arkansas Engineering Forum & Southeast Symposium on Contemporary Engineering.

Frontiers in Control Engineering

Dr. Xiangyu Meng (Tran-SET principal investigator) was invited to become an associate editor of Frontiers in Control Engineering based on his great working relationship and achievements. Frontiers is an interdisciplinary journal that explores the fundamental role control systems play in the automation and regulation of engineering processes, from networked control to mechatronic systems.

Congratulations Dr. Meng!

For more information on the publication, feel free to visit their **website**.

LSU Discover Undergraduate Research Grant

LSU's Discover Undergraduate Research Grant awarded funding for Sunella A. Ramnath's proposal titled, "Lane Following Control With Lane Detection for Autonomous Vehicles." Ramnath is an undergraduate student who has been working with Dr. Xiangyu Meng in the LSU College of Engineering's Division of Electrical & Computer Engineering on one of the tasks related to his Tran-SET-funded project that plans the trajectory of autonomous vehicles crossing signalized intersections.

Each semester, LSU Discover funds at least 10 undergraduate student research or creative projects. The purpose of these grants is to provide students a learning opportunity through participation in faculty-mentored projects. Students from any major are welcome to apply. With an LSU Discover Undergraduate Research Project Grant, currently enrolled, full-time LSU undergraduate students can receive funding for hourly wages, supplies, and travel related to an undergraduate research or creative project. Students must have an LSU-employed faculty member serve as their supervisor and sign their time-sheets. For more information, visit the program **website**.