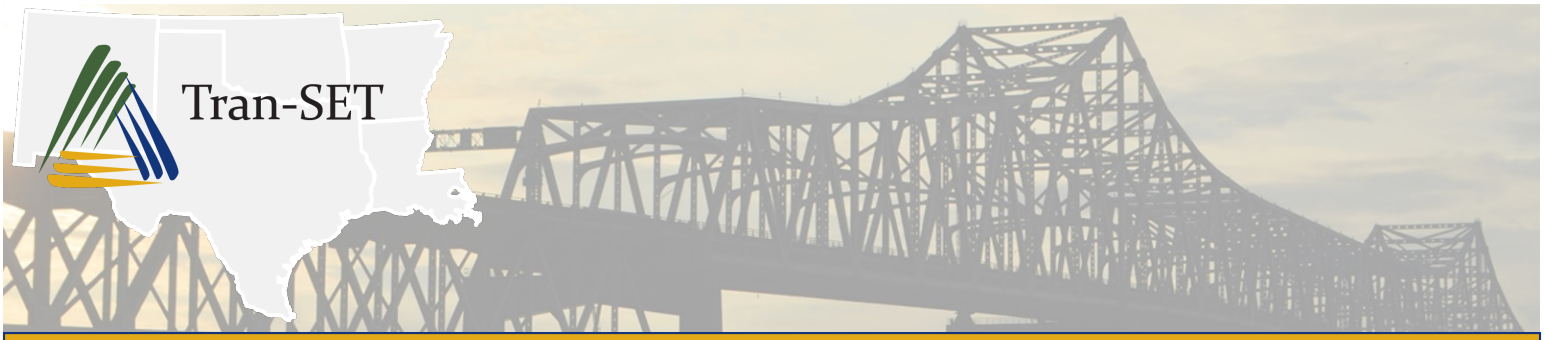


ISSUE 6 | SPRING 2019 TRANSPORTATION CONSORTIUM OF SOUTH-CENTRAL STATES (TRAN-SET)

In this Issue:

About Tran-SET:

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. 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

Spring is Such a Beautiful Time of Year!

Spring is a wonderful season: filled with new growth, new promise, and new beginnings. In the South, Spring is an especially beautiful time of year before the long, hot days of summer.

Tran-SET has several upcoming Spring events! One is the **2019 Tran-SET Conference** to be held in San Antonio, TX on April 11-12, 2019. The Conference will include two keynote speakers, two additional guest speakers, 69 lectern presentations, 38 student posters, and more! It is a great opportunity to learn how Tran-SET is helping solve regional transportation challenges. **Registration is ending soon, so be sure to register now!**

The next webinar in the **Joint Tran-SET Webinar Series** will be held on March 28, 2019 on the topic of "Innovative Approaches to Characterize Asphalt Binders and Mixtures". It is a free webinar jointly hosted by the Mountain-Plains Consortium and the Center for Transportation Research (CTR). **Please be sure to register before the webinar to ensure a spot!**

Lastly, I would like to highlight one of our recent **success stories**. A first-cycle, Tran-SET-funded project developed a technique to utilize ultra-high performance fiber-reinforced concrete (UHP-FRC) for repair of concrete pavement that can be easily cast onsite without special treatments (e.g., heat, pressure, and vacuum). This developed technique has led to a 20'x25' pavement repair field implementation at Dallas Fort Worth (DFW) Airport. Please see the article on page 6 for details.

I highly encourage you to follow Tran-SET on **LinkedIn**, **Twitter**, and **Facebook**. Please also subscribe to our mailing list **here**.

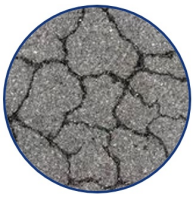
I invite you to read through our Spring 2019 newsletter and learn more about our research, technology transfer, educational, and workforce development activities.

Enjoy!

Marwa Hassan, PhD, PE, M.ASCE
CETF Distinguished Professor; Graduate Coordinator
College of Engineering, Louisiana State University

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.**



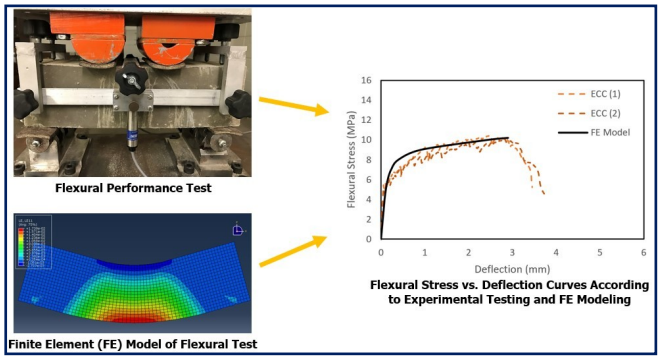
Enhancing durability and service life of infrastructure

Application of Engineered Cementitious Composites (ECC) for Jointless Ultrathin Whitetopping Overlay

Dr. Gabriel Arce, Dr. Marwa Hassan - Louisiana State University; Dr. Susan Bogus - University of New Mexico; Dr. Tyson Rupnow - Louisiana Transportation Research Center

Whitetoppings are concrete overlays on top of hot mix asphalt (HMA) pavement structures and can be divided in two categories: thin whitetoppings (TWT) and ultrathin whitetoppings (UTW). UTW are used to rehabilitate distressed HMA pavement structures, which may have failed from rutting, local surface distresses, fatigue cracking, and low- temperature cracking. Commonly observed distresses in whitetoppings include: corner, reflective and load related cracking; yet, corner cracking appears to be the primary distress observed in UTW when joints coincide with the wheel path. Enhancements in the properties of concrete materials could allow for the utilization of UTW with large joint spacing that would mitigate joint related distresses, increase construction speed, and be more cost-effective.

The objective of this study is to evaluate engineered cementitious composites (ECC) in jointless UTW overlay application. An ECC material will be specifically designed for UTW application based on locally available materials. Fatigue evaluation of the UTW-ECC material will be performed, finite element analysis (FEA) and fatigue performance data will be integrated to produce an UTW- ECC overlay performance prediction model. To validate the developed model, a full- scale experiment of an UTW-ECC overlay system will be performed, leading to a cost- analysis of the construction of jointless UTW-ECC compared to traditional jointed UTW.



Finite element modeling of ECC under flexural loading

Addressing other Region 6 Transportation Needs

Toward Portable Roadway High Water Detection System for Driver Safety and Infrastructure Assessment

Dr. Hatim Sharif, Dr. Samer Dessouky - University of Texas at San Antonio

Dense roadway networks and abundant low-water crossings throughout the South Central region contribute to the significant and increased rates of roadway flooding. Many of these crossings are constructed as armored sag vertical curves, often with small corrugated metal culverts used to prevent long-term ponding of water upstream of the roadway embankment. In flood conditions, water flows over the road, posing immediate danger to crossing vehicles, and leading to the majority of vehicle-related flood fatalities.

Flooded roadway

This study aims to evaluate the performance of flood warning systems installed in Texas during Hurricane Harvey and devise a portable high water detection system based on the weigh- in-motion (WIM) technology that can serve as the core of a future roadway flood warning system: recording data on the flood depth, duration, and type of passing vehicle. A mechanism for two-way communication between the portable high water detection system and traffic control systems will also be developed. In conjunction with other post-event data, the system is envisioned to assist in the evaluation of flooding impacts on the roadway system.

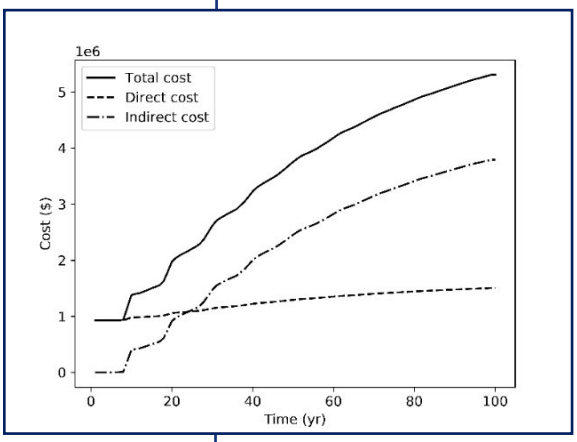
RESEARCH IN PROGRESS: HIGHLIGHTS

Preserving Existing Transportation Systems

A Comprehensive Framework for Life-Cycle Assessment of Reinforced Concrete Bridge Decks

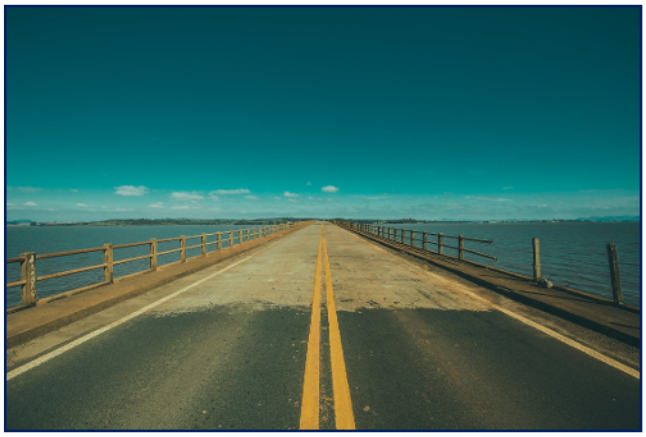
Dr. Mohamed Soliman, Dr. Samir Ahmed - Oklahoma State University

Various environmental and mechanical stressors cause deterioration of concrete bridge decks. These conditions lead to steel reinforcement corrosion, cracking, delamination, and spalling which affect the surface conditions and reduce the safety of the deck. In order to maintain the deck safety above defined thresholds, frequent interventions (maintenance, repair, deck replacement, etc.) are usually required during the life-cycle of the bridge. The quantification of the life-cycle cost of bridge decks considering maintenance and repair activities represents a significant challenge facing local and state transportation agencies.



Life-cycle cost of bridge deck with conventional reinforcement

This study will attempt to fill in the knowledge gaps in quantifying the indirect costs associated with bridge deck maintenance and their impact on the overall bridge life-cycle cost. Specifically, this study introduces an approach that: (a) characterizes the life-cycle maintenance needs and repair intervals, (b) develops a systematic methodology for quantifying the impact of bridge maintenance on indirect costs (increased travel time, work zone crashes, etc.), and (c) compares different steel reinforcement materials based on their long-term performance and maintenance requirements. The life-cycle cost analysis will integrate a comprehensive sustainability assessment including evaluating the carbon footprint of bridge decks constructed using different reinforcement alternatives.



Example of concrete bridge deck

Preserving the Environment

Smart Charging of Future Electric Vehicles using Roadway Infrastructure

Dr. Sara Ahmed, Dr. Ethan Ahn, Dr. Samer Dessouky - University of Texas at San Antonio; Dr. Mahmoud Reda Taha - University of New Mexico

Electric vehicles (EVs) are promoted as a key contributor to building a new sustainable mobility system. Increasing the use of EVs can result in considerably lower emissions of carbon dioxide and other air pollutants. However, additional electricity is required to charge EV batteries, partially offsetting their benefits. Likewise, future vehicles may need to be equipped with large-capacity batteries to operate for a satisfactory distance. Contemporary battery technologies have shortcomings of long charging time, large size and weight, limited life time and relatively high cost.

Pavement marking indicating spot for EV charging station

Aiming to tackle today's challenges caused by limited battery capacity, this study will explore innovative smart charging techniques, namely smart and illuminative charging, for vehicles of the future. Specifically, this study will explore implementing a novel wireless charging power system where: (a) nanomaterials-powered LEDs as the energy transmitter, are embedded under a transparent polymer-modified nanocomposite overlay and (b) thin-film photovoltaic solar panels, as the energy receiver, are placed under each vehicle. This study will also investigate other energy harvesting techniques by exploiting piezoelectric and thermoelectric properties of nanomaterials embedded in vehicle tires.

RESEARCH IN PROGRESS: HIGHLIGHTS

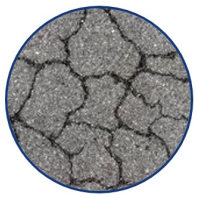
Preserving Existing Transportation Systems

Elimination of Empirical, Ineffective, and Expensive PG Plus Tests to Characterize Modified Binders

Dr. Zahid Hossain, Dr. Ashraf Elsayed - Arkansas State University

Most state departments of transportation (DOTs), such as Arkansas Department of Transportation (ArDOT), evaluate high-temperature resistance of asphalt binders using a dynamic shear rheometer (DSR) in accordance with AASHTO T315. However, this test is unable to adequately capture the effects of elastomeric modification. Thus, ArDOT requires conducting the elastic recovery (ER) method (AASHTO T301) and a performance grade (PG) plus test that is empirical in nature, expensive, and time-consuming. Recent studies have revealed that neither ER nor multiple stress creep recovery (MSCR) tests are effective to characterize high PG grade binders modified with non-polymeric additives, such as acid. Therefore, other mechanistic or chemical-based test methods need to be explored to find a simple and effective test protocol for characterizing high PG grade binders irrespective of the modification process. This study will develop new test method(s) to evaluate modified binders as a replacement to PG plus tests. Specifically, this study will: (a) perform chemical analyses and other mechanistic tests to characterize non-polymeric high PG binders, (b) explore other test methods that are capable of characterizing polymer modified binders, and (c) propose simple and effective tests methods for characterizing non-polymeric high PG grade binders.

Example of paving operation

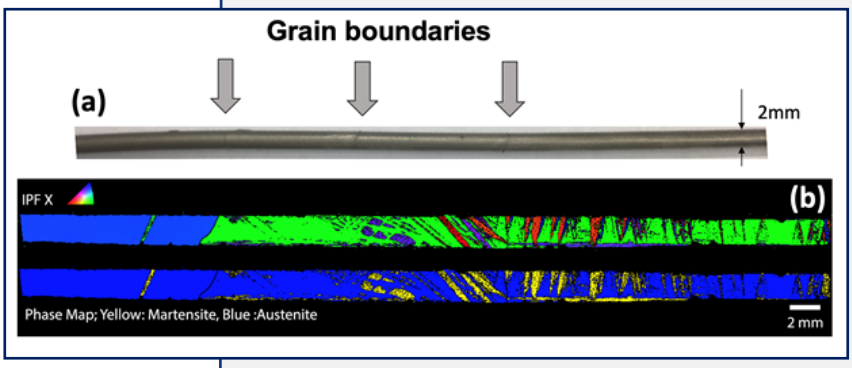


Enhancing durability and service life of infrastructure

Disaster-Resilient and Self-Assessing Multi-functional Transportation Structures

Dr. Ibrahim Karaman, Dr. Darren Hartl - Texas A&M University

Shape memory alloy (SMAs) are a smart construction material that can produce large recoverable deformations triggered by stress in a response known as "superelasticity". This response has been shown to limit the damage sustained by structures from natural hazards (such as earthquakes and hurricanes) by limiting/controlling the deformation and crack growth of the structure.



Crystal analysis of FE-SMA bars

The most common SMA candidate for civil engineering applications is the NiTi SMA, which is cost-prohibitive for large-scale use. However, a low-cost and easily processed iron (FE)-based SMA exists as an alternative. FE-SMA also shows an interesting meta-magnetic shape memory response, where a change induces magnetization of the material occurs from applied stress, and can be easily detected using commercial magnetometers. This property can be harnessed to create a method to monitor the stresses and strains on a structural system. The combination of these properties enable a new kind of structural health monitoring framework where the load-bearing and sensing elements are one-in-the-same and quantitative information could be collected in real-time with simple instruments. This study will develop large dimension Fe-SMA rods that are suitable for structural and transportation applications. Optimal configuration of rods and sensors will be computationally determined through combined magnetic-mechanical modeling and validated through experiments. The main objectives are to: (a) design topology and configuration of bulk Fe-SMA rods and cables in cementitious composites for optimal magnetic sensing capabilities, (b) determine maximum Fe-SMA component size through microstructural characterization and validation experiments, and (c) demonstration of self-assessing capabilities in a realistic infrastructure system.

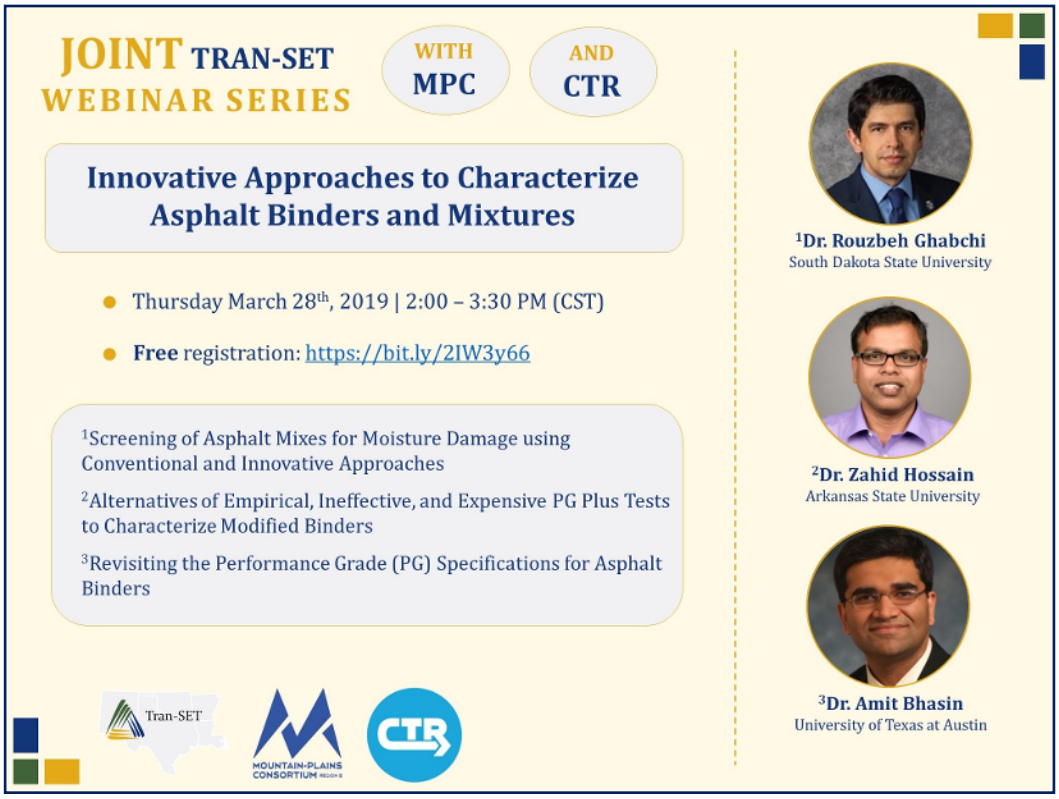
TECHNOLOGY TRANSFER ACTIVITIES

Tran-SET has two objectives that guide its technology transfer (T2) activities: 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 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 liking us on **Facebook**, following us on **LinkedIn** and **Twitter**, and visiting our **website**! You can also subscribe to our mailing list **here**!

Free Upcoming Webinar!

The next webinar in the Joint Tran-SET Webinar Series will present "Innovative Approaches to Characterize Asphalt Binders and Mixtures". It is jointly hosted by the **Mountain-Plains Consortium** and the Center for Transportation Research (**CTR**). Please see below and our **website** for more information. Please register at: **https://bit.ly/2IW3y66**.



Still Time to Register for the 2019 Tran-SET Conference!

Tran-SET will be hosting the 2019 Tran-SET Conference on **April 11-12, 2019** in San Antonio, TX. The Conference will include two keynote speakers, two additional guest speakers, 69 lectern presentations, 38 student posters, and more! It is a great opportunity to learn how we are solving transportation challenges in the South-Central U.S.

Registration is open but will be closing soon! Please visit the Conference **website** to view the detailed Program, learn more about the Conference and location, to register, or to become a sponsor.

Conference will be hosted at the beautiful downtown campus of the University of Texas at San Antonio

TECHNOLOGY TRANSFER ACTIVITIES

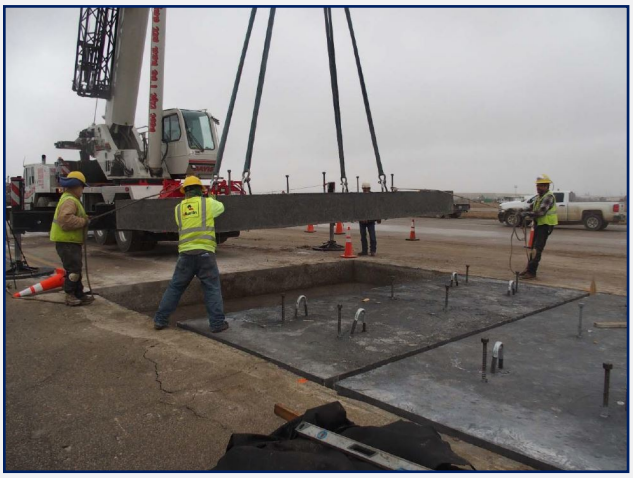
Research Featured at the 2019 TRB Annual Meeting

University of Texas at San Antonio team at TRB

Tran-SET had a strong presence at the 2019 Transportation Research Board (TRB) Annual Meeting held in Washington, DC from January 13-17, 2019. Six Tran-SET-related lectern presentations and fifteen poster presentations were scheduled/given, and over 30 Tran-SET-related researchers and ten students attended. 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 policy makers, administrators, practitioners, researchers, governments, industry, and academic institutions. Over 13,000 transportation professionals were in attendance.

During the Conference, Tran-SET also conducted their Mid-Year Meeting with our Associate and Program Directors. During the Meeting, Tran-SET communicated important Center-wide updates, discussed current reporting requirements, and identified "lessons learned" from recently completed first-cycle projects.

Success Story: Full-Depth Repair using Ultra-High-Performance Fiber-Reinforced Concrete (UHP-FRC)



Placement of precast slabs at DFW Airport taxiway

As part of Tran-SET project **Use of Ultra-High-Performance Fiber-Reinforced Concrete (UHP-FRC) for Fast and Sustainable Repair of Pavements** a new technique was developed that utilizes UHP-FRC for repair of concrete pavement that can be easily cast onsite without special treatments (e.g., heat, pressure, and vacuum). This includes developing a method for cast-in-place UHP-FRC joints without the need for dowel bars.

Pouring of concrete into the precast forms

Dr. Shih-Ho Chao, Tran-SET Principal Investigator, and his research team implemented this technique at the Dallas Fort Worth (DFW) Airport on March 2019. Partnering with a DFW contractor, the research team installed three 18'-4"x7'-10"x 1'-5" precast UHP-FRC slabs at one of the airport's taxiways. The benefits of this technique included: no dowel bars, reduction of thickness, rapid early strength, efficient emergency repair method, and elimination of transportation costs (if precasted onsite). The research team will monitor the section for cracking and deterioration for the first 8 weeks of installation. The repair area has been and will continue to be load tested with heavy equipment and (potentially) aircrafts.

For more information, please see the project **research report** and corresponding **dataset**.

Team to Attend Upcoming University Centers (UTC) Spotlight Conference

The Tran-SET team (Director, Program Manager, Research and Technology Transfer Coordinator, and others) will be attending the University Transportation Centers (UTC) Spotlight Conference on May 14, 2019 in Washington, DC. The one-day conference will highlight UTC activities to members of Congress and other stakeholders. It is co-hosted by the Council of University Transportation Centers (CUTC) and the Research, Education, and Training Reauthorization Coalition (RETRC).

Tran-SET will prepare a poster highlighting its technology transfer process (T2) and the main success stories (important research-, education-, and workforce development-related products and outcomes) that it has produced.

TECHNOLOGY TRANSFER ACTIVITIES

Presentation Session at the 56th Annual Paving and Transportation Conference

Four Tran-SET research projects were presented at a dedicated Tran-SET session at the 56th Annual Paving and Transportation Conference on January 10, 2019. The Conference was hosted by the Department of Civil Engineering from the University of New Mexico with the theme of "Transformation and Revolution in the Transportation Industry". Over 500 participants attended the Conference.

Presenters at the Tran-SET Session

Dr. Susan Bogus, Tran-SET Associate Director, presided over the session, which included the following presentations:

- *What Makes a Street Walkable? A Study on Funding Maintenance and Evaluating New Designs in Albuquerque* – Alexis Corning-Padilla and Gregory Rowangould (UNM)
- *Augmented Reality for Transportation Infrastructure Inspection and Management* – Dilendra Maharjan, Marlon Aguero, Fernando Moreu (UNM) and David Mascarenas (LANL)
- *Innovative Retrofit of Corroded Metal Culverts using Glass Fiber Reinforced Polymers (GFRP) Profiles* – Rahulreddy Chennareddy and Mahmoud Reda Taha (UNM)
- *Bridge Deck Overlays Using Ultra-High Performance Concrete* – Craig Newtson (NMSU)

For more information regarding the Conference, please visit their **webpage**.

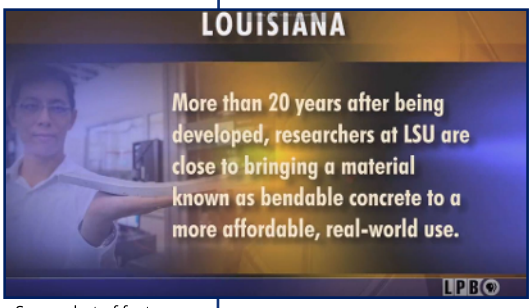
Participation at the 94th AAPT Annual Meeting

Dr. Husam Sadek, Tran-SET Research and Technology Transfer Coordinator, represented Tran-SET at the 94th Annual Meeting and Technical Sessions of the Association of Asphalt Paving Technologies (AAPT) in Fort Worth, TX from March 3-6, 2019. The Annual Meeting included asphalt-related technical sessions, symposia, and workshops presented by experts (from around the world) in all aspects of asphalt paving technology. AAPT has been a leader in advancing asphalt paving technology for more than 90 years. In addition, the AAPT scholarship fund has increased the number of scientists and engineers available for careers in the general area of asphalt, cement, and asphalt concrete technology. More information on the Annual Meeting, and AAPT in general, can be found on their **website**.

Audience at the AAPT Annual Meeting

Research Featured on Louisiana Public Broadcasting

The research products from Tran-SET's project **Evaluation of the Performance and Cost-Effectiveness of Engineered Cementitious Composites (ECC) Produces from Region 6 Local Materials** was featured in the "Louisiana: The State We're In" television program. "Louisiana: The State We're In" is produced by Louisiana Public Broadcasting (LPB) and is one of the longest running television programs in the nation. You can see the four-minute feature **here** (starting at the 22:00 minute mark).



Screenshot of feature on LPB

EDUCATIONAL & WORKFORCE DEVELOPMENT ACTIVITIES

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.

Please see the next two pages for a showcase of select, educational and workforce development activities sponsored by or involving Tran-SET.

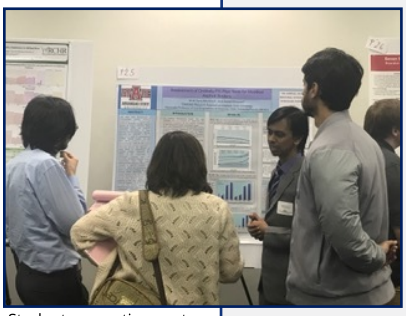
Metro Named Tran-SET's "Outstanding Student of the Year"

Ms. Kristal Metro, a doctoral student from the University of New Mexico, was named Tran-SET's "Outstanding Student of the Year". She received her award at the CUTC 2019 Awards Banquet. Ms. Metro showcased exceptional technical merit, research capability, academic performance, and leadership. She has played a critical role in Tran-SET's **Recruiting, Retaining, and Promoting for Careers at Transportation Agencies** project.

The Banquet was held in Washington, DC at the 2019 TRB Annual Meeting. **Congratulations Ms. Metro!**

Ms. Metro (centered) accepting her award

Students Present at the 4th Annual LSUS Regional Scholars Forum



Student presenting poster

Two Tran-SET-supported students from Arkansas State University presented at the "4th Annual LSUS Regional Scholars Forum" at Louisiana State University at Shreveport. Mr. Kazi Tamzidul Islam presented on the **Use of Rice Husk Ash (RHA) in Flowable Fill Concrete Mix Material**, and Mr. Tariq Morshed presented on the **Elimination of Empirical, Ineffective, and Expensive PG Plus Tests to Characterize Modified Binders**. The forum brought together undergraduate and graduate students from universities in Arkansas, Louisiana, Mississippi, Oklahoma, and Texas to present research in the fields of arts, business, education, humanities, natural sciences, and social sciences. Please visit the following **webpage** for more information.

Students Receive Dwight D. Eisenhower Transportation Fellowships

Tran-SET would like to recognize two graduate students from the University of New Mexico who have been awarded the prestigious Dwight D. Eisenhower Transportation Fellowship from the U.S. Department of Transportation: Ms. Alexis Corning Padilla and Ms. Kristal Metro. Both students have been involved and instrumental in Tran-SET's research program, specifically in: **Evaluating how the Quality of Pedestrian Infrastructure Affects the Choice to Walk** and **Recruiting, Retaining, and Promoting for Careers at Transportation Agencies** projects, respectively.

For more information, please read the article posted on the University of New Mexico's **website**.

EDUCATIONAL & WORKFORCE DEVELOPMENT ACTIVITIES

Participation at the APSE Annual Meeting

Dr. Husam Sadek, Tran-SET Research and Technology Transfer Coordinator, represented Tran-SET at the Annual Meeting of the Academy of Pavement Science and Engineering (APSE) in Washington DC on January 12, 2019. The mission of APSE is to serve the pavement science and engineering academic community through education, research, and professional development. Dr. Sadek serves on the APSE Education Committee Task Force, which aims to develop a body of knowledge which will be essential for the practice of pavement engineering and will target the following levels of training/education: technician (lab, field), BS engineering, and MS/PhD advanced degrees. More information regarding APSE can be found on their **website**.

Education Committee Task Force at the APSE Annual Meeting

Students Participate in Artificial Intelligence (AI) Campus Demonstration Showcase

Mr. Arif Hasan, graduate student from Arkansas State University, participated in the "Artificial Intelligence (AI) Campus Demonstration Showcase" in Little Rock, AR on February 15, 2019. The AI Campus consisted of teams of students, postdoctoral fellows, and junior faculty with projects at the frontier of the AI discipline. The AI Campus represented seven Arkansas institutions with 30 students participating in the first-ever class. The class has been meeting weekly with AI coaches and ended with student teams demonstrating their projects at the event for institutional representatives and news media. For more information on the event, please visit their **webpage**.

Students participating in the AI Campus Demonstration Showcase

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