

ISSUE 3 | SUMMER 2018

TRANSPORTATION CONSORTIUM OF SOUTH CENTRAL STATES (TRAN-SET)

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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

Warm Summer Greetings from Tran-SET!

In this newsletter, I am happy to report a suite of new Tran-SET initiatives! We've established: a jointly-hosted quarterly webinar series, a summer internship with the Navajo Technical University (NTU), a scholarship for veteran students, and our inaugural conference. Much progress has been made! I would like to thank all Tran-SET staff, affiliates, and partners for helping make these activities a success.

We've also started an initiative to improve the consistency, quality, and effectiveness of our social media. This includes: updating and reorganizing the majority of our website, featuring one of our four main research themes each month, featuring a research project each week, and featuring a partnering university each month (highlighting their facilities, researchers, and students). If you haven't already done so, I highly encourage you to like us on **Facebook**, follow us on Twitter, and visit our **website**. You can also subscribe to our mailing list **here**.

Each Tran-SET project consists of a technical (research) phase, followed by a six-month implementation phase. The implementation phase, which is allocated at least 10% of the overall project budget, supports the *dissemination* of research results and activities that move the research results *towards implementation*. The majority of our first-year projects have completed their technical phase and are in their implementation phase. Please "stay tuned" as each project conducts their implementation activities and for the final research reports (which will be published on our website in the upcoming months).

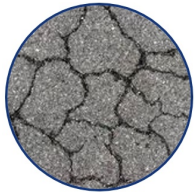


I invite you to read through our Summer 2018 newsletter and learn more about our new initiatives and our other research, technology transfer, educational, and workforce development activities. Please do not hesitate to contact us if you have any questions, comments, or suggestions. Thank you.

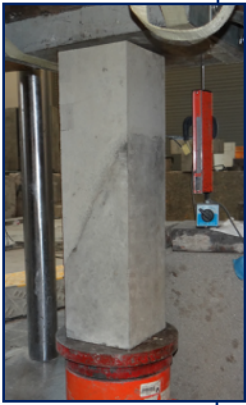
Enjoy!

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

RESEARCH IN PROGRESS: HIGHLIGHTS



Enhancing durability and service life of infrastructure



Conventional and UHP-FRC concrete specimen



Preserving Existing Transportation Systems

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 70 active research projects), please visit our **website** for project *Fact Sheets* and *Highlights*.

Use of Ultra-High-Performance Fiber-Reinforced Concrete (UHP-FRC) for Fast and Sustainable Repair of Pavements

Dr. Shih-Ho Chao - University of Texas at Arlington

Transportation infrastructure deterioration can be accelerated by climate change, increasing traffic demands, and other environmental loads. For example, summer heatwaves, droughts, flooding, and natural disasters can have major impacts on pavement maintenance and rehabilitation costs. Deficiencies in conventional concrete structures call for a much more durable material. Ultra-high-performance fiber-reinforced concrete (UHP-FRC) and its high compressive strength and excellent durability provides a solution to make the infrastructure more economical and sustainable. UHP-FRC has a high early strength gain, and the presence of fibers imparts tensile cracking resistance, post-cracking strength, ductility and energy absorption capacity.

This study develops UHP-FRC materials *for the repair* of concrete pavements that can be easily cast onsite without special treatments (such as heat, pressure, or vacuum).



Preparing test specimen to replicate pavement repair with UHP-FRC concrete

This study involves: (1) investigating/confirming UHP-FRC properties suit requirements of pavement repair (flowability, surface preparation, and high early strength gain), (2) evaluating existing pavement repair practices to investigate the use of UHP-FRC without significant changes to current practices, (3) investigating behavior of UHP-FRC pavement repair, and (4) developing a simple and reliable approach of using UHP-FRC for pavement repair.

Sustainability-Based Long-Term Management of Bridges under Multi-Hazard Exposure

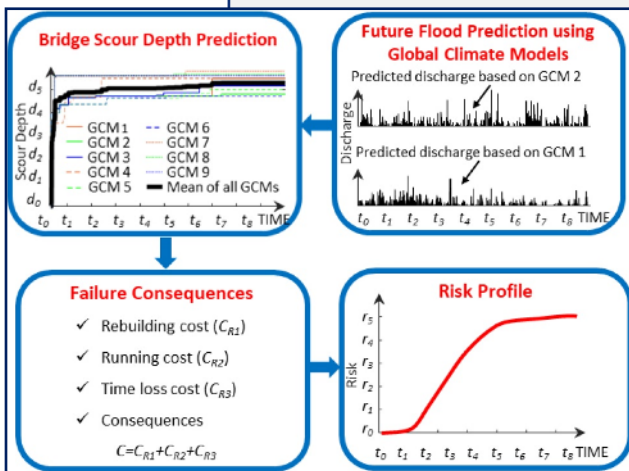
Dr. Mohamed Soliman - Oklahoma State University

Bridges are under deterioration due to various mechanical and environmental stressors. Hydraulic-related hazards (flood and scour), aggressive environmental conditions, and seismic events are recognized as the most significant

threats to the safety of bridges. In traditional risk assessment of structures susceptible to floods and other natural hazards, future hazard predictions are conducted using historic return periods and climate records.

intensity in central-southern states indicate that future hazard occurrence rate may not necessarily follow past trends. Current design, assessment, and management methodologies should adapt to these changes in order to ensure the satisfactory performance of bridges under combined or cumulative action of hazards.

This study presents a framework for risk quantification and optimum management of bridges susceptible to damage due to floods, flood induced scour, and other gradual deterioration mechanism. Downscaled climate data, adopted from the global climate models, are employed to predict future flood hazard at a given location. Probabilistic simulation is used to quantify the time-dependent failure probability, which subsequently helps quantify the long-term sustainability through the systematic integration of economic, social, and environmental metrics associated with bridge failures.



Quantifying risk under flood and flood induced scour

However, recent increase in seismicity and flood

RESEARCH IN PROGRESS: HIGHLIGHTS



Preserving the Environment



Compressive strength test of RHA specimen



Addressing other Region 6 Transportation Needs

Use of Rice Hull Ash (RHA) as a Sustainable Source of Construction Material

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

Due to the shortage of natural raw materials, overall construction project costs have increased in recent years. To find a solution, modern technologies have resulted in sustainable construction methods and materials. Thus, rice hull ash (RHA) has been considered as an alternative source of cementitious material. Rice husk is an agricultural by-product from the rice milling process. The main use of rice husk is as a biofuel, which generates a large volume of ashes (RHA).

This study examines the potential uses of RHA as a sustainable cementitious material (SCM) in preparation of concrete. This study also assesses the use of RHA as an alternative of commonly used polymers in preparing high grade asphalt binders. RHA is a potential sustainable solution because it is currently being treated as an agricultural waste material,

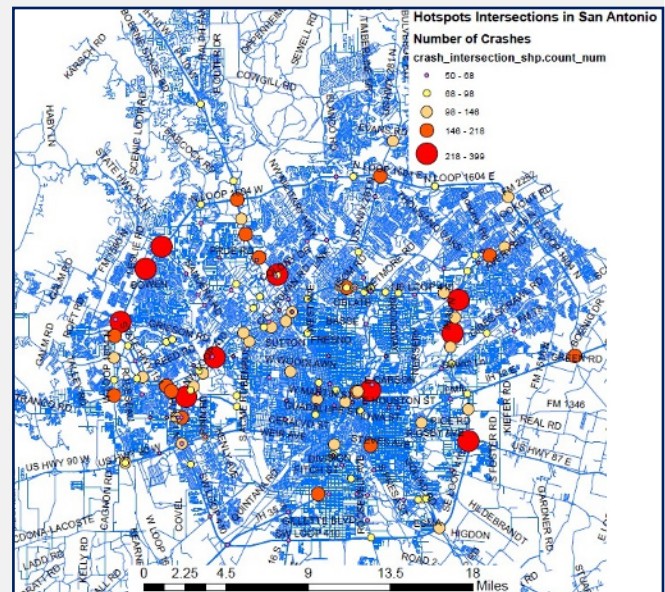
yet its high silica content makes it potentially useful in the construction field. Three different sizes of RHA (600 μm , 150 μm , and 44 μm) with two different partial replacement percentages (10% and 20%) of type I Ordinary Portland Cement (OPC) were considered to prepare concrete and mortar samples. For the comparative analysis, two more SCM materials, namely, class C fly ash and silica fume, were also incorporated in this study. The results of the fresh concrete tests (slump, unit weight, air entrainment) and hardened concrete tests (e.g., compressive, tensile, flexural strength) have suggested that with a 10% replacement of OPC using finer RHA- modified concrete exhibits the improvement of concrete properties compared to the regular concrete. Based on limited test data of RHA-modified binders, RHA appears to be a viable alternative of commonly used polymers.

Relationship between Road Network Characteristics and Traffic Safety

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

Most major cities have complicated roadway networks that include multiple types of roads, intersections, and ramps. Due to budget constraints and the relatively low traffic volumes on some roads, it is often not cost-effective to upgrade the road infrastructure nor is it warranted to implement active traffic control devices (such as traffic lights) to improve safety. Sometimes, it may even be counterproductive to implement certain traffic control systems. Although appropriate signage and improved infrastructure might alleviate the problem, often these intersections do not meet the "Manual on Uniform Traffic Control Devices" (MUTCD) traffic signal warrants. In terms of pedestrian safety, signals may be too far apart, which prompts authorities to apply treatment in between (e.g. mid-block crossing for pedestrians who are not willing to walk to the nearest intersection/signal). However, excessive placement of traffic signals and other signage might negatively affect the reaction of drivers and raise driver expectancy issues.

The city of San Antonio population continues to grow due to strong economic development of the oil and gas industry, and this growth has led to congested traffic and increased crashes.



Intersection hot spots in San Antonio, TX based on crash frequency

This study aims to: (1) perform a thorough analysis of critical intersections with high crashes within the city of San Antonio, TX, (2) analyze key factors leading to root causes, and (3) recommend effective safety countermeasures. The evaluation includes both signalized and un-signalized intersections. The study also identifies select intersections at crash hot spots to observe traffic flow and driver behavior.

RESEARCH IN PROGRESS: HIGHLIGHTS



Preserving Existing Transportation Systems

A Comprehensive Reliability-Based Framework for Corrosion Damage Monitoring and Repair Design of Reinforced Concrete Structures

Dr. Homero Castaneda, Dr. Aydin Karsilayan - Texas A&M University; Dr. Ayman Okeil - Louisiana State University

Dr. Mahmoud Reda Taha - University of New Mexico

Civil infrastructure (i.e., transportation networks, waterways, and energy grids) are critical components of day-to-day life in modern society. The durability and reliability of civil infrastructure are largely affected by corrosion-induced deterioration of reinforced concrete (RC). A recent study by FHWA estimates the annual cost of corrosion to bridges in the U.S. is \$30 billion, not including indirect costs incurred by the traveling public due to closures. It is obvious that being able to monitor and manage RC corrosion is critical.



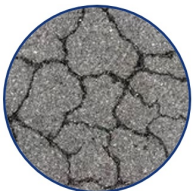
Exposed RC samples being monitored in Galveston, TX

This study aims to develop an effective reliability-based model and management system for corrosion dynamics, in corrosion-damaged RC, that relates the corrosion process with precursors from the environment and inherent to the material. This is accomplished by: (1) developing a continuous and noninvasive corrosion detection and deterministic-probabilistic quantification



In-situ measurements of exposed RC sample using a ring probe

model based on materials damage evolution, (2) developing a reliability-based service life prediction model using the uncertainties inherent in the parameters identified and quantified from the corrosion detection process, and (3) tying the service life prediction model to the design and repair/strengthening and load rating of RC structures using the reliability-calibrated design factors. This will provide the framework of an effective approach to monitoring and quantifying the evolution of damage as well as providing the framework to select cost-effective maintenance/repair strategies for RC corrosion.



Enhancing durability and service life of infrastructure

Development of a Standard Test Method for Characterization of Asphalt Modifiers and Aging-Related Degradation using an Extensional Rheometer

Dr. Nazimuddin Wasiuddin - Louisiana Tech University

Asphalt binder may be modified for improved performance at locations with extreme hot-cold temperature variations. Also, areas which experience frequent heavy truck traffic and/or slow-moving truck traffic will benefit from the use of polymer modified asphalt binder. Therefore, the use of polymer-modified asphalt binders have grown tremendously in North America. While polymers are the most commonly used modifiers, other modifiers such as polyphosphoric acid are also used. Superpave Performance Grading (PG) tests, however, are unable to characterize different polymers or other modifiers that may be used. These tests also cannot quantify the degradation of polymers due to aging.

This study aims to: (1) characterize modified asphalt binders in terms of their aging-related degradation and (2) develop a new standard and specification to supplement the knowledge gap in



Asphalt binder sample during an extensional deformation test

the PG system for modified asphalt binders. An extensional rheometer fixture will be used to perform a suite of tests for modifier characterization and quantification of polymer degradation in asphalt due to aging. A standard test method will be proposed, and specifications will be developed for future pilot projects.

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 significant impact to the transportation industry. To this end, Tran-SET recently developed its **Center-wide T2 plan**. The plan outlines how Tran-SET forms and supports T2 activities at the programmatic and project-specific levels.

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 Twitter, and visiting our **website**! You can also subscribe to our mailing list **here**!



Tran-SET Hosts Inaugural Conference

On April 3-4, 2018 Tran-SET hosted its inaugural Conference in New Orleans, LA: the 2018 Tran-SET Conference. The Conference began with a student poster competition, where 17

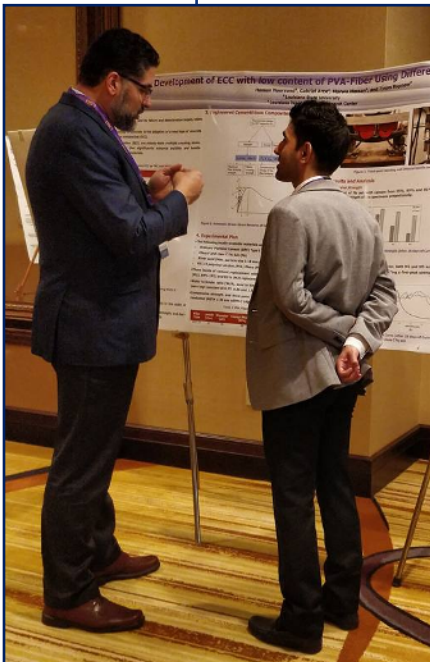
Tran-SET-sponsored students from seven universities presented on their research. The posters were judged by a panel; certificates and small monetary prizes were awarded for first, second, and third place.

The Conference also included an in-person Business Meeting with Tran-SET's Center Advisory Board (CAB). Each Associate Director presented on their research, T2, educational, and workforce development activities. The meeting also involved open discussion where CAB members supplied crucial

feedback and guidance to the Center, especially on the future direction of its research.

The majority of the Conference comprised of technical sessions: 8 technical sessions with 35 lectern presentations. The presentations gave an overview of each of Tran-SET's 33 first-year projects by their respective PI. Each lectern presentation was recorded and is currently being edited into short, promotional video clips.

The 2018 Tran-SET Conference had over 75 attendees from 14 different academic institutions, six public agencies, and four private entities.



Student discussing his research at poster competition



Tran-SET Director addressing CAB members at the Business Meeting

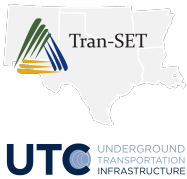


Dr. Matamoros explaining his research

Please visit our **website** for the Conference Program, Business Meeting agenda, and Conference Proceedings (which includes extended abstracts of the 35 lectern presentations).

We are in the preliminary planning stages for our next Tran-SET Conference to be held in Texas. "Stay tuned" for additional details!

TECHNOLOGY TRANSFER ACTIVITIES



Tran-SET Establishes Webinar Series!

Tran-SET recently established the "Joint Tran-SET Webinar Series"! Each webinar will be conducted on a quarterly basis, involve a rotating research theme, and are jointly hosted by rotating University Transportation Centers (UTCs).

Our inaugural webinar will cover "Novel Concrete Materials to Enhance Durability of Transportation Infrastructure" and is jointly hosted by the UTC for Underground Transportation Infrastructure (UTC-UTI). Please see below and our **website** for more information.

JOINT TRAN-SET WEBINAR SERIES

Novel Concrete Materials to Enhance Durability of Transportation Infrastructure

 Wednesday July 11th, 2018 | 1:00 – 2:00 PM (EST)

 **Free registration:** <https://goo.gl/vVWhGf>

¹Self-Healing Microcapsules as Concrete Aggregates for Corrosion Inhibition in Reinforced Concrete

²Evaluating the Use of Recycled and Sustainable Materials in Self-Consolidating Concrete for Underground Infrastructure Applications

³Use of ECC in Shear Keys, Closure Pours, and Culvert Repairs





¹Dr. Homero Castaneda
Texas A&M University



²Dr. Mehran Mazari
California State University - LA



³Dr. Celik Ozyildirim
Virginia DOT

Please register at <https://goo.gl/vVWhGf>



Tran-SET Sponsors and Participates in ICPIC 2018

Dr. Mahmoud Taha, Tran-SET Program Director, and his team from the University of New Mexico organized the 2018 International Congress of Polymers in Concrete (ICPIC) on April 29 - May 1, 2018. ICPIC is an international forum with the objective of following progress in the field of polymers and their use in concrete and construction. Tran-SET was a diamond sponsor of the ICPIC 2018 Conference, showcasing its research at its booth, through a sponsored presentation, and through a series of technical presentations in a Tran-SET-specific session track. The conference had participation from 29 countries worldwide with 96 technical papers covering new advances in the field. For more information, please visit the Conference **website**.



Researchers in front of Tran-SET's booth at ICPIC 2018

TECHNOLOGY TRANSFER ACTIVITIES



Tran-SET Research Leads to Closer Partnership with the City of San Antonio

The continued population growth of the City of San Antonio (COSA) has led to increased congestion and crashes. COSA has higher than the national average of crashes, many resulting in severe injury. The Transportation and Capital Improvement (TCI) division of COSA identified that 56% of severe injuries take place on 105 miles of corridor segments.

The University of Texas at San Antonio (UTSA) partnered with TCI to examine the details of intersection crashes along these corridor segments in the Tran-SET-sponsored project **"Relationship between Road Network Characteristics and Traffic Safety"** (featured on page 3). This partnership led to a new contract between the PIs and TCI to build on the original research - expanding the study with additional \$100k of funding for a project entitled, "Police Traffic Services Enforcement and Education Campaign to Reduce Intersection Crashes".



Dr. Dessouky presenting at COSA's first Vision Zero Summit

The goal of the partnership is to help COSA's traffic and law enforcement agencies to identify critical (hot spot) intersections, increase public awareness, and increase effective implementation of traffic safety measures to reduce fatal and serious injury crashes.



Tran-SET Participates in World Transport Convention (WTC) 2018

World Transport Convention (WTC) 2018 convened in Beijing, China on June 18-21, 2018 with the theme of "Better Transport, Better World". WTC 2018 consisted of six major parts: (1) keynote presentations, (2) the "Belt and Road" International Transport Cooperation Summit Forum, (3) academic forums, (4) science and technology exhibitions, (5) the 2018 World College Student Bridge Design Competition, and (6) various product launches and other special events. Over 5,000 participants (est.) attended - with participants from around the world.



Dr. Elseifi presenting in Tran-SET track at WTC 2018

Tran-SET PIs presented 10 lectern presentations at WTC 2018, including 5 presentations in a Tran-SET-specific session on June 20, 2018 over "Pavement Materials and Structure". The other 5 presentations occurred in varied sessions, including "Pavement Rehabilitation and Maintenance", "New Functional Road Materials", and "Long Term Asphalt Pavement" to reach a wider audience.

Please visit the WTC 2018 **website** for additional information.

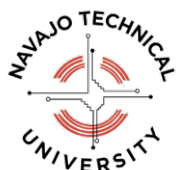
Session No. 1
Tran-SET Track: Pavement Materials and Structure
Characterizing and Understanding Self-Healing Microcapsules Embedded in Reinforced Concrete Structures Exposed to Corrosive Environments <i>Dr. Homero Castaneda</i>
Evaluation of Degradation of Polymer due to Aging in Asphalt Binder Using a Novel and DSR-Based Extensional Deformation Test <i>Dr. Mostafa Elseifi</i>
Low Fiber Content PVA-ECC for Transportation Infrastructure <i>Dr. Marwa Hassan</i>
Asphalt Binder and Asphalt Mixtures with Sodium-Alginate Fibers Containing a Rejuvenator Product <i>Dr. Marwa Hassan</i>
A Framework for Reliability Assessment of Corrosion Damaged Reinforced Concrete Structures <i>Dr. Homero Castaneda</i>

Tran-SET track at
WTC 2018

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.



Tran-SET Established Internship with Navajo Technical University

The Navajo Technical University (NTU) Internship is a (recurring) one-month, fully-paid internship that provides support for NTU students to travel to Louisiana State University (LSU) and work onsite on select Tran-SET-funded research projects. It is a partnership between LSU and NTU with funding from LSU's College of Engineering, Department of Construction Management, and Tran-SET.

The Internship includes three synergistic components: (1) hands-on research experience on several Tran-SET funded projects as a student worker (main component), (2) presentation series on diverse, relevant transportation topics, and (3) informal sessions with varied transportation professionals (from industry, practitioner community, and state and federal government). The Internship is meant to expose and educate the students on the transportation field – and encourage a future career in transportation.

The inaugural Internship took place June 4-29, 2018 and included two Navajo students: **Ms. Christine Whitehorse** and **Ms. Arlyssia Sells**.



NTU interns and other LSU students visiting the Alliance Safety Council

The students were exposed to a variety of transportation topics and professions, including a site visit to the FHWA LA Division Office, a site visit to the Capital Region Planning Commission (CRPC), a site to the Alliance Safety Council, and two on-site presentations from the Deep South ITE President and Vice President, respectively. Please visit our **website** for further detail on the Internship and its activities.



Tran-SET Researchers Present Findings at 2018 Create@State

The research team of **Dr. Zahid Hossain**, Tran-SET Associate Director, participated in the 2018 Create@State, a campus-wide symposium organized by the Arkansas State University (A-State) Office of Research and Technology. The team presented four posters and one oral presentation that showcased the research findings of several Tran-SET-funded projects. The theme of the symposium was the integration of STEM with art and design. It was held on April 16-18, 2018. Dr. Hossain was also a member of the Student Research Advisory Committee, which assisted in the planning and execution of the symposium.



Dr. Hossain and his research team at Create@State

EDUCATIONAL & WORKFORCE DEVELOPMENT ACTIVITIES



Tran-SET Researchers Participate in TinkerFest STEM Event

The research team of **Dr. Zahid Hossain**, Tran-SET Associate Director, assisted the Arkansas State University (A-State) Museum in organizing the 2018 TinkerFest. The event introduced regional youth, through fun demonstrations and interactions with A-State staff, to STEM careers.

Dr. Hossain's team assisted youth in constructing bridge structures (out of marshmallows) and educated them on concrete materials. The event took place on June 9, 2018 and had over 1,200 visitors.



Graduate students educating youth on bridge structures and concrete materials



Tran-SET Presents at Gulf Region ITS Workshop

Christopher Melson, Program Manager of Tran-SET, presented at the 2018 Gulf Region ITS (GRITS) Spring Workshop on April 25, 2018. The workshop topic was planning for connected and automated vehicles (CAVs) in the Gulf Region and included presentations from industry, state government officials, and researchers. Mr. Melson presented on two in-house research projects involving the potential operational impacts of CAV applications, specifically **"Characterizing the**

Impact of Production Adaptive Cruise Control on Traffic Flow: An Investigation" and **"Dynamic Traffic Assignment of Cooperative Adaptive Cruise Control"**.

Approximately 50 transportation practitioners, students, and faculty members were in attendance. For more information regarding GRITS, please visit their **website**.



Tran-SET Research Contributes to "Dance Engineering" High School Project

Ms. Selene Diaz is a recent high school graduate of Menaul Academy in Albuquerque, NM. Through her internship at the University of New Mexico, she worked with **Dr. Fernando Moreu** as part of the engagement activities involved in Tran-SET project, **"Development, Training, Education, and Implementation of Low-Cost Sensing Technologies for Bridge Structural Health Monitoring (SHM)"**. As her senior project, Ms. Diaz chose to study the interface between dancing and engineering; using the accelerometers involved in the project, she measured the vibration of a pedestrian bridge generated by a dancer conducting various ballet moves. She hypothesized that the bridge will vibrate differently under different ballet moves and dancer skill level – potentially using the sensors to



Dr. Moreu and Ms. Diaz presenting at EMI 2018

assist in learning ballet and other dance moves.

Ms. Diaz presented her "Dance Engineering" research at the 2018 Engineering Mechanics Institute Conference (EMI 2018) – which was held on the campus of MIT on May 29 – June 1, 2018. She is the first high school student to present at an EMI Conference. For more information, please visit the EMI 2018 **website**.



Ms. Diaz measuring bridge vibrations due to ballet dance moves

differently under different ballet moves and dancer skill level – potentially using the sensors to