TRAN-SET
QUARTERLY NEWSLETTER

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INSIDE THE ISSUE

ABOUT TRAN-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions across five states (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas) and is led by LSU. 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

Happy Holidays!

I want to wish everyone a safe and relaxing holiday season! I would also like to take this opportunity to personally thank all Tran-SET staff, associate directors, program directors, and principal investigators. Your efforts are much appreciated and are directly responsible for the success and achievements Tran-SET has had throughout 2019. Thank you all.

There are a few important updates I would like to highlight. Registration is now open for the upcoming **2020 Tran-SET Conference**, which will be held in Albuquerque, New Mexico, on April 2-3, 2020. The conference is a great opportunity to learn how Tran-SET-sponsored research is solving regional transportation needs and to network with professionals from a wide-range of transportation fields. Please visit the **conference website** to register. Early registration ends **January 31, 2020!**

Tran-SET is now accepting proposals for two select projects for its fourth cycle of funding. To learn more about these projects, detailed submission requirements, and how to submit a proposal, please visit **Tran-SET's website**. Proposals are due no later than **February 15, 2020**. Tran-SET's second-cycle projects have been successfully closed out. All 32 research reports and datasets have been finalized and publicly posted. They can be accessed from **Tran-SET's website**.

I invite you to read through the Winter 2019 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!

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

RESEARCH PROGRAM UPDATES

SECOND-CYCLE RESEARCH REPORTS AND DATASETS NOW AVAILABLE

Tran-SET's second-cycle projects ended their implementation phase September 2019 and have been successfully closed out. This includes finalizing and publicly posting all 32 research reports and datasets. Research reports and datasets can be accessed from **Tran-SET's website** or directly at **LSU Digital Commons**.

REQUESTING PROPOSALS FOR TWO FOURTH-CYCLE PROJECTS

Tran-SET received 96 problem statements for its fourth cycle of funding. All problem statements have been reviewed by independent experts and ranked accordingly. Tran-SET is currently developing its fourth-cycle funding program based on these rankings and is now accepting proposals for two projects:

- Bridge Load Posting Prediction; and
- Developing Notification and Enforcement Systems to Communicate and Administer Bridge Load Postings.

Only institutions within Region 6 (institutions located within the states of Arkansas, Louisiana, New Mexico, Oklahoma, and Texas) are eligible to submit a proposal, which are due no later than **February 15, 2020**. Please visit **Tran-SET's website** to learn more.

STAFF UPDATE: MR. MELSON'S DEPARTURE

Christopher Melson

Christopher Melson will be leaving Tran-SET as of December 2019. He has served as the program manager of Tran-SET since December 2017. During his tenure, Melson developed Tran-SET's main management processes and procedures, established Tran-SET's webinar series, developed Tran-SET's Technology Transfer (T2) Plan (and corresponding T2 processes), and generally oversaw Tran-SET's main research, T2, educational, and workforce development activities.

Melson will become the program manager for the **Louisiana Local Technical Assistance Program**. He will be missed!

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****.*

BRIDGE DECK INSPECTION USING SMALL UNMANNED AIRCRAFT SYSTEMS-BASED AIRBORNE IMAGING

Dr. Su Zhang, Ms. Shirley Baros, and Dr. Susan Bogus – University of New Mexico

Traditional bridge deck inspection is primarily conducted on the ground by having inspectors either visually inspect the surface condition or interpret the acoustic feedback from hammer sounding or chain dragging to determine the subsurface condition. These traditional methods are expensive, time-consuming, labor-intensive, unsafe, can exhibit a high degree of variability, and require specialized staff on a regular basis.

Recently, remote sensing technologies (unmanned aircraft systems (sUAS), structure-from-motion (SfM), object-based image analysis (OBIA), etc.) have shown promise in bridge deck inspection. sUAS have emerged as an important platform for collecting various types of hyper-spatial resolution aerial imagery to provide a synoptic view of ground objects. As an advanced photogrammetric method, SfM is used for creating 3D coordinates of objects by analyzing overlapping aerial images captured from varied perspectives. This project will focus on using small, unmanned aircraft systems-based airborne imaging techniques and image analysis techniques to develop a complete data acquisition and analysis system to accurately and rapidly detect bridge deck surface and subsurface distresses at a low cost. This project will also develop a guidebook for the implementation of the proposed bridge deck inspection system to assist transportation agencies with workforce development and professional training.

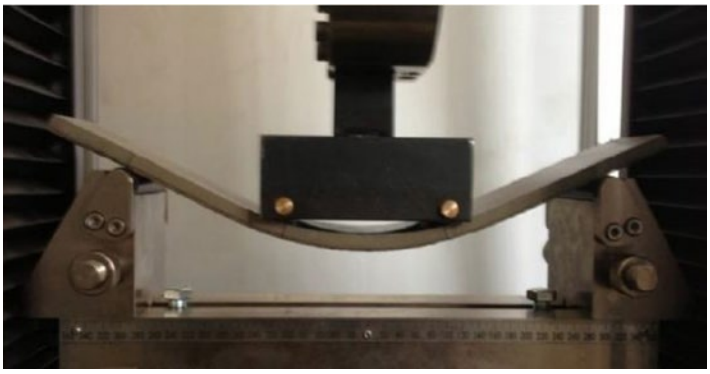
Example of unmanned aircraft system

ENGINEERED GEOPOLYMER COMPOSITES (EGC) FOR SUSTAINABLE TRANSPORTATION INFRASTRUCTURE

Dr. Marwa Hassan, Dr. Gabriel Arce – LSU; Dr. Miladin Radovic, Dr. Svetlana Sukhishvili – Texas A&M University

Adding fibers is a well-established practice to mitigate concrete's brittle behavior. Yet, traditional fiber-reinforced concrete (FRC) produces rather marginal improvements in ductility and tensile strength. High-performance fiber-reinforced cementitious composites (HPFRCC) were developed as a superior alternative to mitigate concrete brittleness. In contrast to FRC, HPRFRCC exhibits a strain-hardening performance after first cracking under tensile stresses. Early versions of HPFRCC achieved desirable improvements in tensile strength and ductility. However, high-fiber contents limited its application in the field due to constructability issues and cost.

This study evaluates an emerging class of strain-hardening fiber-reinforced composites, engineered geopolymer composites (EGCs). The objective of the study is to develop novel EGCs implementing locally available ingredients to produce a new generation of materials that are practical, cost-effective, and eco-friendly for repair and new construction of transportation infrastructure. EGC mixtures will be designed with different types and proportions of locally available precursor materials. EGCs' fresh and hardened properties will be evaluated to identify key parameters, ensuring EGC strain-hardening response, as well as optimum design of the composition, balancing fresh and hardened properties. Furthermore, bonding properties of EGC with regular concrete will be assessed.



High-ductility behavior of EGC specimen

RESEARCH IN PROGRESS: HIGHLIGHTS

FLOODING USING LOW-COST HIGHLY SENSITIVITY ULTRASONIC SENSING OF WATER LEVEL

Dr. Suyun Ham, Dr. Dong-Jun Seo, and Dr. Seongjin Noh - University of Texas at Arlington

Flooding poses safety hazards to motorists, emergency and maintenance crews, and may cause costly damage to transportation infrastructure and its operation. Water-level detection units are commonly designed for riverine flooding rather than flash flooding. Moreover, installation and maintenance of traditional water-level sensing systems are expensive. The current cutting-edge water-level detection techniques, on the other hand, have significant limitations—noise and erroneous signals from sensors, unstable power management, and slow data transmission. Unmanned aerial vehicles (UAV) may also be used to sense flash floods in real time. UAVs, however, have limitations in that they only provide "snapshots" of flood information in the short time period they operate.

As a promising solution, this study will evaluate a low-cost, real-time, ultrasound water-level measuring unit at critical corridors to develop integrated-sensing of the low-cost, highly sensitive ultrasonic water-level detection (UWLD) unit to increase its reliability and resolution and to integrate it with a highly efficient solar power system and reliable cellular network. The flood stage information will be transmitted using a cellular module in the UWLD unit to the Region 6 Flood Control District or sent directly to emergency command centers for early warning so they may take timely action, such as citizen/driver evacuation, route/ramp closures, and signal-timing modification.

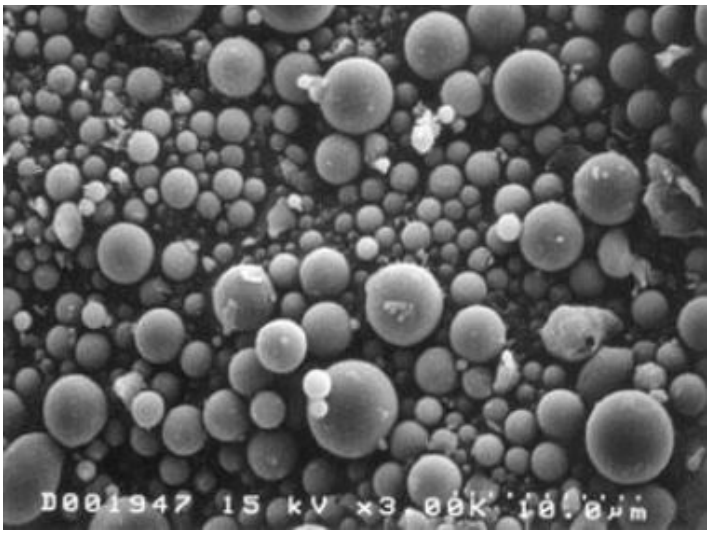
Hazardous flash flood conditions

INFLUENCE OF POWDER-ACTIVATED CARBON (PAC) IN FLY ASH ON THE PROPERTIES OF CONCRETE

Dr. Zahid Hossain – Arkansas State University

Class C fly ash (CFA) is routinely used as a partial replacement of ordinary portland cement to produce concrete. However, some departments of transportation (DOTs) are concerned about certain CFAs since they contain powder-activated carbon (PAC). PAC in fly ash increases the demand of an air-entraining agent (AEA) used to achieve a specified air content. High amounts of large entrained air bubbles can lead to the reduction in volume of entrained air bubbles. The degree of coalescence of air bubbles can be reduced by careful selection of the AEA and the mixing procedure. Alternatively, the unburned carbon can be reduced or removed by a high-temperature burnout or separated physically. To separate carbon from ash, additional steps, such as froth flotation process, can be adopted.

Such knowledge and techniques do not exist in the public domain today. The main objective of this study is to assess the influence of PAC in fly ash on the properties of concrete. Specifically, it will develop guidelines controlling the PAC in fly ash to be used in concrete. This will be accomplished through a comprehensive review of available literature and extensive laboratory testing of selected fly ashes. Fresh concrete will be prepared in the laboratory to determine air content, and hardened concrete will be tested for expansion properties. Data collected from laboratory tests will be analyzed and summarized to provide implementation recommendations to the Arkansas DOT.



Fly ash particles

RESEARCH IN PROGRESS: HIGHLIGHTS

DEVELOPMENT OF A SELF-POWERED WEIGH-IN-MOTION SYSTEM

Dr. Tom Papagiannakis, Dr. Samer Dessouky, and Dr. Sara Ahmed – University of Texas at San Antonio

Traditional systems for weighing and classifying vehicles in motion involves fixed weigh-in-motion (WIM) systems. These systems require access to electric and telephone grids to operate and transmit data. Installations are expensive, and, as a result, state DOTs can afford operating only few of them. Texas, for example, has fewer than 40 statewide. New low-power microprocessors powered by piezoelectric elements can revolutionize this type of traffic data collection. Using the same piezoelectric elements for sensing the load can provide a self-sustained WIM system that can operate independently of the power grid.

The objective of this study is to develop a self-powered weigh-in-motion system–building upon a previously developed roadside piezoelectric energy harvester. The basic sensing element is a stack of six piezoelectric disks, 1-inch in diameter and connected in parallel. A set of four of these stacks supports a metal load-carrying plate installed flush with the pavement surface. These stacks exhibit a linear voltage versus stress behavior that is relatively independent of loading frequency, allowing for the estimation of axle loads. At the same time, these four piezoelectric stacks generate very high voltages but relatively low amperages. The study will conduct a field test of the prototype system and a full-scale demonstration.

Example of WIM installation

ENHANCING THE PERFORMANCE OF ASPHALT MIXTURES CONTAINING HIGH RAP CONTENT WITH THE USE OF DIFFERENT WMA TECHNOLOGIES

Dr. Husam Sadek, Dr. Marwa Hassan, and Dr. Charles Berryman – LSU

The term “warm-mix asphalt (WMA)” refers to various technologies that allow reducing mixing and compaction temperatures of asphalt mixtures without negatively affecting their performance against common major distress types. WMA technologies include foaming processes, chemical additives, and organic (wax) additives. Application of WMA technologies was found to reduce production and construction costs, extend the construction season, improve field compaction, and enhance working conditions by reducing exposure to fuel emissions, fumes, and odors.

In this study, three additives/technologies will be evaluated to perform concurrently as a WMA technology and as a rejuvenator. To this end, Sasobit (organic), Evotherm (chemical), and Advera (foaming) will be used to prepare different asphalt mixtures with high contents of reclaimed asphalt pavement (RAP). The prepared mixtures will be short- and long-term oven-aged and will then be tested against permanent deformation and moisture damage using the Loaded Wheel Tracker (LWT) test at high temperature and against cracking using the Semi-Circular Bending (SCB) test at intermediate temperature. Furthermore, the rheological properties of the extracted and recovered binders from the prepared mixtures will be evaluated using Dynamic Shear Rheometer (DSR) and will be correlated to the mixtures testing results.

Example of WMA operation

TECHNOLOGY TRANSFER ACTIVITIES

Tran-SET has two objectives that guide its technology transfer (T2) activities: to ensure that scientific and technological developments are: (1) accessible, disseminated, and transferred to a wide range of users including state agencies, universities, and industries and (2) have long-term research value and significant impact to the transportation industry. Please see below for a showcase of select, T2 activities sponsored by or involving Tran-SET. Please stay up-to-date with our activities by following us on ***LinkedIn*** *and* ***Twitter****, visiting our website, and subscribing to our mailing list!*

2020 TRAN-SET CONFERENCE: REGISTRATION IS OPEN NOW!

Registration is now open for the upcoming 2020 Tran-SET Conference! The conference will be held in Albuquerque, New Mexico, on **April 2–3, 2020**. It is co-sponsored by the ASCE Construction Institute and hosted by the University of New Mexico and New Mexico State University. To register for the event and to learn more about the venue and program, please visit the **conference website**. Early registration ends **January 31, 2020**!

The conference is a great opportunity to learn how Tran-SET-sponsored research is solving regional transportation challenges and to network, collaborate, and engage with professionals in a wide range of transportation fields. We hope to see you there!

ESTABLISHMENT OF TRAN-SET SEMINAR SERIES

In support of our teaching, research, and outreach initiatives, Tran-SET established a seminar series to bring transportation industry leaders together with faculty, staff, and students on the LSU campus. The inaugural seminar was conducted October 30, 2019, on "Enhanced Live Load-Carrying Capacity of Existing Infrastructure for Extended Life Span." The presentation was given by Dr. Hatem Seliem of SDR Engineering Consultants. Dr. Seliem provided a comprehensive overview of the strengthening technique, along with examples of field applications where fiber-reinforced polymer materials (FRPs) have been successfully used for repair and strengthening of infrastructures. SDR is a multidisciplinary engineering firm dedicated to providing quality engineering services in the areas of structural design and rehabilitation of bridges/structures. For more information about the Tran-SET Seminar Series, including upcoming seminars, please visit **Tran-SET's website**.

Dr. Hatem Seliem presenting at seminar

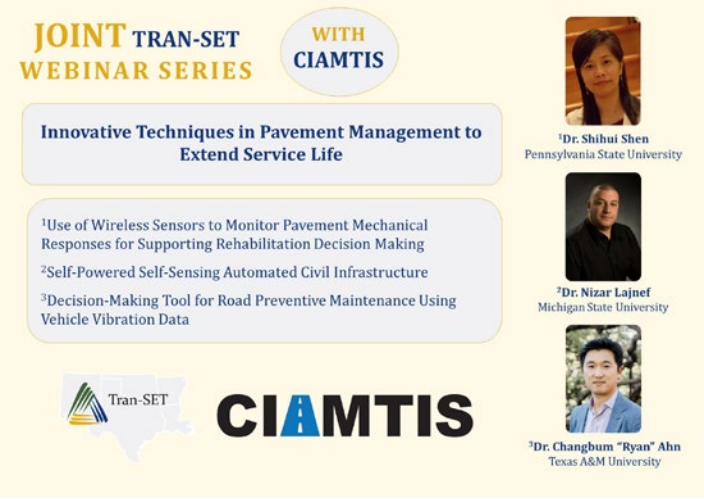
TECHNOLOGY TRANSFER ACTIVITIES

RECORDING OF WEBINAR ON PAVEMENT MANAGEMENT NOW AVAILABLE

CIAMTIS
U.S. DOT Region 3 University Transportation Center

On December 4, 2019, Tran-SET conducted a webinar on "Innovative Techniques in Pavement Management to Extend Service Life." The webinar was jointly hosted by the **Center for Integrated Asset Management for Multi-Modal Transportation Infrastructure Systems** (Region 3's UTC). A recording of the webinar is now available and can be viewed on **Tran-SET's website** or directly on Tran-SET's **YouTube page**.

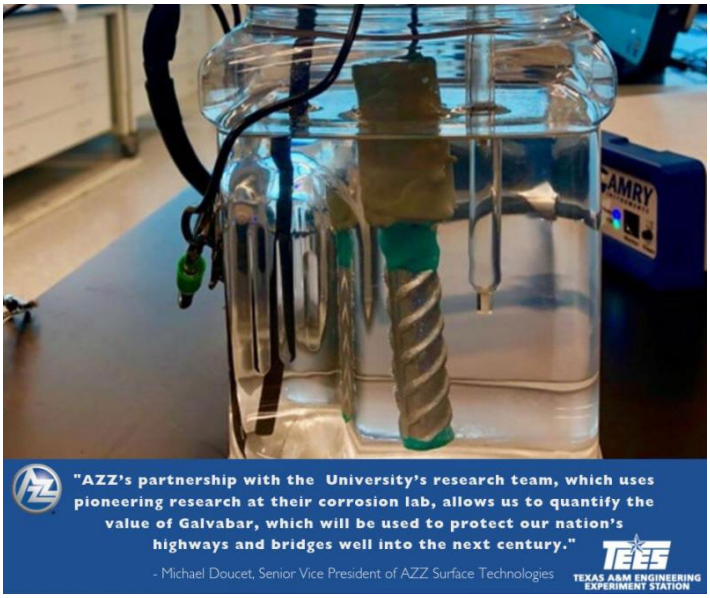
Tran-SET would like to sincerely thank the webinar presenters (please see below).



HOSTED SEMINAR ON CONCRETE REINFORCEMENT SOLUTIONS

AZZ

Dr. Homero Castaneda (Tran-SET principal investigator) hosted an informational seminar on the cost-effectiveness and longevity of different concrete reinforcement solutions at the Texas A&M Engineering Experiment Station (**TEES**) Center for Infrastructure Renewal (**CIR**). Dr. Castaneda presented preliminary findings of the Tran-SET project, "**Corrosion Management System of Regional Reinforced Concrete (RC) Bridges**." Results showed that the use of continuous galvanized rebar (CGR), specifically from AZZ GalvaBar, provides reliable long-term reinforcement with a potential lifespan of more than 100 years. For more information on the seminar and CGR, please visit **AZZ Galvabar's website**.



EDUCATIONAL & WORKFORCE DEVELOPMENT

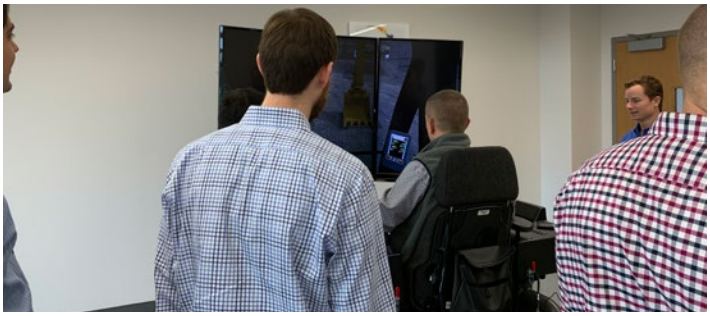
Tran-SET has a firm initiative to advance the transportation workforce and to develop its next generation of leaders by: (1) attracting and supporting diverse, promising individuals to the transportation field through internships/research assistantships, (2) providing experiences through education and 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 below a showcase of select, educational and workforce development activities sponsored by or involving Tran-SET.

HOSTED ASCE (BATON ROUGE BRANCH) LUNCHEON

Tran-SET hosted the Baton Rouge branch of ASCE for its November luncheon on the campus of LSU. Christopher Melson (Tran-SET program manager) gave a brief presentation and led a tour of several Bert S. Turner Department of Construction Management laboratories—the Advanced Materials and Methods Laboratory, the Building Simulation and Information Modeling (BIM) studio, and the CAT® equipment simulators. Approximately 30 civil engineering professionals attended.

For more information about the Baton Rouge branch of ASCE and its upcoming events, please visit **its website**.

Christopher Melson presenting at luncheon



ASCE members testing the CAT® equipment simulators

PRESENTATION AT NEW YORK CITY BRIDGE CONFERENCE

Dr. Adolfo Matamoros (Tran-SET principal investigator) presented research findings from Tran-SET project, "**Structural Vulnerability of Coastal Bridges Under Extreme Hurricane Conditions**," at the 10th annual New York City Bridge Conference. The theme of the conference was risk-based bridge engineering, and representatives from industry, academia, and state agencies were in attendance. The presentation educated bridge engineers on the interaction between bridges and waves during an extreme weather event and brought awareness on the need for improved methods of designing resilient coastal bridges.

Additional information about the event can be found on the **conference website**.

PARTICIPATION IN SWE CAREER PANEL

On November 13, 2019, Christopher Melson (Tran-SET program manager) participated in a career panel jointly hosted by the Society of Women Engineers (SWE) Baton Rouge section and the SWE LSU section. Panelists shared their career experiences and provided general career advice, specifically focusing on career changes. It was held on the campus of LSU, and approximately 20 students and professionals attended. SWE's mission is to empower women to achieve their full potential in careers as engineers and leaders, expand the image of engineering and technology professions as a positive force in improving quality of life, and demonstrate the value of diversity and inclusion. For more information about the SWE Baton Rouge section, please visit **its website**.

EDUCATIONAL & WORKFORCE DEVELOPMENT

LIGHT-WAVE SENSING AND COMMUNICATION KITS AS EDUCATIONAL TOOL

Dr. Sabit Ekin (Tran-SET principal investigator) and his research team prepared "Do-It-Yourself Light-Wave Sensing and Communication Kits" as a tool to teach students how data can be wirelessly transmitted by light. The kits were accompanied by a detailed instructional guide and were used in Oklahoma State University's Summer Bridge Program. Students enjoyed building their own sensing and communication system using light while learning the basics of communication and sensing (such as modulation and electromagnetic spectrum). The Summer Bridge Program is an 18-day residential, on-campus, preparatory program for incoming freshmen students who have been accepted to Oklahoma State University and who plan to study a major in the College of Engineering, Architecture, and Technology (CEAT). These outreach activities were conducted as part of Tran-SET project "**Vehicle Sensing and Communications Using LED Headlights to Enhance the Performance of Intelligent Transportation Systems: Proof of Concept, Implementation, and Applications.**"

Students assembling and testing their sensing kits

PRESENTATION AT FALL 2019 CONCRETE CONVENTION AND EXPOSITION

On October 20, 2019, Dr. Shih-Ho Chao (Tran-SET principal investigator) presented at the Fall 2019 Concrete Convention and Exposition in Cincinnati, Ohio. His presentation, entitled "Achieving High Strength, Ductility, and Durability in Flexural Members Reinforced With Fiber-Reinforced Polymer Rebars by Using UHP-FRC," was part of a special educational session on innovations/changes in structural design using ultra-high performance concrete (UHPC). Dr. Chao presented findings of Tran-SET project, "**Toward Non-Corrosion and Highly Sustainable Structural Members by Using Ultra-High-Performance Materials for Transportation Infrastructure.**"

For more information about the convention, please see its program of activities.

Exhibitions at the Concrete Convention and Exposition