Tran-SET
Transportation Consortium of South-Central States

Quarterly Research Newsletter

Issue 1

December 2017

REGION 6 UNIVERSITY TRANSPORTATION CENTER

LETTER FROM THE DIRECTOR

It is my pleasure to welcome you to the Transportation Consortium of South-Central States, Tran-SET. Tran-SET comprises of 11 institutions (listed below), is Region 6's (LA, TX, AR, OK, and NM) University Transportation Center, and is led by Louisiana State University (LSU). Tran-SET was established in late-November 2016.

With limited funding and the downsizing of transportation agencies due to challenging economic conditions, the backlog of transportation projects has reached alarming levels and continues to grow. The American Society of Civil Engineers (ASCE) graded America's infrastructure at a D+ in 2013, assessing that $3.6 trillion dollars would be needed to fix our nation's aging and crumbling infrastructure. It is clear that addressing these challenges with "business as usual" approach will not suffice. To this end, Tran-SET established its mission, vision, and research goals/themes.

VISION: *Address the accelerated deterioration of the transportation infrastructure through the development, evaluation, and implementation of cutting- edge technologies, novel materials, and innovative construction management processes.*

MISSION: *Conduct all phases of research, technology transfer, workforce development, and outreach activities as to solve transportation challenges in Region 6 and support implementation.*

RESEARCH THEMES:

- *Enhancing Durability and Service Life of Infrastructure*
- *Preserving Existing Transportation Systems*
- *Addressing other Region 6 Transportation Needs*

Tran-SET is uniquely positioned to achieve its vision and mission by leveraging complementing expertise, capabilities, and facilities of its university partners. Tran- SET also involves diverse, regional stakeholders in *all* aspects of its research, from project selection to implementation. Tran- SET has formed strategic partnerships with major state authorities, regional and national transportation research centers, and public and private organizations. With these partnerships, it is our hope that Tran-SET becomes a transportation focal point in the region – as well as nationally.

I hope you enjoy our inaugural newsletter, meet key members of our consortium, learn more about our current research efforts and outreach activities, and ways to collaborate and/or otherwise utilize our research. Thank you. Welcome!

Marwa Hassan, Ph.D., PE Civil (VA), LEED AP BD+C,M.ASCE

CETF Distinguished Professor;

Graduate Coordinator; College of Engineering, Louisiana State University

MEET OUR ASSOCIATE DIRECTORS

Tran-SET is a collaborative partnership between nine major institutions and two community colleges. Its leadership team consists of ten associate directors that help coordinate our research (their main role), technology transfer, educational, and workforce development activities among their respective institutions.

Dr. Ibrahim Karaman (TAMU)

Dr. Karaman is a Professor and Head of the Materials Science and Engineering Department at Texas A&M University (TAMU). His research interests include: development and characterization of shape memory alloys and nanostructured materials. He has received over $24.7M in research grants and has authored over 133 peer reviewed journal publications, with an impressive 6,600 citations for his work. His expertise will bring new applications of novel materials in the transportation industry.

Dr. Stefan Romanoschi (UTA)

Dr. Romanoschi is a Professor at the University of Texas at Arlington (UTA) and has over 21 years of experience in research and academics. He has published 18 journal articles and has been awarded $4.9M in research funds. His research interests include: pavement engineering and design, pavement materials and construction, and pavement testing and management.

Dr. Susan Bogus Halter (UNM)

Dr. Bogus is an Associate Professor at the University of New Mexico (UNM) and has over 20 years of experience in industry and academics. She has received over $7.7M in research grants and authored 24 peer reviewed journal articles. Her expertise is in Construction Engineering, and her research interests include: project delivery, asset management of infrastructure projects, and sustainable design and construction.

Dr. Samir Ahmed (OSU)

Dr. Ahmed is a Professor of Civil Engineering at Oklahoma State University (OSU). His research interests include: design, planning, and management of transportation systems and facilities; highway traffic operations and control; intelligent transportation/ infrastructure systems; transportation safety; systems modeling, simulation, and optimization; and statistical quality assurance and quality control of highway construction.

Dr. Zahid Hossain (A-State)

Dr. Hossain is an Associate Professor of Civil Engineering at Arkansas State University (A-State). He has over ten years of experience in academics and 55 peer- reviewed journal articles. His research interests include: energy conservation, recycling, nano- and bio- modifications, and intelligent system design of geotechnical and transportation materials for pavement applications.

Dr. Raghava Kommalapati (PVAMU)

Dr. Kommalapati is a Professor of Civil and Environmental Engineering at Prairie View A&M University (PVAMU), where he also serves as the Director of the Center for Energy & Environmental Sustainability (CEES). He has received $10.76M from 40 research grants and has authored 58 journal articles.

Dr. Craig Newtson (NMSU)

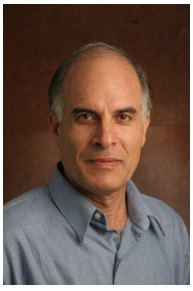
Dr. Newtson is a Civil Engineering Professor at New Mexico State University (NMSU) with over 20 years of academic experience. His research interests include: structure, properties, behavior, and durability of construction materials. Dr. Newtson has received over $2M in research funding, and has published 28 journal papers and 8 conference papers.

Timothy Dykes (BRCC)

Mr. Dykes is a Program Manager and Instructor of the Construction Management Department at Baton Rouge Community College (BRCC). He has served as site construction manager in a field environment, supervised project personnel on over 50 projects totaling $3.5 million, and has executed over 580 work orders totaling over $582K supporting 74 facilities.

Dr. Samer Dessouky (UTSA)

Dr. Dessouky is an Associate Professor of Civil Engineering at the University of Texas at San Antonio (UTSA). He has more than 20 years of experience in infrastructure sustainability, pavement management and safety, and his funding at UTSA exceeds $6M. Dr. Dessouky has 90 cited technical publications on bituminous materials, computational micromechanics of asphalt mixtures, pavement sustainability, geogrid reinforcement, energy harvesting from roadways and motorists' safety.



Dr. Gholam Ehteshami (NTU)

Dr. Ehteshami is a Professor and Department Chair of the School of Engineering, Mathematics and Technology at Navajo Technical University (NTU). He has collaborated and worked on response reports to High Learning Commission (HLC) for institutional accreditation.

MEET OUR PROGRAM DIRECTORS

Tran-SET's leadership team also involves program directors that guide and shape Tran-SET's research, technology transfer, educational, workforce development, and outreach activities as a whole. They showcase remarkable leadership abilities and research experiences through their involvement in national efforts and committees.

Dr. Mostafa Elseifi (LSU)

Dr. Elseifi is a Professor in Civil Engineering at Louisiana State University. He has managed several research projects and developed specifications for NCHRP and LADOTD. Dr. Elseifi has also served as Associated Editor of the ASCE Journal of Transportation Engineering, and as a member of TRB AFD80, TRB AFD40, and ASCE Pavement Committees. In addition, he has substantial experience in organizing and delivering successful TRB and ASCE sponsored webinars.

Dr. Louay Mohammad (LSU)

Dr. Mohammad is a Professor at Louisiana State University, and the Director of the Engineering Materials Characterization and Research Facility. He also serves as the Coordinator of the Transportation Engineering Faculty Group, Chair of ASTM subcommittee on Bituminous Mixture Analysis, Associate Editor of ASCE Journal of Materials in Civil Engineering, Chair of the TRB Committee AFK40, and member of TRB AFK50 Committee. Dr. Mohammad has managed more than 50 research projects, and his research interests include: Highway Construction Materials, Pavement Engineering, Accelerated Pavement Testing, Advanced Materials Characterization and Modeling, and Infrastructure Sustainability.

Dr. Anand Puppala (UTA)

Dr. Puppala is a Professor in Civil Engineering at the University of Texas at Arlington. With over 28 years of industrial and academic experience, he serves as the Associate Dean of Research for the College of Engineering, and the Coordinator of Geotechnical Engineering.Dr. Puppala also served as President of United States Universities Council on Geotechnical Education and Research (USUCGER), chaired the American Society of Civil Engineers (ASCE)'s Geotechnical Institute's "Engineering Geology and Site Characterization" committee, and recently served as the chairman of TRB committee on "Soil and Rock Instrumentation (AFS 20).

Dr. Mahmoud Reda Taha (UNM)

Dr. Taha is a Professor and the Department Chair of the University of New Mexico (UNM) Civil Engineering department.He has over 23 years of experience in industry and academia, and has managed research projects in excess of $8.5 million. He serves as the Director of UNM Resilience Institute, Chairman of the ACI Committee on Polymers and Adhesives in Concrete, Secretary of the ACI Committee on Nanotechnology, and Chair of the upcoming International Congress on Polymers in Concrete (ICPIC) in 2018.

Dr. Paola Bandini (NMSU)

Dr. Bandini is an Associate Professor of Civil Engineering at New Mexico State University (NMSU), specialized in geotechnical engineering. Her research interests include: development and application of bio- mediated and bio-inspired methods for ground improvement and foundations; applications of new and recycled materials; and earthen construction. Dr. Bandini is a Past President of the NM Section of the American Society of Civil Engineers (ASCE). She served as chair of two TRB committees: AFS50- Modeling for the Design, Construction and Management of Geosystems, and AFS20 Geotechnical Instrumentation and Modeling.

Dr. Tyson Rupnow (LTRC)

Dr. Rupnow is the Associate Director for Research at the Louisiana Transportation Research Center (LTRC). With over 10 years of experience and 30 peer reviewed journal articles, his work includes evaluation of high portland cement replacement ternary mixtures, implementation of the surface resistivity test method, and full-scale load testing and evaluation of RCC. Dr. Rupnow serves as a member of TRB Committees AFN30 "Durability of Concrete" and AFN10 "Basic Research and Emerging Technologies for Concrete." He is a Member of ACI – Louisiana and a Member of ASCE and the Geo-Institute.

Dr. Sam Cooper, Jr. (LTRC)

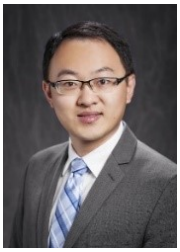
Dr. Cooper is the Director of the Louisiana Transportation Research Center. He has over 36 years of experience and over 50 publications. As Director, Dr. Cooper is responsible for overseeing and directing research, technology transfer, workforce development, and materials testing programs. Dr. Cooper is currently serving on the Transportation Research Board (TRB) as the TRB representative for the State of Louisiana.He is also a member of the Research Advisory Committee (RAC) and was nominated as a member of Standing Committee on Research (SCOR).

MEET OUR PROGRAM COORDINATORS

Tran-SET program coordinators work directly with the director, associate directors, program directors, researchers, and others to successfully execute the Center's research, technology transfer, educational, and workforce development activities.

Dr. Christopher Harper (LSU), *Research and Technology Transfer Program Coordinator*

Dr. Harper is an Assistant Professor at Louisiana State University (LSU) in the Construction Management Department. He has over 15 years of academic and industry experience. He currently serves in the Transportation Research Board (TRB) Committees on Construction Management (AFH10) and Project Delivery Methods (AFH15). His research interests include:delivery methods and contracting strategies for construction projects, measuring and evaluating the integration of project teams, and productivity improvements and contracting methods.



Dr. Chao Wang (LSU), *Educational and Workforce Development Program Coordinator*

Dr. Wang is an Assistant Professor at Louisiana State University (LSU) in the Construction Management Department. He currently serves as an Assistant Director of the LSU-Industrial Assessment Center funded by the US Department of Energy. His research interests include: automation and robotics in construction, construction safety and health, Building Information Modeling (BIM) and data sensing, and building energy efficiency.

Did You Know? Six out of Tran-SET's 11 university partners are minority serving institutions. Tran-SET aims to integrate diversity related activities into research and educational activities - and to increase the number of underrepresented students' enrollment in transportation programs.

RESEARCH AND TECHNOLOGY TRANSFER PROGRAM

Tran-SET's first-round of research proposals occurred in mid-March 2017– and after review by experts in academia, industry, and the public sector– were awarded in early May 2017. Tran-SET awarded 33 projects, totaling over $4.4 million (with matching funds or in-kind services):

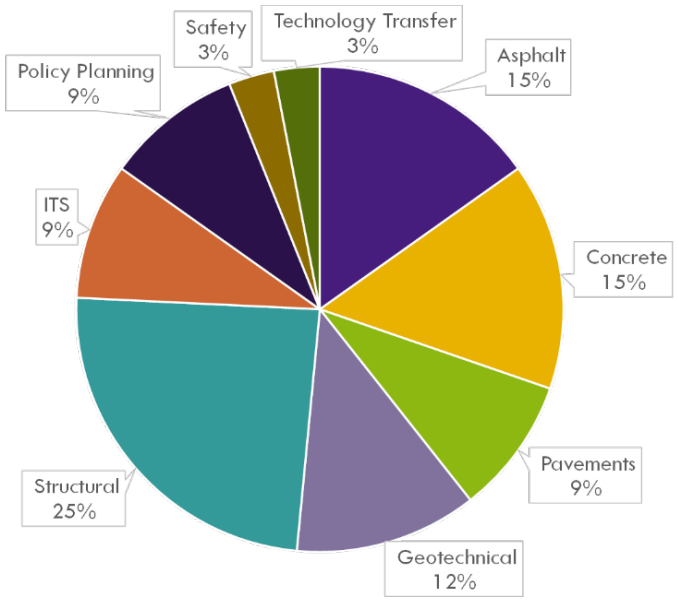
- 14 projects (43%) involved *Enhancing Durability and Service Life of Infrastructure*
- 8 projects (24%) involved *Preserving Existing Transportation Systems*
- 2 projects (6%) involved *Preserving the Environment*
- 9 projects (27%) involved *Addressing other Region 6 Transportation Needs* – which covered such diverse topics as: metropolitan growth, congestion mitigation, under-served/under-invested communities, and safety.

The program can be further categorized by research area, showcasing the breadth of the Center, ranging from materials research (e.g., Portland cement concrete and asphalt) to Intelligent Transportation Systems (ITS). *(See chart)*

Tran-SET places a great emphasis on the implementation of research – requiring all projects to have at least 10% of the allocated funding for a six-month implementation phase, after the 12-month technical research phase (typically).

Of the 33 funded projects, 11 collaborative studies will be conducted through a partnership between the consortium members and 8 through public-private partnerships.

Please visit our **website** for more information about our current research efforts (includes detailed descriptions of each project).



RESEARCH IN PROGRESS: *Highlights*

Please see below for a showcase of select, current research. 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!

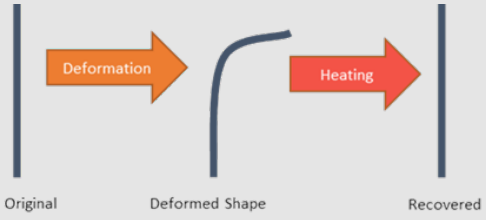
Enhancing Durability and Service Life of Infrastructure - *Through Novel Materials*

Integrating Health Monitoring and Reinforcement of Transportation Structures with Optimized Low-Cost Multifunctional Braided Cables

Institution: TAMU

Dr. Karaman, Dr. Hartl

Shape memory alloys (SMAs) are a smart construction material that can recover its original shape when heated after deformation beyond its elastic limit – and recover from large deformations trigged by unusually large strains without heating. SMAs can limit damage sustained by structures from natural hazards (such as earthquakes and hurricanes) by limiting/controlling the deformation and crack growth of the structure.



The Shape Memory Effect (SME)

This effort explores iron-based SMAs (over the more commonly used and expensive Nickel Titanium allows) that are capable of providing suitable mechanical properties for a structure – while demonstrating magnetic sensing capabilities. This property can be harnessed to create a method to monitor the stresses and strains on the structural system. Through a series of demonstrations and laboratory tests, this effort will design, fabricate, and characterize multi-functional high strength and self-sensing, braided cable structures using iron-based SMAs.

To learn more, please see the project's information **sheet**.

RESEARCH IN PROGRESS: *Highlights*

Evaluating the Performance and Cost -Effectiveness of Engineered Cementitious Composites (ECC) Produced from Local Materials

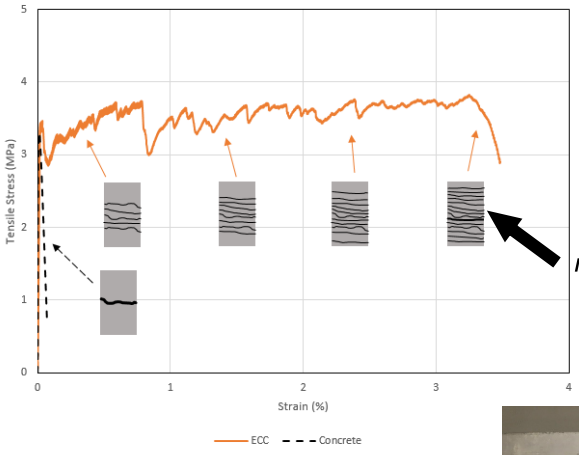
Institution: LSU

Dr. Arce, Dr. Hassan, Dr. Rupnow

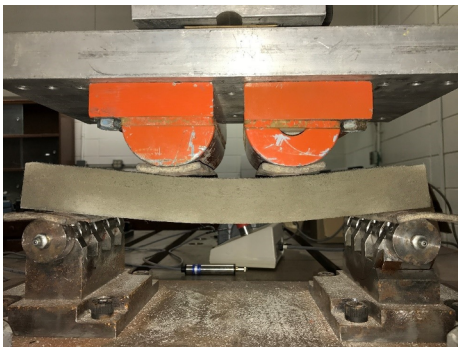
Engineered cementitious composites (ECCs) have the potential to be a superior construction material for transportation infrastructure due to its unique properties – namely its ability to undergo substantial amounts of deformation (100x to 500x that of regular concrete). This is achieved via a controlled process of micro-cracking or "pseudo strain-hardening".

This effort will develop and evaluate (through various laboratory strength tests) a series of ECC mix designs that include locally available materials/ingredients. Key parameters will be identified from the mix designs that most greatly influence the ECC properties. To date, cost reductions in the order of 10 to 15% can be achieved in the ECC production with local materials and exhibit: (1) compressive strength of regular concrete, (2) roughly 2x its flexural strength, and (3) 200x its ductility.

To learn more, please see the project's information **sheet**.



Pseudo Strain-Hardening Process of ECC in Direct Tension



Laboratory test of ECC concrete mix

Developing Self-healing and Rejuvenating Mechanisms for Asphalt Mixtures Containing Recycled Asphalt Shingles

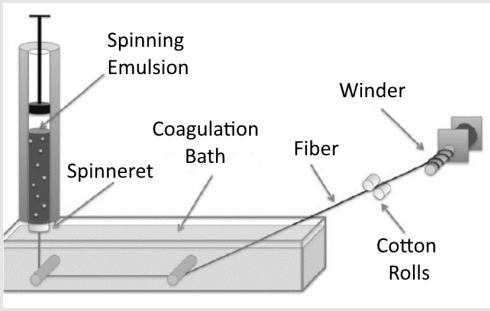
Institution: LSU

Dr. Hassan

The use of recycled materials in Hot- Mix Asphalt (HMA) has increased substantially in practice. However, aged binder in Recycled Asphalt Shingles (RAS) and Reclaimed Asphalt Pavement (RAP) limit the amount of recycled materials that can be included in the mix. The use of asphalt rejuvenators can be applied as a potential solution in restoring the original binder's properties.

This effort will investigate an innovative, self- healing approach to disperse asphalt rejuvenator: by encapsulating the rejuvenator in biodegradable polymer fibers. The "self- healing" mechanisms will then be trigged through either: (1) a cracking event which ruptures the fibers and enables the release of the rejuvenator or (2) the controlled release of the rejuvenator through the polymer's membrane over time. This effort will evaluate the suitability (through thermal stability and tensile strength tests) of the polymer fibers in asphalt production processes, assess its healing efficiency, and determine the optimum fiber percentage to be included in the mix. These self-healing mechanisms can provide a more reliable and resilient mix design to resist the initiation and propagation of cracking caused by vehicular and environmental loading.

To learn more, please see the project's information **sheet**.



Wet-spinning Line Set-up for fiber

Preparing asphalt samples for testing

RESEARCH IN PROGRESS: *Highlights*

Preserving Existing Transportation System - *Through Novel Materials*

Developing a Self -Powered Structural Health Monitoring System for Transportation Infrastructure

Institutions: UTSA, TAMU

Dr. Karsilayan, Dr. Dessouky, Dr. Papagiannakis

Collecting infrastructure utilization data is critical to properly monitoring and managing a transportation system – and doing so inexpensively and in multiple locations throughout the system is ideal. The main goal of this effort is to develop an inexpensive self-powered structural health monitoring system that will allow monitoring strains independently of the electric power grid. Its source of power is the thermal gradient between the surface and the lower layers of pavement; thermal harvesting is done through Thermal Electric Generators (TEGs).

This effort will develop and evaluate (through laboratory and field evaluation) self-powered sensors using energy harvested from available power sources in pavement.

Prototype TEG harvester installation and power output

To learn more, please see the project's information **sheet**.

Preserving Existing Transportation Systems - *Through Cutting-Edge Technology*

Cost-effective Methods to Retrofit Metal Culverts Using Composites

Institution: UNM

Dr. Bogus, Dr. Taha

Metal culverts have served as a common structure in highway design since the mid-1950s. However, there has been an epidemic of corrosion of metal culverts for the last decade. Currently, corroded metal culverts are repaired using a corrugated steel liner with a grouting material or using shotcrete material; both techniques are still prone to corrosion and degradation.

Corroded Metal Culvert Cross-Section

This effort investigates a cost-effective, corrosion-free technique to retrofit corroding metal culverts using glass fiber reinforced polymers (GFRP). GFRP has a high strength to weight ratio, does not require additional protective coatings or maintenance, and recent techniques have dropped its cost significantly. In conjunction with the New Mexico Department of Transportation (NMDOT), this effort will develop a state-wide culvert database, initialize an experimental program to examine bond issues and identify the optimal method and adhesive to attach GFRP to metal culverts, conduct a cost-analysis on the optimal method, and conduct a laboratory load test of a scaled model.

To learn more, please see the project's information **sheet**.

Addressing Other Region 6's Transportation Needs - *ITS*

Improving the Performance of the Transportation System through Supply- and Demand-Oriented Traffic Mitigation Strategies

Institutions: LSU, OSU

Dr. Ahmed, Dr. Osman, Dr. Codjoe

Adverse impacts of traffic congestion (unreliable travel times, increased stress levels, increased air pollution, decreased economic competitiveness, etc.) are well-known. Limited resources, growing demand, and increasing constraints related to capacity expansion have implored agencies to investigate Intelligent Transportation Systems (ITS) and Active Traffic Management (ATM) strategies to better manage operational performance.

Congestion at Interstate 10 in Baton Rouge, Louisiana

This effort performs network analysis to identify the location, extent, and nature of the main congestion problems in the Baton Rouge, LA area – especially at the I-10 Mississippi Bridge.

It will develop a simulation model and identify and evaluate potential supply- and demand-oriented traffic mitigation strategies.

To learn more, please see the project's information **sheet**.

EDUCATIONAL & WORKFORCE DEVELOPMENT PROGRAM

Tran-SET aims to promote educational and workforce development in the transportation field through training and continuous education – and has a firm commitment to improve existing transportation-related programs at our 11 university partners. This is accomplished by coordinating and leveraging the results of our research activities; it is anticipated that our currently funded projects will lead to: over 25 new or revised courses, over 40 new educational modules, over 25 seminars/workshops, over 15 webinars being developed/presented, and supports 50 graduate students. Tran-SET is exploring a variety of ways and working to establish new educational partnerships (e.g., establishing a research internship program between LSU and BRCC, establishing a relationship with LSU Veteran & Military Student Services, etc.). Please see below for a showcase of select, educational outreach activities sponsored by or involving Tran-SET.

Educational Outreach Activities - *Highlights*

Summer Transportation Institute (STI)

UNM's Engineering Student Services (ESS), with the support of the U.S. DOT and the U.S. Army Education Outreach Program (AEOP), sponsored the Summer Transportation Institute (STI) and UNITE Summer Programs for high school students. UNM's EES successfully implemented the three-week STI program from June 4th to June 23rd, 2017. The program hosted 30 rising 10th and 11th grade students from throughout the state of New Mexico, Texas, and northern Arizona.

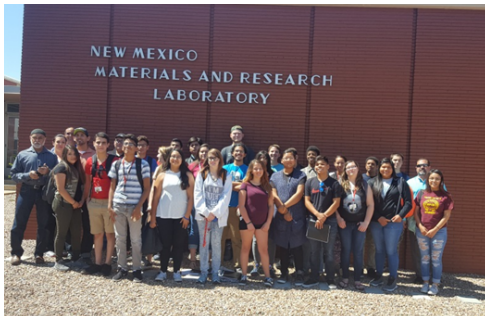
The STI Program provided participants with presentations from experts in the transportation industry, opportunities to attend field trips, and participate in hands- on, interactive activities. The educational activities covered topics related to transportation engineering, including: construction materials testing, smart transportation systems, bridge building, rocket building, and solar cars. Participants attended classes in English for expository and technical writing, math classes for problem solving, and computer classes for basic programming. STI also offered afternoon events related to transportation, improving pre-college skills and self-awareness, and preparing for ACT and SAT exams.

The Department of Civil Engineering at UNM and Tran-SET greatly contributed to STI's activities with sessions on construction materials testing, smart transportation systems, and bridge building.

Construction Materials Testing

Dr. Mahmoud Reda Taha, one of Tran-SET's Program Directors and Principal Investigator for "Cost- effective Methods to Retrofit Metal Culverts Using Composites" (project highlighted above), organized a workshop to teach the STI students how to test the behavior of metals (steel and aluminum), timber, concrete aggregates, Portland cement, Portland cement concrete, asphalt binders, and hot mix asphalt for pavement.

Smart Transportation Systems



Dr. Fernando Moreu (the Principal Investigator for Tran- SET project 17S-TUNM02 – to learn more, please see the project's information **sheet**), Dr. Su Zhang, and research assistants at the Smart Management of Infrastructure Laboratory (SMILAB) developed a workshop to teach the STI students how to use Arduinos to build low-cost accelerometer sensors to monitor the vibration of a structure. This group also organized a field trip to the Sandia Peak Tram to use the sensors, where the STI students learned how to use the accelerometer sensors they built and how to interpret their results. The accelerometer sensors captured the movements of the tramway car in all directions, and the movements were plotted in real-time.

Bridge Building

Dr. Walter Gerstle developed a workshop to introduce topics and concepts related to bridge building. The STI students constructed wooden model bridges and tested the stress point of failure with the supervision of Dr. Gerstle's research assistants.

LSU College of Engineering Residential Summer Camps

Every year, the LSU College of Engineering offers two residential engineering summer camps to qualified high school students: REHAMS (Recruiting into Engineering High-Ability Multicultural Students) and XCITE (Xploration Camp Inspiring Tomorrow's Engineers). These programs give high school students the chance to explore, create, experiment, build, code, design, and compete in a variety of engineering and college preparatory activities. The camps are held on LSU's Baton Rouge campus where college faculty and college students interact with attendees through several hands- on workshops and activities.

REHAMS

Tran- SET developed, organized, and engaged students with a hands-on session to learn the basics of mortar mixing. The students learned how the proportioning affected the workability and strength of the mix, and placed the mortar into Star Wars- and Lego- themed molds. The next day, the students retrieved their samples and took them as souvenirs.

XCITE

Tran- SET help attract high school students to careers in transportation by offering interactive, and educational demonstrations of traffic engineering on July 13th, 2017. The students learned about traffic simulation models by using the VISSIM software tool, were taught on the utility of ramp meters, and considered the traffic levels at which they are effective in controlling congestion.

XCITE students were also exposed to the driving simulator lab, which consists of a full- sized passenger car (Ford Fusion) combined with a series of cameras, projectors, and screens to provide a high fidelity virtual environment that offers a high degree of driving realism. Most of the participating high school students had little to no driving experience, and as such they were able to use the driving simulator for practice in a stress-free, fun environment.

CONNECT WITH TRAN-SET!

Visit our website to learn more

Like us on Facebook

Follow us on Twitter

Subscribe to our mailing list

CONNECT WITH TRAN-SET!

International Congress
on Polymers in Concrete
April 29-May 1, 2018
Washington, D.C.
www.icpic2018.unm.edu

2018 Tran-SET Conference
April 3-4, 2018
New Orleans, LA
www.transet.lsu.edu

World Transport
Convention
June 18-21, 2018
Beijing, China
www.wtc9811.com.cn