



PROGRAM PROGRESS PERFORMANCE REPORT

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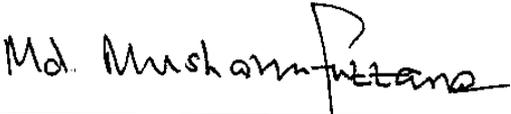
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1 ACCOMPLISHMENTS

1.1 Goals The two complementary goals of the Southern Plains Transportation Center (SPTC) are: (i) to develop comprehensive, cost-effective and immediately implementable solutions to critical infrastructure-related issues facing the transportation system in Region 6 and the nation; and (ii) to prepare aspiring transportation personnel and students for leadership roles in professional and research careers that support sustainment and improvement of the nation's transportation systems. We particularly focus on under-represented professionals – Hispanic, Native Americans and African Americans – capable of leading public and private sector efforts aimed at providing U.S. citizens a sustainable and resilient transportation system. Our focus is climate adaptive freight and transportation infrastructure.

1.2 Accomplishments The Southern Plains Transportation Center is making significant progress toward realizing its vision of developing a diverse and inclusive, regionally-based and nationally recognized research, education and outreach center. During the reporting period, our primary accomplishments included: (i) delivering research and education/outreach programs and project outputs, outcomes and impacts; (ii) delivering the 2nd Transportation-Climate Summit and the 2016 Oklahoma Transportation Research Day; (iii) conducting many other education and outreach activities at member institutions across the consortium, including tribal outreach; (iv) continuing the 2016 SPTC Workshop Series; (v) delivering the 2017 Annual Leadership Retreat; (vi) enhancing collaborations; (vii) and preparing to offer the 2017 TRIP internships. An overview of some of these activities is provided in the following sections.

1.2.1 Research and Technology Transfer In the reporting period, the SPTC was engaged in advancing the following activities: executing the SPTC15 research solicitation program, facilitating progress in SPTC Research and Education projects, delivering the 2nd Transportation-Climate Summit and the 2016 Oklahoma Transportation Research Day. An overview of each of these activities follows.

SPTC15 Program: The SPTC completed the SPTC15 funding competition. The program focus is on high impact and implementable projects consistent with the priorities of the SPTC that can produce meaningful deliverables within the one-year project period. A summary of each funded project is listed in the following table and posted on the SPTC website (<http://www.sptc.org>).

SPTC15 Program (continuation):

SPTC Project	Title	PI (Institution)
15.1-45	A Sustainable Performance-Based Methodology to Address the Impact of Climate Changes on the "State of Good Repair" of Transportation Infrastructure	Carlos Chang (UTEP)
15.1-46	Degradation of Mechanically Stabilized Earth Reinforcements Exposed to Different Environmental Conditions	Arturo Bronson (UTEP)
15.1-50	Rapid and cost-effective rehabilitation alternatives for transportation infrastructure affected by extreme conditions	Vanessa Valentin (UNM)
15.1-49	Field Implementation of Fatigue Enhanced Polymer Concrete Incorporating Nanomaterials	M.R. Taha (UNM)
15.3-03	Cotton-Derived Composite Materials for Climate Resilient Transportation Infrastructure	Noureddine Abidi (TTU)
15.5-01	Towards an Open-source Web GIS-based Bridge Management System Using Advanced Geo-Spatial Data Visualization and Integration Technologies	Hongchao Liu (TTU)
15.5-03	Development of Novel Analysis Model for Foundations Subjected to Combined Torsional and Lateral Loads Due to High Wind	Hoyoung Seo (TTU)
15.5-04	Infrastructure-Relevant Climate Projections for the Southern Great Plains	Katharine Hayhoe (TTU)

Research Project Progress: The following institutions are currently reporting research progress for the SPTC14 and 15 programs: Arkansas State University (ASU); Langston University (LU); Louisiana State University (LSU); Louisiana Tech University (LTU); Oklahoma State University (OSU); The University of Oklahoma (OU); Prairie View A&M

University; University of Tulsa (TU); Texas Tech University (TTU); University of Arkansas (UArk); University of New Mexico (UNM); The University of Texas at Austin (UT-Austin); The University of Texas – Rio Valley Grande (UT-RVG); and The University of Texas at El Paso (UTEP). A short summary of progress by project category follows.

Climate and Safety

- “Enhancing Driver Safety during Severe Weather Conditions” (Project team includes Mohammed Atiquzzaman (OU), Ron Barnes (OU), Joseph Havalcek (OU) and Majeed Hayat (UNM).) A safety application is being developed to analyze information from neighboring vehicles and create a threat map to alert drivers of potentially hazardous road conditions. During this reporting period progress has included solving various issues which were causing the program to crash and cleaning up the code to make the communication between on board unit and road side equipment more efficient. The communication between the OBU and RSU now also includes GPS location of the vehicles. Implementation of results will contribute to a reduction in vehicle crashes, fatalities and injuries due to adverse weather conditions. See more about this project in the April 2016 SPTC brief found here <http://www.sptc.org/briefs/>.
- “Identifying Dust Emission ‘Hot Spots’ in the Southern Plains Region of New Mexico, Oklahoma and Texas: Effect of Blowing Dust on Highway Safety” (Project team includes Junran Li (TU), Thomas Gill (UTEP) and Jeffrey A. Lee (TTU).) This study is identifying and quantitatively assessing the spatial and temporal patterns of wind erosion hot spots that contribute to blowing dust to the highways of New Mexico, Oklahoma and Texas. During the reporting period, progress has included modeling of dust emission. Implementation of the developed integrated modeling and monitoring system will assist in highway safety management and mitigate the hazardous impacts of dust. See Products section for related products. See more about this project in the September 2015 SPTC brief found here <http://www.sptc.org/briefs/>.
- “Trends in Cold Temperature Extremes and Winter Weather for the SPTC Region” (Project team includes Renee A. McPherson (OU), Esther Mullens (OU), Derek Rosendahl (OU), Mark Shafer (OU) and Michael Richman (OU).) This project is quantifying historical and future trends in winter precipitation (ice, snow and rainfall), cold air outbreaks (frequency, intensity), and freeze-thaw cycles for the southern plains region. During the reporting period, progress has included preparing the final report. Project outcomes will be of benefit across a broad range of sectors, covering the necessary “first step” in climate risk assessment. See Products section for related products. Find more information about this project in the 2015 Spring SPTC Newsletter (pp.16,17) found here <http://www.sptc.org/publications/>.
- “Safety Evaluation of Pavement Surface Characteristics with 1mm 3D laser Imaging” (Project Principle Investigator – Kelvin Wang (OSU).) PaveVision3D technology data is being used to evaluate various benchmarks for surface characterization related to pavement safety. During the reporting period, progress has included preparing the final report. The research outcomes will be particularly relevant when extreme weather conditions cause substantial water on the pavement surface contributing to hydroplaning, which contributes to numerous accidents and fatalities. An SPTC Brief contains highlights of this project and can found at: <http://www.sptc.org/briefs/>.
- “Crash Severity Formulation and Analysis under Extreme Weather Conditions” (Project team includes Guohui Zhang and Rafiqul A Tarefder, (UNM).) A new approach is being developed to identify the underlying patterns behind crash data. A series of significant contributing attributes on crash severities impacted by weather extremes in the southwest region will be identified. During the reporting period, progress has included conducting in-depth statistical analyses and geographically clustering analyses on crash hotspots under weather extremes in the southwest region and developing the new multinomial Logit model-Bayesian network hybrid approach to capture cause-effect relationships between contributing attributes and crash severity outcomes. Implementation will help transportation agencies to develop cost-effective countermeasures to reduce crash severities under extreme weather conditions and minimize weather-related risks to traffic safety in the southwest region. See Products section for related products. Find more information about this project in the 2016 Spring SPTC Newsletter (pp.24,25) found here <http://www.sptc.org/publications/>.
- “Understanding Impact of Climate Change on Highway Hydraulic Design Procedures” (Project team includes Vivek Tandon and Vinod Kumar, (UTEP).) The study will evaluate current resiliency of highway drainage infrastructure. During the reporting period, progress has included climate change vulnerability and risk assessment. Implementation will include delivery of cost-effective adoption solutions that extend service life despite not having been designed for climate change.
- “Assessing the Risk of Landslide on I-35 Near Davis Oklahoma Utilizing LiDAR 3D Mapping” (Project team includes

Yongwei Shan, Joshua Qiang Li and Xiaoming Yang, (OSU).) Landslides are a threat to public traffic when they occur on roads passing through mountainous regions. The main goal of this research is to investigate the use of Light Detection and Ranging (LiDAR) technology for slope monitoring and landslide/rockslide risk assessment on major highways in Oklahoma. During the reporting period, progress has included monitoring slopes using LiDAR 3D mapping technology. The effort will yield an innovative procedure for DOTs to monitor slopes and assess the risk of landslide on highways in the mountainous regions so that proactive actions can be taken to reduce the disruptions and dangers to the traffic due to landslides.

- “A Sustainable Performance-Based Methodology to Address the Impact of Climate Changes on the “State of Good Repair” of Transportation Infrastructure” (Project PI is Carlos Chang (UTEP).) This research investigates how to incorporate performance measures for climate change and risk assessment methods into Transportation Asset Management (TAM) practices. During the reporting period, progress has included development of the framework for climate change modeling in TAM-based decision making process. The results of this research will facilitate transportation agencies to incorporate climate change effects and risk assessment in the TAM decision making process specifically when formulating sustainable strategic plans to preserve the transportation infrastructure in a “State of Good Repair.”
- “Infrastructure-Relevant Climate Projections for the Southern Great Plains” (Project team includes Katharine Hayhoe, Darryl James and Anne Stoner (TTU).) . During the reporting period, progress has included project start up. The project will assess the potential future impacts of climate non-stationarity on the SPTC region and explore the extent to which these projections can be incorporated into the design, building, and maintenance of a transportation infrastructure that is resilient in the face of a changing climate.

Bridge Structures

- “Impact of Extreme Summer Temperatures on Bridge Structures” (Project team includes Micah Hale (UArk) and Royce Floyd (OU).) This multi-institutional project is assessing the effects of recent heat events on prestressed concrete bridges in Region 6. During the reporting period, progress has included obtaining data from the girder and developing the model. The project’s outcomes will support the management and design of current bridges subjected to extreme temperatures, reduce maintenance costs and increase the service life, safety and effectiveness of our transportation infrastructure.
- “Evaluation of Surface Treatments to Mitigate ASR” (Project Principle Investigator – Micah Hale (UArk).) This project is examining the effectiveness of silane (and other sealers) in reducing the internal relative humidity of ASR-infected concrete. During the reporting period, progress has included monitoring the barrier wall and exposure blocks. See Products and Impacts sections for related work. An SPTC Brief contains highlights of this project and is available at: <http://www.sptc.org/briefs/>.
- “Temperature Effects in Bridge Condition Evaluation and Capacity Rating in Oklahoma” (The OU project team includes Naiyu Wang, K.K. Muraleetharan and Luther White.) This research is using Finite Element Analysis to perform heat flow and thermal stress analysis. During the reporting period, progress has included preparing the final report. Implementation of the developed guidelines for considering temperature effect in capacity rating will enhance efficient estimation of temperature-induced stresses in bridges with different construction materials, skewnesses and cross section geometries and lateral constraints, which will be economically beneficial to the improvement of the transportation systems regionally and nationally.
- “Impact of Deicing Salts on Corrosion Rates of MSE Reinforcement” (The TTU project team includes Priyantha Jayawickrama, Sang-Wook Bae, Andrew Jackson, William Lawson and Hoyoung Seo.) This research is evaluating corrosion rates in steel MSE reinforcement and embedded MSE backfill materials under different levels of exposure to deicing chemicals. During the reporting period, progress has included preparation of the final report. The effort will result in a comprehensive test protocol and assessment criteria that can be used to evaluate the complete range of MSE backfill materials, including coarse graded fill, under specified levels of exposure to deicing chemicals.
- “Development of Mixture Designs for Pumpable Concrete for Extreme Weather” (Project Principle Investigator – Tyler Ley (OSU).) This study is investigating the concrete pumping process and evaluating if frost durable concrete can be achieved. During the reporting period, progress has included preparation of the final report. Implementation will allow immediate changes to be made to the optimized graded concrete specifications for structural concrete. See Products section and link (www.optimizedgraded.com) for related information.
- “Design of Integral Abutment Bridges (IABs) in Extreme Climate” (The OU project team includes K.K.

Muraleetharan and Gerald A. Miller.) This project is utilizing data collected from an instrumented IAB in Oklahoma and computer models to develop readily implementable design and construction guidelines for IABs in areas with extreme variations in temperature and moisture. During the reporting period, the final report was being prepared. SPTC Brief contains highlights of this project and can found at: <http://www.sptc.org/briefs/>. This project was also highlighted by the UTC: http://www.rita.dot.gov/utc/publications/spotlight/spotlight_2015_09.

- “Evaluation and Repair of Bridges in Extreme Environments” (Project team includes Royce Floyd (OU) and Gary Prinz (UArk).) This project is investigating comprehensive strategies for evaluation and resilient repair of prestressed concrete and steel bridge girders subjected to extreme environments in order to increase the longevity of existing structures. During the reporting period, the final report was delivered and is posted at <http://www.sptc.org/reports/>. Implementation will allow agencies to better evaluate and repair bridges with exposure to extreme environments.
- “Improving Fatigue of Polymer Concrete Overlays using Nanomaterials” (The UNM project team includes Mahmoud Reda Taha and Rafiqul Tarefder.) The objective of this work is to improve the bond, fracture and fatigue performances of PC overlays using nanomaterials such as carbon nanotubes (CNTs), graphene nanoparticles (GNPs) or alumina nanoparticles (ANPs). During the reporting period, the final report was delivered and is posted at <http://www.sptc.org/reports/>. Implementation will produce significant improvement in the mechanical, durability, fracture and fatigue characteristics of PC. SPTC Brief contains highlights of this project and can found at: <http://www.sptc.org/briefs/>.
- “Monitoring Extreme Loading and Climate Impact on Infrastructure” (The OSU project team includes Julie Ann Hartell, Tyler Ley, Phil Lewis and Yongwei Shan.) This project is evaluating climate and overload impact on transportation infrastructure, determining extent of damage and monitoring damage progression. During the reporting period, progress has included acoustic emissions monitoring and analysis and destructive/non-destructive testing. Implementation of the developed guidelines will facilitate an effective condition assessment system. This project will provide the transportation industry a monitoring tool so that infrastructure problems can be detected and corrected sooner, resulting in improved public safety and reduced maintenance costs.
- “Rapid and cost-effective rehabilitation alternatives for transportation infrastructure affected by extreme conditions” (The UNM project team includes Vanessa Valentin and John Stormont.) This study will provide methods to quantify, manage and decrease the vulnerability of transportation infrastructure - specifically bridges and drainages - to wildfires. During the reporting period, progress has included evaluating the sensitivity of a hydrology model to site-specific input data and identifying transportation infrastructure components at risk. The results can be immediately implemented through the decision support tool, which can be used by decision-makers to manage and reduce the risks associated with fires. Additionally, a report on post-wildfire mitigation and rehabilitation best practices will be produced.
- “Risk-based life-cycle management of deteriorating bridges” (The OSU project team includes Mohamed Soliman and Julie Ann Hartell.) The research will develop a risk-based life-cycle management technique for bridges susceptible to failure due to scour and floods considering the long-term impact of climate change. A decision making tool will be formulated to assist in planning future adaptation and mitigation strategies. During the reporting period, progress has included performing finite element modeling to understand the effect of scour on structural reliability. Implementation will yield a tool that will identify available adaptation strategies, as well as their effect on the risk profile, and perform stochastic optimization to obtain the optimum time and adaptation type required to reduce the risk of failure and extend the service life.
- “Experimental Investigation of Tangential Heave Stress Acting on Deep Foundations in Cold Regions” (The TTU project team includes Hoyoung Seo, William Lawson and Priyantha Jayawickrama.) This study will quantify the effect of ground conditions such as frost depth, water content, and ground temperature on tangential heave stress which is a key design parameter for deep foundations in cold regions. During the reporting period, progress has included conducting hydraulic conductivity tests for the test silt. Implementation will yield a testing system and procedure may serve as a standard test method to more reliably determine peak and residual values of tangential heave stress.
- “Structural performance of concrete bridge decks reinforced with high-strength reinforcing bars” (The UARK project team includes Micah Hale, Gary Prinz and Canh Dang.) The main objective of this project is to investigate the behavior of bridge decks reinforced with A1035 steel at the service and strength limit states. The experimental program is aimed at generating necessary information to understand the mechanical properties of A1035 steel,

and how these properties affect the design of bridge decks at the two limit states. During the reporting period, progress has included project start up. Based on the findings, recommendations will be made for using A1035 steel in the design of bridge decks.

- “Rehabilitation of Deteriorated Timber Piles using FRP Composites” (The LaTech project team includes David Hall and Shaurav Alam.) This project will evaluate the capacity of fiber reinforced polymers (FRP) strengthened deteriorated timber piles under axial loads, and a combination of axial loads plus bending with different lengths of deterioration zone. During the reporting period, progress has included evaluation load capacity of FRP-strengthened deteriorated piles. Implementation will facilitate investigation of the feasibility of restoring and enhancing the capacity of the original timber piles.
- “Degradation of Mechanically Stabilized Earth Reinforcements Exposed to Different Environmental Conditions” (The project PI is Arturo Bronson (UTEP).) This study examines the effect of moisture in the fines in which chlorides tend to segregate and corrode the mechanically stabilized earth (MSE) reinforcements composed of galvanized steel. During the reporting period, progress has included project start up. The project will yield a methodology of monitoring the degradation of Mechanically Stabilized Earth Reinforcements.
- “Towards an Open-source Web GIS-based Bridge Management System Using Advanced Geo-Spatial Data Visualization and Integration Technologies” (The TTU project team includes Hongchao Liu and Dayong Wu.) This project will (1) provide a comprehensive review of current BMS development activities; (2) identify available bridge-related data sources at the state DOT, which enable the further data integration needed for a variety of analytical purposes; (3) build a more realistic model to represent the deterioration of bridge components by using a semi-Markov transition process. During the reporting period, progress has included project start up. Implementation will yield a web GIS-based bridge management system, which allows advanced geospatial visualization and potential data integration on a centralized cloud platform.
- “Development of Novel Analysis Model for Foundations Subjected to Combined Torsional and Lateral Loads Due to High Wind” (The project PI is Hoyoung Seo (TTU).) In this study, a mechanically-rigorous-yet-easy-to-use analysis model will be developed for load-displacement response of circular foundations (circular footings or drilled shafts) in a layered soil under combined loading of torsion and lateral load. During the reporting period, progress has included project start up. Results will provide invaluable insights on combined effects of lateral load and torsion on the foundation behavior, potentially leading to a safer and optimized foundation design.

Traffic and Multimodal Considerations

- “Web-Based Routing Assistance Tool to Reduce Pavement Damage by Overweight and Oversize Vehicles” (The TTU project team includes Hongchao Liu and Sanjaya Senadheera.) This project is developing a web-based routing assistance tool to optimize the overweight/oversize routes based on the historical and expected number of repetitions of super heavy loads. During the reporting period, the final report was delivered and is posted at <http://www.sptc.org/reports/>. The results will contribute to efficient vehicle permitting and routing of oversize/overweight vehicles to significantly reduce road damage.
- “Incorporation of Speed/Travel-time Data Sets in Traffic Performance Analysis” (Project team includes Hazem Refai (OU) and Samir Ahmed (OSU).) This project will develop a Travel Time Reliability Monitoring System (TTRMS) composed of Bluetooth identification devices strategically placed on interstate highways coupled with analytical models and software algorithms designed to evaluate the quality of real-time collected data. During the reporting period, progress included developing, deploying and validating a portable, functional, inexpensive monitoring station, develop a web service application, and develop a Matlab code based on Bayesian Probability model to detect various traffic flow conditions. Implementation will improve system responsiveness and reliability.
- “The Effects of Weather Events on Truck Traffic Using Fixed and Mobile Traffic Sensors” (Project team includes Sarah Hernandez and Song Feng (UARK).) This study will develop a predictive model that relates variations in truck traffic patterns to weather conditions, with a focus on extreme weather events. It will explore spatial regression models which correct for spatial autocorrelation that exists in explanatory variables due to spatial differences in transportation network density and land uses. During the reporting period, progress included development of a full base line model using OLS, assessment of the possibility of spatial lag and spatial error models using the base line model and determination of a distance threshold for weather and WIM station association. Ultimately, this research will help leverage existing freight data sources to support freight transportation planning and decision making.
- “The Dependence of Infrastructure Restoration on Transportation Networks” (Project PI is Sarah Nurre (UARK).) This research effort will explicitly model the transportation network for the development of infrastructure restoration

plans. During the reporting period, progress included developing the optimization model and linking the feasible completion and timing of an interdependent network on the restoration activities of the transportation network. Delivery will include an integrated network design and scheduling problem to determine restoration plans for transportation and other networks by deciding (i) what damaged components or temporary components should be installed and made operational immediately after event, (ii) who performs the tasks necessary to make these selected components operational, and (iii) at what time the tasks are conducted.

- “Modeling Resilience and Impact in Multi-Modal Transportation Networks” (Project PI is Kash Barker (OU).) During the reporting period, progress included formulation of an optimization model for preparedness decision making. This work will assist transportation planners in understanding the contribution of individual components in the multi-modal network to economic productivity given a protracted disruption. It could also assist logistics planners in measuring the efficacy of rerouting strategies given a disruption, and policy makers will benefit from the methods to analyze how network development decisions in terms of the accessibility of potential nodes/links within the network and the availability of incremental capacities would improve the network survivability at the time of a disruption.

Pavement and Materials

- “Resistance of Asphalt Mixes with Recycled Materials to Withstand Extreme Temperatures” (The project team includes Amit Bhasin (UT-Austin) and Zahid Hossain (ASU).) This research is investigating the use of low-temperature tests on asphalt binders, as well as mortars with and without RAP, to determine the resistance of asphalt materials to low temperature cracking. During the reporting period, progress has included drafting of the final report. This effort will result in a user-friendly test method and analysis program that can be used by material and pavement engineers to evaluate cracking resistance of asphalt materials for any pavement cooling scenario.
- “Numerical Modeling of Asphalt Crack Resistance” (The project team includes Enad Mahmoud (UT-Pan American) and Soheil Nazarian (UTEP).) This study is developing a Discrete Element Method (DEM)-based model of the resistance to cracking exhibited by asphalt mixtures using the Overlay Tester, which will be beneficial to asphalt design programs within state DOTs. During the reporting period, progress has included progress has included drafting of the final report.
- “Asphalt Binder Rheological Characterization for Extreme Climate Events” (The TTU project team includes Sanjaya Senadheera and Rajesh Khare.) This research is analyzing climate data to predict future weather patterns, relating climate to pavement condition, and using techniques of molecular modeling to elucidate the relationship between asphalt chemical composition and rheological properties. During the reporting period, progress has included progress has included drafting of the final report. Research findings will contribute to the building of highways that better adapt to new climate realities. See Products section for related products.
- “Evaluating Rutting and Stripping Potentials of Asphalt Mixes using Hamburg Wheel Tracking Device” (Project Principle Investigator – Rafiqul A. Tarefder (UNM).) The issues of repairing transportation infrastructure by preventing damage resulting from extreme weather conditions are addressed. During the reporting period, progress has included development of the HTWD specifications. The outcome of this study will be a specification that addresses rutting due to extreme temperatures that will be useful in areas with extreme hot climate. The February 2016 SPTC Brief contains highlights of this project and is available at: <http://www.sptc.org/briefs/>.
- “Impact of Severe Drought on the Compacted Expansive Clays (Subgrade) in Northern Louisiana” (Project Principle Investigator – Jay Wang (LTU).) This study is evaluating the fundamental volume change behaviors of compacted expansive clays in Louisiana, with a focus on severe drought conditions. During the reporting period, progress has included validation of a heave prediction model. The research will advance in-depth understanding of the volume change properties of expansive clays. See Products section to see related work. See Products section for related products.
- “Characterization of Asphalt Binders Exposed to Extreme Temperatures through Simple and Effective Test Methods” (Project team includes Nazimuddin Wasiuddin (LTU), Zahid Hossain (ASU), Rouzbeh Ghabchi (OU) and Louay N. Mohammad (LSU).) The research is developing a simple and dynamic shear rheometer-based test method that can be used as an alternative to PG Plus tests (elastic recovery and force ductility) to accurately determine high temperature performance of asphalt materials. During the reporting period, progress has included analysis of test results. Implementable specifications for commonly used extreme temperature asphaltic materials will be developed to reduce cost and testing time. The June 2016 SPTC Brief contains highlights of this project and is posted to: <http://www.sptc.org/briefs/>.

- “Development of the MASW Method for Pavement Evaluation” (Project Principle Investigator – Clinton Wood (UArk).) This research is developing the MASW method into a tool for characterization of concrete and asphalt pavements, bases, and subgrades for transportation projects. During the reporting period, the final report was delivered and is posted at <http://www.sptc.org/reports/>. Implementation will assist agencies in early detection of delamination, cracks, and concrete deterioration, which can be critical for planning future repairs or replacement of the existing infrastructure.
- “Validating Field Employed X-Ray Fluorescence (XRF) on Stabilized Subgrade Projects to Assess Impact of Extreme Precipitation Events, Improve Construction Quality Control and Facilitate Geotechnical Forensic Investigations” (The OU project team includes Amy Cerato and Gerald A. Miller.) This research is validating the portable field employed XRF (PFXRF) test by assessing its detection accuracy on selected roadway stabilization projects. During the reporting period, progress has included performing leaching tests on stabilized soils in the laboratory to determine how fast and how much stabilizer leaches from the soils and using the XRF technique to determine how much stabilizer to add back to regain the necessary strength. Recommendations will be developed for transportation officials to employ PFXRF and to implement a laboratory XRF testing protocol that will enhance jobsite quality control, assess impact of extreme precipitation events and expedite geotechnical forensic investigations. See Products section for related products.
- “Special Provisions for Intelligent Compaction (IC) of Stabilized Soil Subgrades” (The OU project team includes Sesh Commuri, Musharraf Zaman and Manik Barman.) This study is developing and validating Oklahoma Department of Transportation “Special Provisions” for the use of IC rollers during compaction of stabilized subgrades. During the reporting period, progress has included preparation of the final report.
- “Development of statewide WIM data quality control and axle load spectra and traffic volume adjustment factors for Oklahoma” (Project team includes Joshua Qiang Li (OSU) and Musharraf Zaman (OU).) This project will develop quality control (QC) metrics and associated software interfaces for checking the quality of statewide WIM data. It will also develop site-specific, region-specific, and statewide traffic inputs that are required for the Mechanistic-Empirical (ME) based pavement design in Oklahoma. During the reporting period, progress included working on dynamic modulus data for asphalt concrete. The WIM data sets have been imported to the customized Prep-ME software. Implementation will facilitate design and analysis of pavement structures.
- “Development of Guidelines for High-Volume Recycled Materials for Sustainable Concrete Pavement” (Project team includes Jeffrey Volz (OU) and Julie Hartell (OSU).) This study will evaluate concrete in conventional pavement construction, incorporating at least 50% recycled materials (both recycled concrete aggregate and supplementary cementitious materials) without compromising performance or service life. During the reporting period, progress included evaluation of fresh and hardened properties and durability, as well as development of implementation guidance. Outcomes include guidelines for material selection and mixture optimization.
- “Development of a SFE Database for Screening of Mixes for Moisture Damage in Oklahoma” (Project team includes Rouzbeh Ghabchi (OU) and Rifat Bulut (OSU).) Surface Free Energy (SFE) characteristics of asphalt mixes will be evaluated for bond strength and debonding of aggregate and asphalt binder in presence of water, which cannot be achieved using either a TSR or a HWT test. During the reporting period, progress included the TAN test to determine the acidity of the asphalt binders and elemental analysis of the asphalt binders using an XRF. This study will deliver a SFE database and training for pavement designers for the implementation of this innovative and cost-effective mechanistic approach for screening of asphalt mixes.
- “Design Data for Rigid Pavements in New Mexico” (Project team includes Rafiqul A. Tarefder and Mahmoud Reda Taha (UNM).) During the reporting period, progress included cylindrical and beam specimen preparation and testing for MOR, elastic modulus and compressive strength. This study will develop three most important inputs among many inputs required by the AASHTOWare pavement M-E design software in the design of rigid pavement for New Mexico materials, traffic, and climate.
- “A Novel Approach for the Characterization of the Rutting Performance of Pavement Foundations” (Project team includes Reza Ashtiani and Bill Tseng (UTEP).) The study will provide a Variable Dynamic Confining Pressure (VDCP) stress path protocol for permanent deformation characterization of geomaterials in the laboratory. During the reporting period, progress included assessment of the synergistic effect of moisture, fine content, and stress path. Implementation will potentially mitigate the unforeseen maintenance and repair costs associated with underestimation of the parameters of the rutting models for the design of pavement structures.
- “Development of Numerical Simulation Tool for Continuously Reinforced Concrete Pavements” (Project team

- includes Cesar Carrasco and Soheil Nazarian (UTEP).) During the reporting period, progress included implementing the mathematical model into an existing Matlab code using the same modular structure that serves as the foundation of NYSLAB. This research project will expand the capacity of the existing source code of NYSLAB by upgrading its FEM models to predict the stresses and strains in continuously reinforced concrete pavement.
- “Quantifying Thermomechanical Fatigue of Hot Mix Asphalt: A Feasibility Study” (Project team includes Calvin M. Stewart and Imad N. Abdallah (UTEP).) A systematic experimental-theoretical-numerical paradigm will be developed to evaluate the fracture and fatigue resistance of HMA materials, especially when subjected to thermomechanical conditions. During the reporting period, progress included using DCT specimens to evaluate the fracture and fatigue properties of asphalt at relevant temperatures and mechanical load rates. A provisional standard test method for the fracture and fatigue resistance of HMA subjected to TMF and a computational model capable of predicting the mechanical state of HMAs subjected to climate extremes will be developed.
 - “Mitigating Dry Shrinkage Pavement Cracking by Geocell” (Project team includes Xiaoming Yang, Rifat Bulut and Joshua Qiang Li (OSU).) This project investigates an innovative and potentially cost-effective approach to mitigate the dry shrinkage cracking problem in pavements. It uses a three-dimensional geosynthetic product (commonly known as geocell). During the reporting period, progress included developing and calibrating a discrete element model that can simulate the dry shrinkage cracking in the subgrade. Preliminary design and construction guidelines will be developed for geocell use to treat expansive subgrade soils for pavement construction and maintenance.
 - “Development of a mechanistic-based design method for geosynthetics-reinforced pavement on expansive soils” (Project PI is Jay Wang (LaTech).) This project extends the current SPTC project by characterizing local expansive soils, developing methods to predict soil heaves and calculate induced stresses in pavements and shallow foundations. During the reporting period, progress included developing an analytical model, which renders an innovative coupling methodology for predicted heaves, earth pressure on the Winkler/Timoshenko foundation, and stresses through the Winkler/Timoshenko beam. An easily implementable model will be developed on the basis of the theory of Timoshenko beam on elastic foundation, in which the mechanism of soil strength and stiffness enhancements from geosynthetics is mathematically considered.
 - “ODOT Guidelines for the Use of FRS in Highway Construction” (Project PI is Kianoosh Hatami (OU).) Transportation agencies in the U.S. are continually faced with a persistent problem of landslides and slope failures along highways. During the reporting period, progress included compilation of Fiber-Reinforced Soil (FRS) test data and development of a computational spreadsheet to determine FRS properties using properties of constituent materials. This study will develop guidelines for FRS technology for the mitigation of landslides and slope failures.
 - “Development of a RTFO-Aging Test Protocol for WMA Binders and Its PG Grading” (Project PI is Nazimuddin Wasiuddin (LaTech).) The objective of this study is to investigate the aging during foam-based warm mix asphalt production in the field and during laboratory short-term oven aging and develop a revised rolling thin film oven (RTFO) protocol to simulate these aging. During the reporting period, progress included performing RTFO tests. A method will be developed that will determine if asphalt binder grade bumping is necessary. The method will require a revised RTFO procedure.
 - “Development of Special Provision for Mix Design of Foamed-WMA Containing RAP” (Project team includes Rouzbeh Ghabchi, Musharraf Zaman and Manik Barman (OU and University of Minnesota).) Although the use of Warm Mix Asphalt (WMA) is increasing rapidly in Oklahoma and neighboring states in Region 6, lack of specifications for mix designs is inhibiting the asphalt producers and users (DOTs and others) alike. During the reporting period, progress included performance testing and data analysis. The primary goal of this project is to develop a draft special provision that can be adopted readily by the Oklahoma Department of Transportation (ODOT), Oklahoma Turnpike Authority (OTA), the asphalt industry and others for WMA mix designs, and to realize the benefits of WMA without compromising quality of constructed pavements.
 - “Rapid and Continuous Assessment of Soil Conditions along Highway Alignments” (Project PI is Clinton Wood (UARK).) The purpose of this study is to improve upon this method of characterization, to include geophysical methods, particularly capacitively coupled resistivity (CCR), which can be used to provide a rapid and continuous evaluation of the subsurface soil conditions. During the reporting period, progress included determining the optimal field testing setup for CCR for various subsurface conditions. Ultimately, the project will develop a new testing methodology, which can be used to evaluate subsurface soil conditions for new highway alignments in order to reduce the cost of the investigation and provide more comprehensive results for design.
 - “Field Implementation of Fatigue Enhanced Polymer Concrete Incorporating Nanomaterials” (Project PI is

Mahmoud Reda Taha (UNM.) This project will identify the optimal nanomaterials combination for producing PC with nanomaterials for efficient field implementation. During the reporting period, progress included project start up. Optimal nanomaterial combinations and PC mixture proportions to meet field requirements will be identified. Performance of a small set of selected PC mixes incorporating nanomaterials will be monitored after field implementation.

- “Cotton-Derived Composite Materials for Climate Resilient Transportation Infrastructure” (Project team includes Nouredine Abidi, Priyantha W. Jayawickrama (TTU).) This study examines cellulose and its derivatives, which have been extensively used for diverse applications. Amongst them, acidic hydrolysis of native cellulose leading to low-molecular-weight (MW) cellulosic products, referred to as nanocrystalline cellulose (NCC), has become an effective way to develop nano-based materials. During the reporting period, progress included project start up. These cotton fiber-concrete and NCC microbeads-concrete composites have potential to effectively serve as an alternative to conventional construction materials while significantly enhancing the sustainability of infrastructure construction, maintenance, and rehabilitation.

Education and Outreach

- “STEM Teacher Professional Development – Transportation Series/Student Outreach and Education Companion Proposals” (The TTU project team includes Cathy H. Allen, Sanjaya Senadheera, Priyantha Jayawickrama and Hongchao Liu.) This project produced continuing education workshops that presented educators with current/emerging transportation infrastructure issues and will equip them with classroom implementation materials to inform and inspire students about STEM careers in the transportation industry. It is also focused on outreach/recruitment efforts for 6th – 12th grade students. During the reporting period, progress has included development of the final report. The SPTC Brief highlighting these accomplishments can be found at: <http://www.sptc.org/briefs/>.
- “Technology-Rich Transportation Engineering Projects” (Project team includes Sanjay Tewari (LTU), Norman Pumphrey Jr. (LaTech), David Hall (LaTech) and Raghava Kommalapati (Prairie View A&M University).) This project is generating interest among K-12 and college freshman students towards transportation related degrees and careers by exposing them to modern technology related projects. During the reporting period, progress has included development of the final report. The effort should increase the population of qualified transportation professionals. Materials are available here: <http://www2.latech.edu/~dehall/SPTC/main.html>. The SPTC Brief highlighting these accomplishments can be found at: <http://www.sptc.org/briefs/>.

2nd Region 6 Transportation-Climate Summit:



Co-organized by the SPTC and the South Central Climate Science Center (SC-CSC), this is a highly successful technology transfer event that occurred on November 14, 2016. This biannual, one-day summit is focused on critical climate-related transportation issues. It brought together 105 participants including weather,



climate and transportation specialists to educate one another, spur new ideas and promote fruitful collaborations to develop viable solutions for complex and costly climate-related transportation challenges. The conference was held at the National Weather Center in Norman, Oklahoma. The program included renowned experts from the climate, weather, and transportation sectors sharing their insights into weather and climate impacts on transportation. SPTC projects were showcased. Eligible participants had the opportunity to receive six (6) Professional Development Hours (PDH). Region 6 students also played a major role in this program. A student competition provided an opportunity for three SPTC research students to be included in the summit's presentation program. “Evaluation of the 1-Day, 1%AEP Rainfall Depths in Oklahoma,” was presented by Blake Kronkosky (Ph.D. Student, Texas Tech University). “Feasibility of Using Phase Change Materials (PCM) to Mitigate Distresses in Asphalt Concrete Caused by Extreme High Temperatures,” was presented by Tharanga Dissanayaka (Ph.D. Student, Texas Tech University). “Durability Performance of High Volume Recycled Concrete Pavements,” was presented by Jonathan T. Drury (Ph.D. Student, University of Oklahoma). Student posters were displayed at the event. These posters were prepared by the Transportation Leadership Council Chapters at the SPTC consortium partners. The “Best Poster” was awarded to Zafrul Khan and Mehedi Hasan from the University of New Mexico for their work on “Investigation of the Pavement Response with Temperature Variation Based on Field

Instrumentation”. The “Best Poster – Runner Up” was awarded to Md. Amanul Hasan and Biswajit K. Bairgi from the University of New Mexico for their work on “Effects of Climatic Change on Pavement Performance.” The 2016 Program can be found at: <http://www.sptc.org/summit-2016/>.



Oklahoma Transportation Research Day: The ODOT-SPTC Oklahoma Transportation Research Day (OTRD) is a major technology transfer event in Oklahoma. It consists of oral presentations, poster presentations, discussions, and identification of potential research topics for ODOT, Oklahoma Turnpike Authority (OTA), FHWA, and other transportation stakeholders. SPTC worked



closely with the Oklahoma Department of Transportation in delivering the 2016 Oklahoma Transportation Research Day on October 18th. For this event, 177 guests were in attendance, with many representing academia, state/federal agencies, tribal organizations, and the private sector. The program highlights included opening remarks from the Oklahoma Department of Transportation. The invited guest speaker was Dr. Melissa Tooley (Director of External Initiatives, Texas A&M University) who discussed future opportunities and challenges for DOTs resulting from autonomous vehicles. Additionally, there were several project presentations focusing on transportation, geotechnical and climate-related research. Eligible participants had the opportunity to receive eight (8) Professional Development Hours (PDH). Students were invited to showcase their research presentation and to compete for one of three cash prizes. A total of 25 poster submissions were received and entered into the competition, with several projects reflecting collaborative research within the consortium. Winners, which represent four of the consortium partners (OU, OSU, LaTech, ARK State), were then selected by a panel of independent judges based on the overall rankings. First place was awarded to Cameron D. Murray, Royce Floyd, Ph.D., P.E., Jin-Song Pei, Ph.D. for their work entitled, “Construction of a Half-scale Bridge to Examine Load Transfer and Shear Behavior of Composite Bridge-slab System.” Second place was awarded to Hope Hall, Tyler Ley, David Welchel, Jacob Peery, and Jake Leflore for their work entitled, “Validation of the Super Air Meter with Lab and Field Mixtures.” The tie for third place went to Badrul Ahsan and Zahid Hossain for their work entitled, “Feasibility Study of the Use of Rice Husk Ash as a Supplementary Construction Material in Concrete,” and Mohammad Readul Islam, Shams Arafat, and Nazimuddin M. Wasiuddin for their work entitled, “Quantification of Reduction in Hydraulic Conductivity and Skid Resistance due to Fog Seal in Low Volume Roads.” Each winner received a monetary award in addition to a certificate of achievement. More information about this event can be found at: <http://www.sptc.org/ok-trans-res-day-2016/>.

1.2.2 Workforce Development, Education and Outreach: In the reporting period, the SPTC was engaged in advancing the following activities: Transportation Leadership Council (TLC); preparing for Transportation Regional Internship Program (TRIP); Tribal Safety Champions Workshop; SPTC Workshop/Seminar Series and other education/outreach events; and SPTC Briefs. An overview of some of these activities follows.

Transportation Leadership Council (TLC) Chapters: TLC chapters have been formed at each member institution (for more information, see <http://www.sptc.org/tlc/>). These are student-led groups that provide opportunities for developing leadership. The chapters have autonomy to perform leadership development activities locally; however, a central mission is to develop regional collaborative activities with other chapters. The following activities have occurred during this reporting period:



➤ SPTC-TLC Chapters: On November 13th, a Joint Chapter Meeting and Barbeque was held at OU in conjunction with the Transportation-Climate Summit. Students from five chapters (TTU, UTEP, La Tech, UNM, OU) and their faculty participated in this collaborative activity that facilitated a networking opportunity. On November 14th, the students participated in the TLC Student Poster Competition (pictured left) at the Transportation Climate Summit outlined previously. Participation in this event allowed a networking opportunity for students with renowned experts from the climate, weather, and transportation sectors.

➤ OU TLC: students participated in five meetings and two events. On October 4th, an Officer meeting was conducted.

On October 27th, a Joint Meeting of ASCE Student Chapter and TLC was held and included dinner and a speaker from a local structural engineering consulting firm that provided industry perspective. The Chapter met on November 4th to make plan for hosting the TLC Joint Chapter Meeting and to prepare for the TC Summit Poster Competition. The students participated in two events: the Barbeque with other chapters on November 13th, then the TLC Student Poster Competition at the Transportation Climate Summit the next day. The chapter also held an Officer meeting in February.

- UTEP TLC: 16 students attended the 96th Transportation Research Board Annual Meeting (TRB) on January 9th - 12th, 2017. An active participation of young professionals and/or students inside TRB is made with opportunities such as the David D. Eisenhower Fellowship program and the TRB Minority Fellow program. Thirteen TLC students became Eisenhower Fellows, three TLC students became TRB Minority Fellows, shown right. More info is available at <http://ctis.utep.edu/utc/tlc/>.



3rd Annual Tribal Safety Champions Workshop: The Southern Plains TTAP (SPTTAP) Center and the Southern Plains Transportation Center co-hosted the 3rd Annual Tribal Safety Champions Workshop on Wednesday, November 16, 2016 in Oklahoma City for 85 participants. The goal of the workshop was to prevent crashes and reduce the number of transportation related injuries and fatalities, while highlighting the work of area Safety Champions who are striving toward those efforts every day. Topics included Traffic Incident Management (TIM), the new Statewide Impaired Driving Database, the National Highway Traffic Safety Administration's *Road to Zero Coalition*, Oklahoma DOT's Safety Projects and Partnerships, Tribal Transit Updates, Center Line Rumble Strips, Highlighting a New Safety Partnership Between the Bureau of Indian Affairs and the Oklahoma Highway Safety Office, An Overview of FHWA's *Every Day Counts (EDC) 4* Initiatives, Tribal Peer Presentations, and Charting the Progression of a Fatality through the State's Crash Database. The lunchtime presentation included a focus on this year's SPTTAP Safety Champion Awardees. Winners included Bonita Paddyaker, Comanche Nation, Tribal Child Passenger Safety Technician of the Year; Sarah Hayes, The Chickasaw Nation, Tribal Child Passenger Safety Instructor of the Year; The Choctaw Nation Police Department, Tribal Law Enforcement Officers of the Year; Patrick Keahbone, Anadarko Agency, BIA Law Enforcement Officer of the Year; Joe Williams, Oklahoma Highway Patrol, Local Law Enforcement Officer of the Year; Citizen Potawatomi Nation, Tribal Infrastructure Project of the Year; The Chickasaw Nation Tribal Transit, Tribal Transit Program of the Year; Franklin Brown, Muscogee Creek Nation, Tribal Transit Driver of the Year; Chris McCray, Pawnee Nation, Tribal Safety Champion of the Year; Choctaw Nation Injury Prevention Program, Tribal Safety Champions of the Year. Also featured in the one-day event were six 5-minute poster presentations provided by engineering students from Oklahoma State University, The University of Oklahoma, and the University of Tulsa. Of the presentations, four featured FHWA EDC innovations including GRS IBS bridges, Pavement Preservation, Data Driven Safety Analysis, and Road Weather Management. Workshop participants had an opportunity to interact with the students, and ultimately voted for their favorite poster. The winner in the poster competition was Sonya Wolff, OU, with her poster on Police Automated Records Information Systems (PARIS). Of the 85 attendees this year, 11 different tribes were represented among the 45 tribal employees registered. Other participants included two Tribal Law Enforcement Officers, two BIA Law Enforcement Officers, two members of the Oklahoma Highway Patrol, six university students, two university professors, three FHWA employees, five consultants,



one LTAP employee, four Oklahoma DOT employees, three BIA employees, seven employees from state agencies, one National Highway Traffic Safety Administration employee, and two from a university transportation center. Photos available here: <https://www.flickr.com/photos/karlais/albums/72157672877504544>

2017 SPTC Student of the Year (SOY) Award: Cameron Murray, a graduate research assistant from the University of Oklahoma, Norman, was named the 2017 SPTC Student of the Year – one of the most prestigious awards given by the SPTC under the University Transportation Center program. He was recognized at the Council of University Transportation Center's awards banquet, held January 7, 2017, in Washington, D.C., in conjunction with the annual meeting of the Transportation Research Board. A native of Little Rock, AR, Murray is pursuing a doctoral degree in civil engineering with an emphasis in concrete testing and large-scale structural testing under his adviser, Professor Royce Floyd. His research is titled "Shear and Load Distribution Behavior of Type-II AASHTO Bridge Girders." See info at <http://www.sptc.org/awards/>.



SPTC Seminar Series 2016/2017: October 21, 2016, the Southern Plains TTAP Center hosted a Crash Data Collection Course - *Bringing Data Driven Safety Analysis Home* based on the University of Oklahoma Intelligent Transportation Systems Lab-produced SAFE-T system at the ODOT Training Center in Oklahoma City. The new and improved Crash Data Collection class provided access to **SAFE-T**, Oklahoma DOT's Statewide Analysis for Engineering and Technology crash data system. The afternoon training session guided participants through **SAFE-T** and assisted them in compiling crash data for their areas. Reports generated by the system are used by state, tribal, and local employees to identify problem areas and plan roadway changes. The reports include maps showing locations of collisions, and additional information showing when and why collisions occur.



On December 7, 2016, Dar Hao Chen, Ph.D., P.E. conducted an SPTC Seminar entitled "Texas Experience on Forensic Investigations and Rehabilitation Strategy Selections" at the University of Oklahoma campus. PDHs were provided. Dr. Chen's primary research areas include ground improvement, stabilization of problematic soils, non-destructive testing, characterization of roadway pavements, and forensic investigations of premature highway failures.



On March 9, 2017, Dr. Sesh Commuri (University of Nevada Reno) conducted an SPTC Workshop related to the topic *Intelligent Compaction* at the University of Oklahoma campus. PDHs were provided. Intelligent Compaction (IC) is a relatively new technology for improvement of compaction quality during pavement construction. The overall aim of the workshop was to present the specifications and the use of IC during construction of pavements to ODOT personnel and paving contractors.

SPTC Dissemination: The SPTC develops monthly SPTC Briefs, which are two-page summaries of SPTC projects to be published, distributed and posted to the website to enhance impact. To date, sixteen briefs have been posted that highlight specific SPTC projects (<http://www.sptc.org/briefs/>). The SPTC has engaged a PR firm in an effort to disseminate SPTC findings to users and the general public.

1.2.3 Leadership: In the reporting period, the SPTC leadership was engaged in advancing the following activities (in addition to participating in regularly scheduled meetings): welcoming new SPTC staff and preparing and delivering the 2017 Annual Leadership and the Annual Advisory Board Retreats. An overview follows.



Cerry Leffler joins the team as the SPTC Program Coordinator: Cerry Leffler has a degree in Liberal Arts and 24 years' experience at the University of Oklahoma in financial, administrative, and public relations roles. She is responsible for increasing private sector support for TRIP, serving as a liaison with the private sector, and developing public-private partnerships.



Margaret Vennoch joins the team as the SPTC Financial Associate. Margaret Vennoch has six years' experience at OU where she has served as a Financial Associate for the Mewbourne College of Earth and Energy Dean's Office. She is responsible for managing all financial aspects of the grant and match accounts and serving as financial liaison with partners and Office of Research Services.

SPTC Prepares and Delivers the Annual Associate Directors Leadership Retreat: In February, SPTC held its annual Retreat in Dallas, Texas to discuss the SPTC strategic plan, performance deliverables, changes needed, challenges, opportunities and future direction. Kevin Hall (UARK) moderated the event. The following table show attendees that participated in this productive, one-day retreat.



Attendee (Leadership Retreat)	Role	Institution
Kevin Hall	SPTC Associate Director	University of Arkansas
Kelvin Wang	SPTC Associate Director	Oklahoma State University
Rafiqul Tarefder	SPTC Associate Director	University of New Mexico
David Hall	SPTC Associate Director	Louisiana Tech University
Sanjaya Senadheera	SPTC Associate Director	Texas Tech University
Marshan Marick	SPTC Associate Director	Langston University
D. Chongo Mundende	SPTC Emerging Leader	Langston University
Nazimuddin "Wasi" Wasiuddin	SPTC Emerging Leader	Louisiana Tech University
Imad Abdallah	SPTC Emerging Leader	The University of Texas at El Paso
Ron Barnes	SPTC Emerging Leader	The University of Oklahoma
Musharraf Zaman	SPTC Director	The University of Oklahoma
Cerry Leffler	SPTC Program Coordinator	The University of Oklahoma
Martina Ferguson	SPTC Financial Associate	The University of Oklahoma
Dominique Pittenger	SPTC Technical Director	The University of Oklahoma
Kathy Volz	SPTC Workforce Development	The University of Oklahoma

More information can be found at <http://www.sptc.org/leadership/>.

SPTC Prepares for the Annual Leadership Meeting: In April, the SPTC will hold its Advisory Board Meeting in Dallas, Texas to discuss the SPTC strategic plan, performance deliverables, changes needed, challenges, opportunities and future direction. Dawn Sullivan (ODOT) will moderate the event. More information can be found at <http://www.sptc.org/advisory-board/>.

1.3 Dissemination of Results SPTC uses both electronic and printed materials as well as social media and a public relations firm for the dissemination of results. For example, recently completed final reports have been widely distributed and are now posted on the SPTC website at www.sptc.org/reports. The results of the 15.1 and 15.2 competitions are also posted on the Center website and are included in our recently published Briefs. The Briefs are being distributed widely to all UTCs through OST-R, state DOTs, and other stakeholders. A summary of each funded project and SPTC activities are posted on the website. Also, conferences, seminars, workshops, summits and professional meetings are used to disseminate SPTC results. Basecamp and e-mails are also used regularly as vehicles for communication and dissemination of results. SPTC is using WebEx technology to facilitate webinars delivered by SPTC researchers and serve to disseminate project results.

1.4 Activities for the Next Reporting Period As noted throughout this progress report, the SPTC14 and SPTC15 competitions have resulted in several research, education and outreach projects. Talented teams across Region 6 are working on these projects, which represent a major component of SPTC's work plan for the next period.

Other activities for the next reporting period include: 2017 Advisory Board Leadership Meeting, 2017 TRIP, 2017 Oklahoma Transportation Research Day, TLC activities, Seminars, Webinars and Workshops.

2 PRODUCTS

2.1 Publications, Conference Papers and Presentations The SPTC consortium members have been actively sharing their achievements during the reporting period through associated activities supported by matching and leveraging funds. Publications/ Conference Papers and Presentations produced and delivered by SPTC researchers stemming from the 14.1 and 14.2 programs for this reporting period are listed in this section. To date, researchers have disseminated SPTC research through 45 journal publications or conference papers and 97 presentations.

Publications/Conference Papers

Jay Wang: An ASCE conference paper was in preparation, with a title "Numerical simulation of moisture fluctuations in unsaturated expansive clay, and validation with field measurements", for PanAm-UNSAT 2017: Second Pan-American Conference on Unsaturated Soils (Unsaturated Soil Mechanics for Sustainable Geotechnics), Dallas, Texas, November 12 – 15, 2017.

Jay Wang: A draft journal paper "Characterization of Expansive Soils in Northern Louisiana" has been submitted to "Building and Environment"

Rahaman, Z., Hossain, Z. (2017), "Non-recoverable Compliance and Recovery Behavior of Polymer-modified and Reclaimed Asphalt Pavement-blended Binders in Arkansas," Transportation Research Board (TRB), Compendium of Papers, Volume: 96, January 8-12, 2017, Washington D.C.

Darayi, M., K. Barker, and J.R. Santos. 2016. Component Importance Measures for Multi-Industry Vulnerability of a Freight Transportation Network. Submitted to *Networks and Spatial Economics*.

Stewart, C. M., Reyes, J. G., and Garcia, V. M., 2017, "An Comparison of Fracture Parameters and Test Standards for a Super Pave Dense-Graded Hot Mix Asphalt," *Engineering Fracture Mechanics*, 169, pp. 262-275.

Rashid, F., Hossain, Z., and Bhasin, Amit. (2016). "Investigation of nanomechanistic properties of reclaimed asphalt pavement modified asphalt binders by using an atomic force microscope." *International Journal of Pavement Engineering*, 1-9.

G. Sabih, and R.A. Tarefder, Impact of variability of mechanical and thermal properties of concrete on predicted performance of jointed plain concrete pavements, *Int. J. Pavement Res. Technol.* 9 (2016) 436–444. doi:10.1016/j.ijprt.2016.09.005.

Presentations

Lampert, D. 2016. "Adaptation of Oklahoma Infrastructure for Flood Risks Associated with Climate Change," presented to United States Geological Survey 104(b) Program, Oklahoma Water Resources Center Advisory Board, December 19, 2016.

Shah, M., O. Khandel and M. Soliman 2016. "Risk Assessment of Bridges under Scour Deterioration," 2017 Oklahoma Transportation Research Day, Poster Session.

Shah, M. and M. Soliman, 2016. "Risk Assessment of Bridges Susceptible to Scour Damage," 2016 SPTC Symposium

Volz, J. and J. Hartell, 2016. "Development of Guidelines for High-Volume Recycled Materials for Sustainable Concrete Pavement," 2016 Oklahoma Transportation Research Day, Oklahoma City, Oklahoma.

Volz, J. "Development of Guidelines for High-Volume Recycled Materials for Sustainable Concrete Pavement," 2016 Convention of the American Concrete Institute in Philadelphia, Pennsylvania, October 23-27, 2016.

Darayi, M. 2016 Transportation Network Recovery Based On Multi-industry Economic Impact. Presentation at INFORMS Annual Meeting, Nashville, TN, November 2016.

Wood, C. (2017). Geophysical methods in Geotechnical Engineering (Case histories for 1D and 2D evaluations), Guayaquil, Ecuador, March 24, 2017.

Wood, C. and Baker, T. (2015) "Rapid and Continuous Assessment of Soil Conditions along Highway Alignments" presented at Mack Blackwell Rural Transportation Department (MBTC) annual meeting, Fayetteville, AR, Nov. 18, 2016.

Baker, T. and Wood C. (2016) "Rapid and Continuous Assessment of Soil Conditions along Highway Alignments" presented at 9th annual Jack Buffington student poster session, Fayetteville, AR, Nov. 18, 2016.

Reyes, J. G., and Stewart, C. M., 2016, "Mechanical Properties of Hot Mix Asphalt Materials at Room Temperature for Use in Aerospace Landing Applications" *Southwest Emerging Technology Symposium*, El Paso, TX.

Rashid, F. and Hossain, Z. (2016) "Nanomechanistic Properties of RAP-Modified Asphalt Binders by Using an Atomic Force Microscope (AFM)," Poster presented at 2016 Oklahoma Transportation Research Day, October 18, 2016, Oklahoma City, OK.

Rashid, F., Hossain, Z., and Bhasin, A. (2016). "Investigation of Nanomechanistic Properties of Reclaimed Asphalt Pavement Modified Asphalt Binders by Using an Atomic Force Microscope." Accepted for poster presentation in the Transportation Research Board 96th Annual Meeting, January 8-12, 2017, Washington D.C.

Cong Chen, Guohui Zhang, Zhen Qian, Rafi Tarefder, Tian Zong. Analyzing Driver Injury Severity Outcomes in Rollover Crashes Based on a Support Vector Machine Model. The 96th Annual Meeting of Transportation Research Board, Washington, D.C., Jan. 2017.

Cong Chen, Guohui Zhang, Helai Huang, Jiangfeng Wang, Rafi Tarefder. Identifying Significant Factors for Driver Injury Severities in Rural Non-Interstate Crashes: Hierarchical Ordered-Logit Analysis The 96th Annual Meeting of Transportation Research Board, Washington, D.C., Jan. 2017.

2.2 Website or Other Internet Sites The SPTC website, <http://www.sptc.org>, disseminates the results of the research and program activities, such as seminar, workshop and research related events. It also hosts the *SPTC Newsletters* and *SPTC Briefs*. UTEP developed a website for its Transportation Leadership Council (TLC) Student Chapter <http://ctis.utep.edu/utc/tlc/>. SPTC Researcher Tyler Ley developed the following website to disseminate his findings: www.optimizedgraded.com.

2.3 Technologies and Techniques For this reporting period, SPTC Researcher Jeff Volz and his research team worked with Dolese, one of the industrial partners for the project, to construct four (4) full scale, instrumented pavement test sections. The development of the mixes as well as the quality control for the materials was based on the draft guidelines developed by the research team. This technology transfer activity went both ways in that Dolese personnel offered numerous ideas and suggestions for adjusting the guidelines.

2.4 Inventions, Patent Applications and/or Licenses Nothing to report

2.5 Other Products Nothing to report.

3 PARTICIPANTS AND COLLABORATING ORGANIZATIONS

The SPTC consortium is tied together by its collaborative culture, *sharing to gain*, and its core values of communication and collaboration. Each consortium member (<http://www.sptc.org/consortium>) is committed to sharing its human expertise and facilities to serve Region 6 through research, education, outreach and workforce development effort. This willingness to share extends not just to the members of the consortium, but to all stakeholders including state and local transportation agencies, the private sector, international collaborators and any educational institution in the region that is willing to work with the SPTC. Examples of collaborations for the reporting period are outlined as follows.

3.1 Individuals

Name	Title	Supporting Institution(s)	Activities
SPTC Advisory Board			
Basharat Siddiqi	Non-Voting Member	FHWA (OK)	- Retreat Preparation - Quarterly Conference Call Participation
Michael A. Brown	Member	TxAPA	- Quarterly Conference Call Participation
Dawn Sullivan	Chair	ODOT	- Quarterly Conference Call Participation - Retreat Preparation - Student Awards Review Panel Member - Exploring industry collaborations
Harold "Skip" Paul	Member	LTRC	- Quarterly Conference Call Participation
David Soherr-Hadwiger	Member	New Mexico DOT	- Quarterly Conference Call Participation

Danny Gierhart	Member	Asphalt Institute	- Quarterly Conference Call Participation
Jorge Zornberg	Academic Member	University of Texas at Austin	- Quarterly Conference Call Participation
Sheldon Drobot	Member	NCAR	- Quarterly Conference Call Participation
Michael Kelly	Member	Arkansas State Highway & Transp. Dept.	- Quarterly Conference Call Participation
Michael Lee	Member	Texas Department of Transportation	- Quarterly Conference Call Participation
Angel Correa	Non-Voting Member	FHWA, Arkansas Div.	- Quarterly Conference Call Participation
<i>The University of Oklahoma</i>			
Musharraf Zaman	SPTC Director	OST-R, OU and ODOT match	<ul style="list-style-type: none"> - Overseeing the overall operation of the Center - Representing the Center and/or the UTC Program at external meetings - Working closely with the Advisory Board and the Leadership Core to set goals and priorities - Working closely with stakeholders - Enhancing collaborations with both consortium members and non-consortium institutions including international institutions - Working closely with TTAP and LTAP to set-up new opportunities and execute them - Conducting Associate Director's monthly meeting and Retreat
Gerald A. Miller	SPTC Associate Director	OU, OST-R and ODOT Match	<ul style="list-style-type: none"> - 2nd Transportation-Climate Summit Delivery - 2017 AD Retreat Participation - Monthly AD Conference Call Participation - Managing SPTC Requirements - TLC Activities - TRIP Internships
Ronald Barnes	Emerging Leader	OST-R, ODOT match and OU	<ul style="list-style-type: none"> - TSI-ITS collaboration lead - Weekly Core Group Meeting Participation - 2017 AD Retreat Participation
Cerry Leffler	SPTC Program Coordinator	SPTC grant and the ODOT match	<ul style="list-style-type: none"> - Coordinating committee and industry meetings - Coordinating TRIP program and other events - Recording minutes, posting information for current activities - Coordinating seminars/ workshops/special SPTC events including webinar-based activities - Facilitating international collaborations at individual and group levels - manage SPTC website content - 2017 AD Retreat Participation
Margaret Vennoch	SPTC Financial and Outreach Associate	Match from OU's Vice President of Research	<ul style="list-style-type: none"> - Managing all financial aspects of the grant and match accounts - Serving as financial liaison with partners and Office of Research Services
Frank Nguyen	Webmaster & Social Media Manager	ODOT match	<ul style="list-style-type: none"> - Managing the SPTC website - Social media
Arnulf P. Hagen	SPTC Technical Director	Partly by the SPTC Grant and partly by the ODOT match	- SPTC Accessibility Requirements

Dominique Pittenger	SPTC Technical Director	Partly by the SPTC Grant and partly by the ODOT match	<ul style="list-style-type: none"> - Facilitating SPTC15 competition - Participating in SPTC/ODOT research day - 2017 AD Retreat Participation - Managing the review and reporting processes - Drafting institutional reports - Compiling newsletter articles and developing briefs
Langston University			
Marshan Marick	Associate Director	SPTC grant and Langston University	<ul style="list-style-type: none"> - Preparing for 2017 Transportation Academy - Monthly Conference Call Participation - SPTC Reporting
Darlington Mundende	Emerging Leader	Langston University	<ul style="list-style-type: none"> - Preparing for 2017 Transportation Academy - Recruited students for Academy
Louisiana Tech University			
David Hall	Associate Director	Louisiana Tech University	<ul style="list-style-type: none"> - Managing SPTC Requirements - 2017 AD Retreat Participation - Monthly AD Conference Call Participation - TLC Activities - Local Internship Program
Nazimuddin "Wasi" Wasiuddin	Emerging Leader	LA Tech and SPTC grant	<ul style="list-style-type: none"> - SPTC15 Proposal Reviewer - Monthly AD Conference Call Participation - TLC Activities
Jay Wang	Project PI	LA Tech	
Oklahoma State University			
Kelvin C.P. Wang	Associate Director	OSU	<ul style="list-style-type: none"> - Monthly AD Conference Call Participation - Managing SPTC Requirements - Coordinate SPTC Events on the OSU campus - TRIP Internships - 2017 AD Retreat Participation
Tyler Ley	Emerging Leader	OSU	
Mitzi Riggs	Grant Manager	OSU	<ul style="list-style-type: none"> - Assisting with SPTC compliance, contractual documents, finances, and relations
Doug Wright	Director, CLGT	FHWA and OSU	<ul style="list-style-type: none"> - Coordinating participation in the TRIP program
Texas Tech University			
Sanjaya Senadheera	Associate Director	Texas Tech University	<ul style="list-style-type: none"> - Monthly AD Conference Call Participation - Managing SPTC Requirements - SPTC15 process management - TRIP Internships - 2017 AD Retreat Participation
Kim Harris	SPTC Coordinator and Editor	TxDOT (SPR Contract 0-9911-13), SPTC grant and Texas Tech University	<ul style="list-style-type: none"> - Providing administrative support and coordinating activities with SPTC at OU, SPAR, and ORS at TTU - Preparation of proposal, submission, and accounting aspects
Hoyoung Seo	Emerging Leader – Mid-Career	Texas Tech University	Faculty Advisor for TechFLT, the TTU TLC
The University of New Mexico			
Rafiqul A. Tarefder	Associate Director of SPTC	UNM	<ul style="list-style-type: none"> - Monthly AD Conference Call Participation - Managing SPTC Requirements - Develop SPTC Brief - 2017 AD Retreat Participation

Vanessa Valentin	Emerging Leader	UNM	- Attending SPTC related meetings
<i>The University of Texas at El Paso</i>			
Soheil Nazarian	Associate Director of SPTC	UTEP, SPTC grant and TxDOT	- Monthly AD Conference Call Participation - Managing SPTC Requirements - TRIP Internships
Imad Abdallah	SPTC Manager	UTEP, SPTC and TxDOT	- Assisting the Assoc. Director with the center operation - Attending SPTC meetings - TLC activities - 2017 AD Retreat Participation
Patricia Acevedo	SPTC Staff	UTEP and SPTC	- Assisting in all administrative issues as they relate to SPTC
<i>University of Arkansas / Mack-Blackwell Rural Transportation Center (MBTC)</i>			
Kevin Hall	Associate Director of SPTC	University of Arkansas	- 2 nd Transportation-Climate Summit Delivery - Monthly AD Conference Call Participation - Managing SPTC Requirements - TLC Activities - TRIP Internships - 2017 AD Retreat Participation
Andrew Braham	Emerging Leader; Co-Director TLC	University of Arkansas	- TLC activities
Sarah Hernandez	Co-Director TLC	University of Arkansas	- TLC activities

3.2 Other Organizations

Departments of Transportation: State DOTs are an important stakeholder. With one representative from each DOT in Region 6, the SPTC Advisory Board provides a unique opportunity to identify and address some complex and challenging problems in Region 6 and the nation. The Oklahoma Department of Transportation is providing cash match to the SPTC. New Mexico DOT and Louisiana Transportation Center (LTRC) are providing substantial cash match to support a number of SPTC projects. Also, Arkansas Highway and Transportation Department provides significant support for students participating in the TRIP. These projects constitute an integral component of the SPTC work plan.

Private Sector: The private sector is another key stakeholder of the SPTC. During the reporting period, two at-large members from the private sector are serving on the SPTC Advisory Board. A number of companies, within Region 6 and outside, are contributing substantial match (cash and in-kind) for several of the projects funded from the 14.1 and 15.1 competitions. During the reporting period, SPTC researchers worked with private sector companies to execute project tasks for SPTC research projects.

Tribal Entities: Collaboration with Tribal entities is an important goal of the SPTC. During the reporting period, the SPTC co-hosted a tribal event and supported a project for Road Safety Evaluation for Iowa and Sac&Fox Tribes.

Securing 2017 TRIP Sponsors: An important element of SPTC's collaborative effort is the Transportation Regional Internship Program (TRIP). During the reporting period, the TRIP program focused on securing summer internship sponsors and promoting the TRIP to potential student participants.

3.3 Other Collaborations International collaborations are important to the SPTC's visibility and success. During the reporting period, SPTC met with international partners regarding collaborations.

4 IMPACT

4.1 Impact on the Principal Discipline

SPTC Researcher Jeff Volz and his research team developed a draft set of guidelines for material selection and mixture optimization for using high volumes of recycled materials in concrete pavement. The guidelines cover individual material and concrete mix screening tests, *recycled concrete aggregate* (RCA) tests and limits, and mix design recommendations for incorporating large amounts of recycled materials. These guidelines were used with Dolese (aggregate supplier), one of the industrial partners for the project, to construct several full scale pavement test sections.

SPTC Researcher Hazem Refai and his research team have developed an inexpensive (\$500 versus \$5,000 commercial systems) portable bluetooth monitoring system that when incorporated into the DOT network will immediately impact DOT's traffic management programs. The system will be used to develop a travel time reliability and monitoring system composed of multi-sensing-technology that leverages empirically developed models to provide accurate information about traffic flow and congestion levels.

SPTC Associate Director, Rafiqul Tarefder, and his research team have developed a shift factor that allows results from different Hamburg Wheel Track Devices to be easily compared.

4.2 Impact on Other Disciplines The tribal safety efforts noted in the Accomplishment and Collaboration sections will impact other disciplines related to law enforcement, driver safety and education.

4.3 Impact on Workforce Development

Tribal Safety Champions Workshop: Represented among the attendees at this event, as noted in the Accomplishments section of this report, were numerous tribes, state agencies, federal agencies, municipalities, colleges and consulting firms. This workshop afforded the opportunity for new partnerships to be forged and existing partnerships to be strengthened. Local and tribal roads personnel were enlightened on new low cost methods for handling difficult engineering safety situations by interacting with their peers and hearing from highway safety experts.

Continuing Education Seminars, Workshops and Conferences: Events, as noted in the Accomplishments section of this report, provided important educational experience to hundreds of participants, including current workforce seeking to advance their knowledge and others considering transportation as potential career opportunities.

Developed and Disseminated New Educational Materials and Awarded Scholarships: New materials and scholarship award, as stated in the Accomplishments section of this report, provided important educational experience and motivation to college students, including current workforce, seeking to advance their knowledge and others considering transportation as potential career opportunities.

4.4 Impact on Physical, Institutional and Information Resources

SPTC Researcher Jeff Volz and his research team have completed a forensic analysis of field sections and developed a draft set of guidelines for material selection and mixture optimization for using high volumes of recycled materials in concrete pavement that have been introduced to industry and DOT to improve information resources.

4.5 Impact on Technology Transfer

SPTC Rafiqul Tarefder and his research team have developed a database of Portland cement concrete material input parameters that will be used for design and analysis of rigid pavements in New Mexico by using pavement ME design software. They also delivered a shift factor that is being used by the New Mexico DOT to minimize variability between independent testing using Hamburg Wheel Track Devices.

4.6 Impact Beyond Science and Technology Nothing to report.

5 CHANGES/PROBLEMS Nothing to report.