This document summarizes SPTC projects, which were funded to support the SPTC vision and mission. The SPTC mission is twofold: (i) to develop comprehensive, cost-effective, and imminently implementable solutions to critical infrastructure-related issues facing the transportation systems of the region and the nation (***DEVELOP SOLUTIONS***), and (ii) to prepare transportation professionals for leadership roles in professional and research careers in support of the nation's transportation systems (***PREPARE PROFESSIONALS***).

SPTC Focus: *Climate Adaptive Transportation and Freight Infrastructure* is the primary focus of the SPTC's research, education and outreach activities. The SPTC Strategic Plan addresses five specific, mission-related "Develop Solutions (DS)" topics: Impact of Weather Extremes on Transportation and Freight Infrastructure, (**DS 2**) Innovative Monitoring to Quantify Damage Accumulation in Transportation Infrastructure, Innovations in Materials and Construction of Climate Resilient Transportation Infrastructure, Innovative Technology to Monitor Icing and Winter Weather Vehicles, and Multi-Modal Freight Movement Models Considering the Climatic Conditions.

Each project relates to one or more of the SPTC ***Develop Solutions/Prepare Professionals*** focus areas. Some of the programs (e.g. SPTC14.2, SPTC 15.2, ECDP) are funded by an Oklahoma Department of Transportation award to the SPTC.

Project #	***Project Title***	***PI,*** *Co-PI(s)*	***Organization***	***Summary***
			Education & Outreach	
SPTC14.1-01	**STEM Student Outreach and Recruitment – Transportation Series**	**Cathy H. Allen**, Sanjaya Senadheera, Priyantha Jayawickrama, Hongchao Liu	Texas Tech University	This project will produce continuing education workshops that will present 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 will also focus on outreach/recruitment efforts for 6th – 12th grade students.
SPTC14.1-70	**Technology-Rich Transportation Engineering Projects**	**Sanjay Tewari**, Norman Pumphrey Jr, David Hall, Raghava Kommalapati	Louisiana Tech University, Prairie View A&M University	This project focuses on generating interest among K-12 and college freshman students towards transportation related degrees and careers by exposing them to modern technology related projects. The effort will increase the population of qualified transportation professionals.
SPTC14.2-12	**Sustainability and Training Materials for In-Place Recycling**	**Phil Lewis,** Stephen A. Cross	Oklahoma State University	The main objectives of this study are to develop a sustainability calculator and training materials for in-place recycling (web-based training courses). Implementation will provide pavement design professionals and highway agencies with the knowledge and tools necessary to use in-place pavement recycling as a feasible, sustainable, competitive alternative to traditional pavement maintenance and rehabilitation strategies.

Project #	*Project Title*	*PI, Co-PI(s)*	*Organization*	*Summary*
SPTC-Langston	**Langston University**	**D. Chongo Mundende,** Marshan Marick	LANGSTON	The primary objective of Langston's workforce development, education and outreach activities are to attract a diversified group of young people into the transportation workforce.
SPTC-OU	**Driverless Vehicles on Roads - Exploring Future Transportation Systems**	**Zahed Siddique**	The University of Oklahoma	The "Driverless Vehicle Challenge" project combines driverless vehicles and ground transportation to nurture creativity and motivate students to work in teams to design and build a driverless vehicle that is capable to accomplishing multiple tasks, along with understanding the requirements and needs for our current road systems to support such technology.
Climate, Safety, Traffic & Multimodal Considerations				
SPTC14.1-03	**Enhancing Driver Safety during Severe Weather Conditions**	**Mohammed Atiquzzaman**, Ron Barnes, Joseph Havlicek, Majeed Hayat	The University of Oklahoma, The University of New Mexico	A safety application will be developed to analyze information from neighboring vehicles and create a threat map to alert drivers of potentially hazardous road conditions. Implementation of results will contribute to a reduction in vehicle crashes, fatalities and injuries due to adverse weather conditions.
SPTC14.1-39	**Identifying Dust Emission "Hot Spots" in the Southern Plains Region of New Mexico, Oklahoma and Texas: Effect of Blowing Dust on Highway Safety**	**Junran Li,** Thomas E. Gill, Jeffrey A. Lee	The University of Tulsa, The University of Texas El Paso, Texas Tech University	This study will identify and quantitatively assess the spatial and temporal patterns of wind erosion hot spots that contribute blowing dust to the highways of New Mexico, Oklahoma and Texas. Implementation of the developed integrated modeling and monitoring system will assist in highway safety management and mitigate the hazardous impacts of dust.
SPTC14.1-45	**Web-Based Routing Assistance Tool to Reduce Pavement Damage by Overweight and Oversize Vehicles**	**Hongchao Liu**, Sanjaya Senadheera	Texas Tech University	This project will develop 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. The results will contribute to efficient vehicle permitting and routing of oversize/overweight vehicles to significantly reduce road damage.

Project #	*Project Title*	*PI, Co-PI(s)*	*Organization*	*Summary*
SPTC14.1-50	**Trends in Cold Temperature Extremes and Winter Weather for the SPTC Region**	**Renee A. McPherson**, Esther Mullens, Derek Rosendahl, Mark Shafer, Michael Richman	The University of Oklahoma	This project aims to quantify 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. Results will be of benefit across a broad range of sectors, covering the necessary "first step" in climate risk assessment.
SPTC14.1-77	**Safety Evaluation of Pavement Surface Characteristics with 1mm 3D laser Imaging**	**Kelvin Wang**	Oklahoma State University	PaveVision3D technology data will be used to evaluate various benchmarks for surface characterization related to pavement safety. The research outcomes will be particularly relevant when extreme weather conditions cause substantial water on the pavement surface that contribute to hydroplaning conditions.
SPTC14.1-86	**Crash Severity Formulation and Analysis under Extreme Weather Conditions**	**Guohui Zhang**, Rafiqul A. Tarefder	The University of New Mexico	This research project will develop a new approach for discovering the underlying patterns behind crash data. Implementation of results will help transportation agencies develop cost-effective countermeasures to reduce crash severities under extreme weather conditions and minimize the weather-related risks to traffic safety in the southwest region.
SPTC-ECDP15	**A Case Study on Construction Equipment Emissions**	**Rachel Mosier,** Matthew Reyes	Oklahoma State University The University of Oklahoma	The study will review equipment and ODOT self-performed construction projects and maintenance work to validate a framework for allocation of equipment based on emissions.
SPTC14.1-96	**Understanding Impact of Climate Change on Highway Hydraulic Design Procedures**	**Vivek Tandon** Vinod Kumar	The University of Texas – El Paso	Objectives of this study include identification of current resiliency of highway drainage infrastructure and cost-effective adoption solution that extend service life despite not having been designed for climate change.
SPTC-TTAP	**Road Safety Assessment for the Cheyenne & Araphao Tribes**	**Karla Sisco**	Southern Plains TTAP	An assessment of the "trouble spots" was conducted and suggestions were developed for actions that may improve the safety on public roadways in and near facilities of C&A Tribes based upon state-of-practice transportation engineering practices.

Project #	*Project Title*	*PI, Co-PI(s)*	*Organization*	*Summary*
SPTC15.2-04	**Development of statewide WIM data quality control and axle load spectra and traffic volume adjustment factors for Oklahoma**	**Joshua Qiang Li,** Cheng Chen and Kelvin Wang; Nur Hossain and Musharraf Zaman	Oklahoma State University, University of Oklahoma	Oklahoma Department of Transportation (ODOT) operates weigh-in-motion (WIM) stations statewide and is actively adopting portable WIM programs. This collaborative project will develop quality control (QC) metrics and associated software interfaces for checking the quality of statewide WIM data. A site-specific, region-specific, and statewide traffic inputs that are required for the MechanisticEmpirical (ME) based pavement design in Oklahoma will be developed.
SPTC15.2-08	**Incorporation of Speed/Travel- time Data Sets in Traffic Performance Analysis**	**Hazem Refai,** Samir A. Ahmed	University of Oklahoma, Oklahoma State University	The primary goal of this project is to develop a Travel Time Reliability Monitoring System (TTRMS) to improve network reliability and highway travel time by mitigating the effects of events causing travel time to fluctuate unpredictably (i.e., enact to minimize travel time variability).
SPTC15.1-35	**Assessing the Risk of Landslide on I-35 Near Davis Oklahoma Utilizing LiDAR 3D Mapping**	**Yongwei Shan** Joshua Qiang Li Xiaoming Yang	Oklahoma State University	Landslides are a threat to public traffic when they occur on roads that pass 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. The effort will yield an innovative procedure for DOTs to monitor the slopes/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 public traffic due to the disaster of landslide.
SPTC-ECDP16	**Analysis of Transportation Infrastructure Risks to Climate Change**	**David Lampert,** Jason Furtado	Oklahoma State University The University of Oklahoma	The project will use the Environmental Protection Agency's (EPA) Stormwater Management Model (SWMM) model, a continuous rainfall-runoff model that predicts runoff volumes and water quality from primarily urban watersheds, for the downtown Oklahoma City area to analyze the impacts of climate change on existing transportation and stormwater infrastructure from extreme flood events. This model will be used to re-create the hydrologic events of May 2015 and assess the impacts of similarly-probable flood events (but of a different magnitude) in a future climate with today's infrastructure in place.
SPTC15.1-20	**The Effects of Weather Events on Truck Traffic Using Fixed and Mobile Traffic Sensors**	**Sarah Hernandez** Song Feng	University of Arkansas	The goal of this study is to develop a predictive model that relates variations in truck traffic patterns to weather conditions, with a focus on extreme weather events. Unlike previous work which was limited to multiple regression techniques, this study 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. Ultimately, this research will help leverage existing freight data sources to support freight transportation planning and decision making.

Project #	*Project Title*	*PI, Co-PI(s)*	*Organization*	*Summary*
SPTC15.1-25	**The Dependence of Infrastructure Restoration on Transportation Networks**	**Sarah Nurre**	University of Arkansas	The purpose of this research effort is to explicitly model the transportation network for the development of infrastructure restoration plans. An integrated network design and scheduling problem will be used 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.
SPTC15.1-38	**Modeling Resilience and Impact in Multi-Modal Transportation Networks**	**Kash Barker**	University of Oklahoma	Recent US planning documents focus on transportation network preparedness, emphasizing "securing and managing flows of people and goods" along transportation networks. 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 be 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.
SPTC15.1-45	**A Sustainable Performance-Based Methodology to Address the Impact of Climate Changes on the "State of Good Repair" of Transportation Infrastructure**	**Carlos Chang**	University of Texas – El Paso	This research will investigate how to incorporate performance measures for climate change and risk assessment methods into Transportation Asset Management (TAM) practices. 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".
SPTC15.1-50	**Rapid and cost-effective rehabilitation alternatives for transportation infrastructure affected by extreme conditions**	**Vanessa Valentin,** John Stormont	University of New Mexico	This study will provide methods to quantify, manage and decrease the vulnerability of transportation infrastructure - specifically bridges and drainages - to wildfires. 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.
SPTC15.5-04	**Infrastructure-Relevant Climate Projections for the Southern Great Plains**	**Katharine Hayhoe,** Darryl James, Anne Stoner	Texas Tech University	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.

Project #	*Project Title*	*PI, Co-PI(s)*	*Organization*	*Summary*
SPTC17.1-03	**Economic Impacts of Multi-Modal Transportation Network Recovery**	**Kash Barker**	University of Oklahoma	This project will extend the previous SPTC project to include the recoverability dimension of resilience to provide an optimization formulation to recover disrupted components in the multi-modal transportation network with multi-industry impacts in mind. The importance of this work to transportation planners is in understanding (i) what order of components to repair and (ii) how to schedule work crews to perform this repair.
SPTC17.1-04	**Expanding PARIS+ to regional police agencies**	**Ron Barnes,** Joseph Havlicek	University of Oklahoma	This project will expand the availability of the Police Automated Records Information System+ (PARIS) across the state and to begin marketing the system to police agencies in neighboring states.
SPTC17.1-10	**Combined effect of sea-level rise and coastal land subsidence – Identification of critical transportation infrastructure at-risk in coastal SPTC region**	**Sanjay Tewari,** Wesley Palmer	Louisiana Tech University	This project will investigate the trends for sea-level rise and land subsidence in coastal regions of Louisiana and Texas. Spatial maps will be created using ArcGIS for transportation infrastructure that is at risk because of combined risk of land subsidence and sea-level rise.
Bridge Structures				
SPTC14.1-20	**Evaluation of Surface Treatments to Mitigate ASR**	**Micah Hale**	University of Arkansas	One of the major objectives of this project is to examine the effectiveness of silane (and other sealers) in reducing the internal relative humidity of ASR-infected concrete. Results will include identification of effective sealers, dosage rates, and application rates for stopping the ASR.
SPTC14.1-21	**Impact of Extreme Summer Temperatures on Bridge Structures**	**Micah Hale,** Royce Floyd	University of Arkansas, The University of Oklahoma	This project will assess the effects of recent heat events on prestressed concrete bridges in Region 6. 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.

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SPTC14.1-36	**Impact of Deicing Salts on Corrosion Rates of MSE Reinforcement**	**Priyantha Jayawickrama**, Sang-Wook Bae, Andrew Jackson, William Lawson, Hoyoung Seo	Texas Tech University	This research will evaluate corrosion rates in steel MSE reinforcement and embedded MSE backfill materials under different levels of exposure to deicing chemicals. 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.
SPTC14.1-38	**Development of Mixture Designs for Pumpable Concrete for Extreme Weather**	**Tyler Ley**	Oklahoma State University	This study will seek to better understand the concrete pumping process and ensure that frost durable concrete can be achieved. Implementation will allow immediate changes to be made to the optimized graded concrete specifications for structural concrete.
SPTC14.1-52	**Design of Integral Abutment Bridges (IABs) in Extreme Climate**	**Kanthasamy Muraleetharan**, Gerald A. Miller	The University of Oklahoma	The research will utilize data collected from an instrumented Oklahoma IAB and computer models to develop readily implementable design and construction guidelines for IABs in areas with extreme variations in temperature and moisture.
SPTC14.1-58	**Evaluation and Repair of Bridges in Extreme Environments**	**Royce Floyd**, Gary Prinz	The University of Oklahoma, University of Arkansas	This project will produce 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.
SPTC14.1-66	**Improving Fatigue of Polymer Concrete Overlays using Nanomaterials**	**Mahmoud Reda Taha**, Rafi Tarefder	The University of New Mexico	The objective of this work is to improve the bond, fracture and fatigue performances of PC overlays using nanomaterials such as carbon nanotubes, graphene nanoparticles or alumina nanoparticles. Implementation will produce significant improvement in the mechanical, durability, fracture and fatigue characteristics of PC.

Project #	*Project Title*	*PI, Co-PI(s)*	*Organization*	*Summary*
SPTC14.2-09	**Monitoring Extreme Loading and Climate Impact on Infrastructure**	**Julie Ann Hartell,** Tyler Ley, Phil Lewis, Yongwei Shan	Oklahoma State University	The objectives of this project are to evaluate climate and overload impact on transportation infrastructure, determine damage extent and monitor damage progression. Implementation of the developed guidelines will facilitate an effective condition assessment system that 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.
SPTC14.2-21	**Temperature Effects in Bridge Condition Evaluation and Capacity Rating in Oklahoma**	**Naiyu Wang,** Kanthasamy Muraleetharan, Luther White	The University of Oklahoma	This research will use Finite Element Analysis to perform heat flow and thermal stress analysis. 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 our region's and nation's transportation systems.
SPTC-ECDP15	**Assessing the Impact of Climate on Bridge Deck Deterioration**	**Yongwei Shan** Royce Floyd	Oklahoma State University The University of Oklahoma	The primary objective of this research is to assess the deterioration of bridge decks in Oklahoma by incorporating climate data into current assessment strategies.
SPTC-ECDP16	**Prioritizing Bridge Maintenance and Repairs Considering Geospatial and Climatological Factors**	**Yongwei Shan** Royce Floyd	Oklahoma State University The University of Oklahoma	The primary objective of this research is to develop a framework for ODOT to prioritize bridge maintenance and repairs through consideration of geospatial and climatological factors.
SPTC15.1-12	**Risk-based life-cycle management of deteriorating bridges**	**Mohamed Soliman** Julie Ann Hartell	Oklahoma State University	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. The developed tool 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.

Project #	*Project Title*	*PI, Co-PI(s)*	*Organization*	*Summary*
SPTC15.1-17	**Experimental Investigation of Tangential Heave Stress Acting on Deep Foundations in Cold Regions**	**Hoyoung Seo** William Lawson Priyantha Jayawickrama	Texas Tech University	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. The developed testing system and procedure may serve as a standard test method to more reliably determine peak and residual values of tangential heave stress.
SPTC15.1-34	**Structural performance of concrete bridge decks reinforced with high-strength reinforcing bars**	**Micah Hale,** Gary Prinz, Canh Dang	The University of Arkansas	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. Based on the findings, recommendations will be made for using A1035 steel in the design of bridge decks.
SPTC15.1-43	**Rehabilitation of Deteriorated Timber Piles using FRP Composites**	**David Hall,** Shaurav Alam	Louisiana Tech University	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 with the purpose of investigating the feasibility of restoring and enhancing the capacity of the original timber piles.
SPTC15.1-46	**Degradation of Mechanically Stabilized Earth Reinforcements Exposed to Different Environmental Conditions**	**Arturo Bronson**	University of Texas – El Paso	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 and the methodology of monitoring their degradation. This study responds to the foregoing needs in ensuring and improving the health of the transportation infrastructure.
SPTC15.5-01	**Towards an Open-source Web GIS-based Bridge Management System Using Advanced Geo-Spatial Data Visualization and Integration Technologies**	**Hongchao Liu**, Dayong Wu	Texas Tech University	This project will 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. It will develop and implement a web GIS-based bridge management system, which allows advanced geospatial visualization and potential data integration on a centralized cloud platform.

Project #	*Project Title*	*PI, Co-PI(s)*	*Organization*	*Summary*
SPTC15.5-03	**Development of Novel Analysis Model for Foundations Subjected to Combined Torsional and Lateral Loads Due to High Wind**	**Hoyoung Seo**	Texas Tech University	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. Results from parametric studies 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.
Pavement & Materials				
SPTC14.1-30	**Resistance of Asphalt Mixes with Recycled Materials to withstand Extreme Temperatures**	**Amit Bhasin,** Zahid Hossain	The University of Texas at Austin, University of Arkansas	The objective of the research is to use low-temperature tests on asphalt binders, as well as mortars with and without RAP, to determine the resistance of the asphalt materials to low temperature cracking. The 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.
SPTC14.1-47	**Numerical Modeling of Asphalt Crack Resistance**	**Enad Mahmoud,** Soheil Nazarian	The University of Texas-Pan American , The University of Texas El Paso	The objective of this study is to develop a Discrete Element Model of the resistance to cracking exhibited by asphalt mixtures using the Overlay Tester, which will be beneficial to state DOT asphalt design programs.
SPTC14.1-64	**Asphalt Binder Rheological Characterization for Extreme Climate Events**	**Sanjaya Senadheera**, Rajesh Khare	Texas Tech University	This research will analyze climate data to predict future weather patterns, relate climate to pavement condition, and use techniques of molecular modeling to elucidate the relationship between asphalt chemical composition and rheological properties. Research findings will contribute to the building of highways that better adapt to new climate realities.
SPTC14.1-69	**Evaluating Rutting and Stripping Potentials of Asphalt Mixes using Hamburg Wheel Tracking Device**	**Rafiqul A. Tarefder**	The University of New Mexico	The objective of this study is to develop a mix design specification that will reduce occurrences of placing rut- and stripping-prone mixes in roadway pavements. The expected outcome of this study is a specification that addresses rutting due to extreme temperatures that will be useful in areas with extreme hot climate.

Project #	*Project Title*	*PI, Co-PI(s)*	*Organization*	*Summary*
SPTC14.1-76	**Impact of Severe Drought on the Compacted Expansive Clays (Subgrade) in Northern Louisiana**	**Jay Wang**	Louisiana Tech University	The purpose of this study is to develop a clear understanding of the fundamental volume change behaviors of compacted expansive clays in Louisiana, with a focus on severe drought conditions. The research will advance in-depth understanding of the volume change properties of the expansive clays.
SPTC14.1-80	**Characterization of Asphalt Binders Exposed to Extreme Temperatures Through Simple and Effective Test Methods**	**Nazimuddin "Wasi" Wasiuddin**, Zahid Hossain, Rouzbeh Ghabchi, Louay N. Mohammad	Louisiana Tech University, University of Arkansas, The University of Oklahoma	The main objective of this research is to develop 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. Implementable specifications for commonly used extreme temperature asphaltic materials will be developed to reduce cost and testing time.
SPTC14.1-81	**Development of the MASW Method for Pavement Evaluation**	**Clinton Wood**	University of Arkansas	This research aims to develop the MASW method into a tool for characterization of concrete and asphalt pavements, bases, and subgrades for transportation projects. Implementation will assist agencies in early detection of delaminations, cracks, and concrete deterioration, which can be critical for planning future repairs or replacement of the existing infrastructure.
SPTC14.2-02	**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**	**Amy Cerato,** Gerald A. Miller	The University of Oklahoma	This research will validate the portable field employed XRF (PFXRF) test by assessing its detection accuracy on selected roadway stabilization projects. Recommendations will be developed for transportation officials to employ PFXRF and to implement a laboratory XRF testing protocol that will enhance jobsite quality control, impact of extreme precipitation events assessment and geotechnical forensic investigations.
SPTC14.2-03	**Special Provisions for Intelligent Compaction (IC) of Stabilized Soil Subgrades**	**Sesh Commuri,** Musharraf Zaman, Manik Barman	The University of Oklahoma	The objective of this study will be to develop and validate Oklahoma Department of Transportation “Special Provisions” for the use of IC rollers during compaction of stabilized subgrades.

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SPTC-OU	**Performance of Asphalt Binders Modified with Polyphosphoric Acid (PPA)**	**Musharraf Zaman,** Rouzbeh Ghabchi	The University of Oklahoma	The main objective of the project is to conduct a comprehensive study focusing on the characterization of HMA mixes modified with Polyphosphoric acid (PPA) and their associated performance. Recommendations will be presented for developing/adjusting guidelines/special provisions for incorporation of PPA-modified asphalt binder.
SPTC-OSU	**2015 Summer Bridge Program Engineering Design and Fabrication Project: Design and Build a Prototype Earth Retaining Wall with Sand and Paper**	**Xiaoming Yang**	Oklahoma State University	This is a four-week event designed to guide incoming OSU freshmen in engineering through the transition from high school to the collegiate learning environment. A Civil-Transportation Engineering Design and Fabrication (EDF) project was conducted to design a prototype mechanistically stabilized earth (MSE) retaining wall with sand and paper.
SPTC14.3-6	**Design Data for Rigid Pavements in New Mexico**	**Rafiqul A. Tarefder,** Mahmoud Reda Taha	University of New Mexico	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.
SPTC14.1-92	**A Novel Approach for the Characterization of the Rutting Performance of Pavement Foundations**	**Reza Ashtiani** Bill Tseng	The University of Texas – El Paso	The study will provide a Variable Dynamic Confining Pressure (VDCP) stress path protocol for permanent deformation characterization of geomaterials in the laboratory to potentially mitigate the unforeseen maintenance and repair costs associated with underestimation of the parameters of the rutting models for the design of pavement structures.
SPTC14.1-94	**Development of Numerical Simulation Tool for Continuously Reinforced Concrete Pavements**	**Cesar Carrasco** Soheil Nazarian	The University of Texas – El Paso	This research project aims to expand the capacity of the existing source code of NYSLAB by upgrading its FEM models to predict the stresses and strains in CRCP.

Project #	*Project Title*	*PI, Co-PI(s)*	*Organization*	*Summary*
SPTC14.1-97	**Quantifying Thermomechanical Fatigue of Hot Mix Asphalt: A Feasibility Study**	**Calvin M. Stewart** Imad N. Abdallah	The University of Texas – El Paso	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. 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.
SPTC15.2-18	**Development of Guidelines for High-Volume Recycled Materials for Sustainable Concrete Pavement**	**Jeffery Volz,** Musharraf Zaman, Julie Ann Hartell	University of Oklahoma, Oklahoma State University	The main objective of the study is to produce concrete for conventional pavement construction, incorporating at least 50% recycled materials (both recycled concrete aggregate and supplementary cementitious materials) without compromising performance or service life.
SPTC15.2-19	**Development of a SFE Database for Screening of Mixes for Moisture Damage in Oklahoma**	**Rouzbeh Ghabchi**, Rifat Bulut, Richard Steger, Musharraf Zaman	University of Oklahoma, Oklahoma State University	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.
SPTC15.1-06	**Mitigating Dry Shrinkage Pavement Cracking by Geocell**	**Xiaoming Yang** Rifat Bulut Joshua Qiang Li	Oklahoma State University	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). Preliminary design and construction guidelines will be developed for geocell use to treat expansive subgrade soils for pavement construction and maintenance.
SPTC15.1-23	**Development of a mechanistic-based design method for geosynthetics-reinforced pavement on expansive soils**	**Jay Wang**	Louisiana Tech University	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. 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.
SPTC15.1-24	**ODOT Guidelines for the Use of FRS in Highway Construction**	**Kianoosh Hatami**	University of Oklahoma	Transportation agencies in the U.S. are continually faced with a persistent problem of landslides and slope failures along highways. This study will develop guidelines for Fiber-Reinforced Soil (FRS) technology for the mitigation of landslides and slope failures.

Project #	*Project Title*	*PI, Co-PI(s)*	*Organization*	*Summary*
SPTC15.1-28	**Development of a RTFO-Aging Test Protocol for WMA Binders and Its PG Grading**	**Nazimuddin Wasiuddin**	Louisiana Tech University	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 RTFO protocol to simulate these aging. A method will be developed that will determine if asphalt binder grade bumping is necessary. The method will require a revised RTFO procedure.
SPTC15.1-31	**Development of Special Provision for Mix Design of Foamed-WMA Containing RAP**	**Rouzbeh Ghabchi** Musharraf Zaman Manik Barman	University of Oklahoma, 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. 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.
SPTC15.1-33	**Rapid and Continuous Assessment of Soil Conditions along Highway Alignments**	**Clinton Wood**	University of Arkansas	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. 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.
SPTC15.1-49	**Field Implementation of Fatigue Enhanced Polymer Concrete Incorporating Nanomaterials**	**Mahmoud Reda Taha**	University of New Mexico	This project will identify the optimal nanomaterials combination for producing PC with nanomaterials for efficient field implementation. In the first phase, through experimental laboratory investigation, optimal nanomaterial combinations and PC mixture proportions to meet field requirements will be identified. In the second phase, performance of a small set of selected PC mixes incorporating nanomaterials will be monitored after field implementation.
SPTC15.3-03	**Cotton-Derived Composite Materials for Climate Resilient Transportation Infrastructure**	**Noureddine Abidi,** Priyantha W. Jayawickrama	Texas Tech University	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. 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.
SPTC17.1-07	**Surface Resistivity Testing for Quality Control of Concrete Mixtures**	**Julie Ann Hartell**	Oklahoma State University	This project will develop a simple QC/QA tool to validate the actual mixture design parameters of concrete placed during construction. The test method is based on surface resistivity which has the added value of being low-cost, user-friendly, quick and non-destructive.