Texas Department of Transportation Research Program

Fiscal Year 2020

Annual Research Program Overview

Research and Technology Implementation Division

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Texas Department of Transportation Research and Implementation Division

118 E. Riverside Drive
Austin, Texas 78704
512-416-4730
RTIMAIN@txdot.gov

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For more information:

Texas Department of Transportation
www.txdot.gov

Research and Technology Implementation Division
https://www.txdot.gov/inside-txdot/division/research-technology.html

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Message from the Director

Kevin Pete, Director
Research and Technology
Implementation Division

The Research and Technology Implementation (RTI) Division continues to be responsive to relevant issues facing the Texas Department of Transportation (TxDOT) and the transportation industry. RTI provides a critical service for solving many of the modern and complex challenges that directly impact key functional areas of TxDOT's intricate foundation. Research, innovation and technology hold great promise for solving these challenges and improving the current state of travel, creating opportunity for connecting communities and reaching goals that are at the forefront of the TxDOT mission, "Connecting you with Texas".

This document provides an overview of the various research efforts that are currently underway in FY2020. Research projects listed are the result of collaborative work with top research professionals as well as internal TxDOT, and external transportation, subject matter experts. These highly skilled partners provide expert input and give critical priority to the transportation needs of TxDOT. We have also listed transportation pooled fund projects in which TxDOT is partnering with other states' DOTs to study and share information about issues affecting transportation across the country.

I would like to thank all of the project advisors, university researchers, RTI staff, members and chairs of the Functional Area Committees and Research Oversight Committees, for continuing to support and make the research program a success.

Read on to learn more about the variety of innovative research efforts that are contributing to improvements in the functional areas of construction, maintenance, and materials, planning and environmental, safety and operations, strategy and innovation, and structures and hydraulics. Anytime access for ongoing and completed research projects can be found online via the TxDOT Research Library, at https://ctr.utexas.edu/library/. Whether we are working in our own Texas-sized backyard or across the nation, TxDOT is committed to keeping Texas and travelers everywhere, connected.

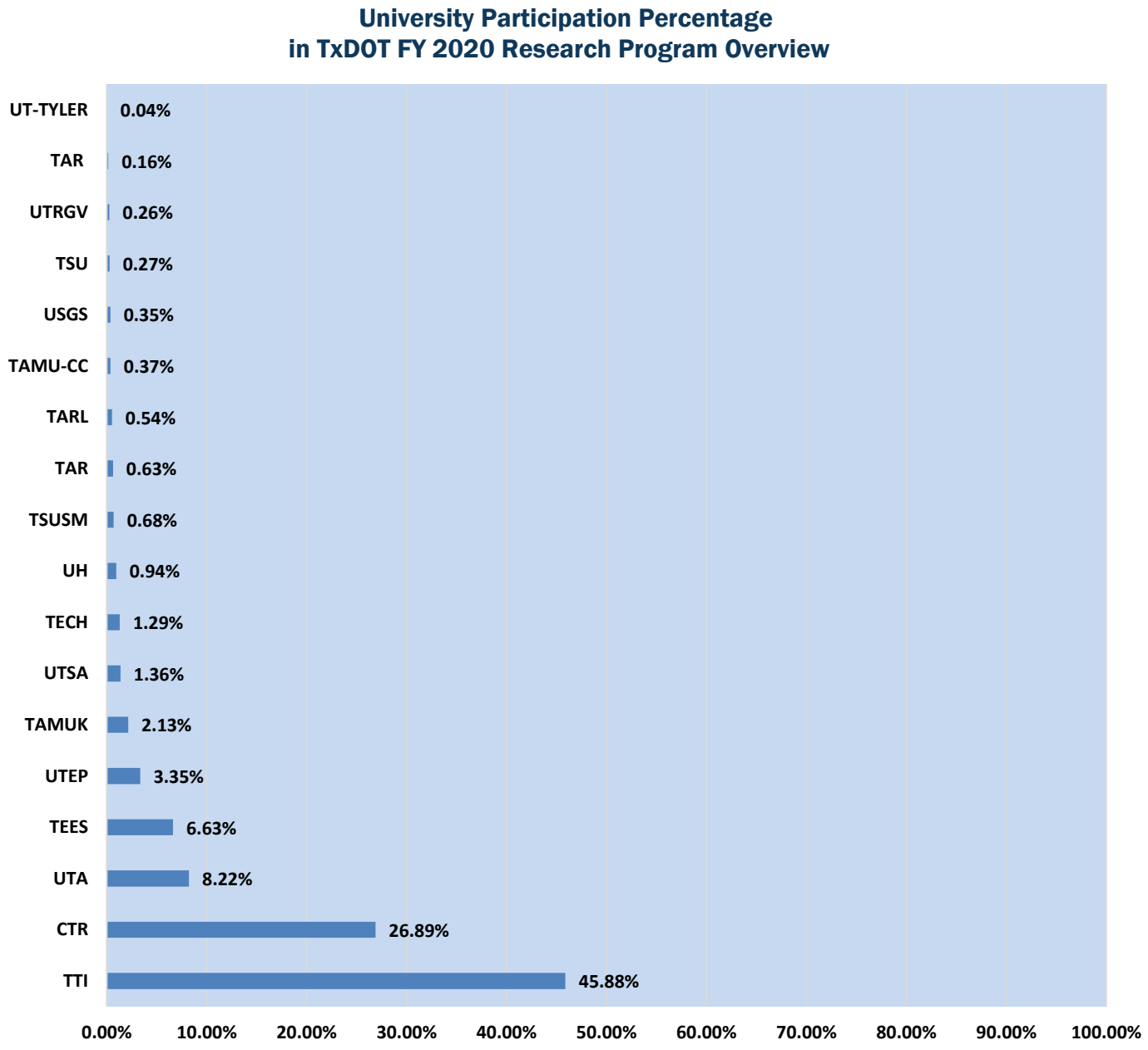
Universities Active in TxDOT's 2020 Research Program

Acronym	University/Research Institution
CTR	Center for Transportation Research, The University of Texas at Austin
TAMU-CC	Texas A&M University–Corpus Christi
TAMUK	Texas A&M University–Kingsville
TAR	Texas A&M AgriLife Research
TARL	Tarleton State University
TECH	Center for Multidisciplinary Research in Transportation, Texas Tech University
TEES	Texas A&M Engineering and Experiment Station
TSU	Texas Southern University
TSUSM	Texas State University–San Marcos
TTI	Texas A&M Transportation Institute, Texas A&M University
UH	University of Houston
USGS	United States Geological Survey
UTA	The University of Texas at Arlington
UTEP	The University of Texas at El Paso
UTRGV	The University of Texas Rio Grande Valley
UTSA	The University of Texas at San Antonio
UT-Tyler	The University of Texas at Tyler

Fiscal Year 2020 Research Program Overview

University Participation

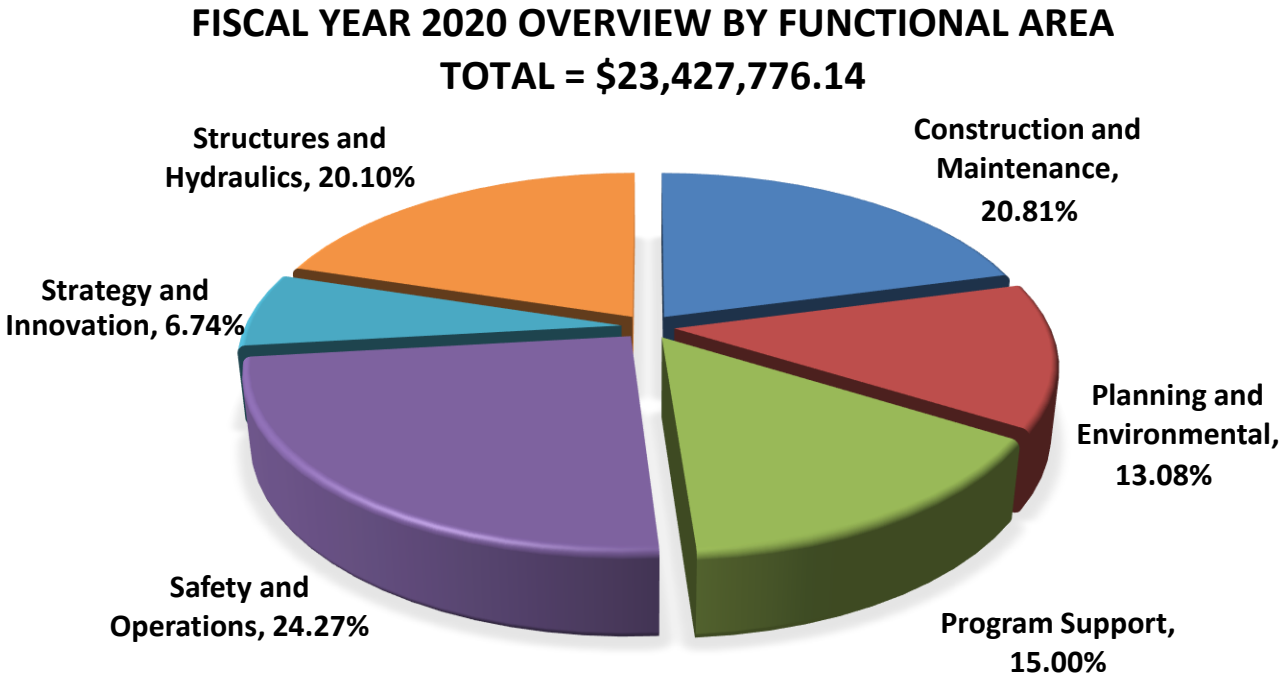
TxDOT's fiscal year 2020 research program overview consists of 117 projects, with budgets totaling $23.4 million. This work is contracted to 17 Texas state-supported universities, as well as the USGS. The figure below shows project agreement participation percentages by university and the USGS, as of May 2020.



Funding

The table below shows an overview summary by functional area of the number of continuing/new projects and funding for fiscal year 2020.

Functional Area	Number of Continuing Projects	Number of New Projects	Total Project Funding
Construction and Maintenance	26	8	$4,874,987.86
Planning and Environmental	7	7	$3,064,682.55
Safety and Operations	22	8	$5,686,703.34
Strategy and Innovation	4	1	$1,577,892.41
Structures and Hydraulics	24	6	$4,709,608.36
RTI Administration and Texas Technology Transfer/Program Support	3	1	$3,513,901.62
Total	86	31	$23,427,776.14



TxDOT Districts/Divisions and Related Organizations Represented by Project Advisors in TxDOT Research and Implementation Projects

Acronym	TxDOT Districts/Divisions/Related Organizations
ABL	Abilene District
AMA	Amarillo District
ATL	Atlanta District
AUS	Austin District
AVN	Aviation Division
BMT	Beaumont District
BRG	Bridge Division
BRY	Bryan District
BWD	Brownwood District
CHS	Childress District
CRP	Corpus Christi District
CST	Construction Division
DAL	Dallas District
DES	Design Division
ELP	El Paso District
ENV	Environmental Affairs Division
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
FOD	Fleet Operations Division
FTW	Fort Worth District
FWS	United States Fish and Wildlife Service
GOV	Government Affairs Division
HOU	Houston District
HRD	Human Resources Division
ITD	Information Technology Division

Acronym	TxDOT Districts/Divisions/Related Organizations
LBB	Lubbock District
LFK	Lufkin District
LRD	Laredo District
MNT	Maintenance Division
MRD	Maritime Division
MTD	Materials and Tests Division
NCTOG	North Central Texas Council of Governments
ODA	Odessa District
PAR	Paris District
PFD	Project Finance, Debt & Strategic Contracts Division
PHR	Pharr District
PEPS	Professional Engineering Procurement Services
PTN	Public Transportation Division
ROW	Right of Way Division
RRD	Rail Division
RTI	Research and Technology Implementation Division
SAT	San Antonio District
SJT	San Angelo District
SSD	Support Services Division
STR	Strategic Planning Division
TCEQ	Texas Commission on Environmental Quality
TPD	Transportation Programs Division
TPP	Transportation Planning & Programming Division
TPWD	Texas Parks and Wildlife Department
TRF	Traffic Safety Division
TYL	Tyler District
WAC	Waco District
WFS	Wichita Falls District
YKM	Yoakum District

Projects by Functional Area Committees
Construction, Maintenance and Materials

Project	Title	Start Date	Page
0-6875-03	Automated and Connected Vehicle (AV/CV) Test Bed to Improve Transit, Bicycle, and Pedestrian Safety - Phase III	5/14/2019	11
0-6880	Full Depth Reclamation in Maintenance Operations Using Emerging Technologies	7/24/2015	12
0-6906	Chemical Solutions to Concrete Durability Problems	1/1/2016	13
0-6923	Develop Guidelines and Design Program for Hot-Mix Asphalts Containing RAP, RAS, and Other Additives Through a Balanced Mix-Design Process	6/22/2016	14
0-6949	Establishing Best Practices for Design and Construction of Cement Treated Materials	9/1/2017	16
0-6959	Documenting the Impact of Aggregate Quality on Hot Mix Asphalt (HMA) Performance	9/1/2017	17
0-6966	Assessment of Test Methods for Supplementary Cementitious Materials	9/1/2017	18
0-6985	Perform Feasibility Study on Use of Innovative Tools and Techniques to Accelerate Pavement Construction	9/1/2018	19
0-6986	Proper Selection of Ride Quality Pay Adjustment Schedule and Re-evaluation of Current Bonus/Penalty Structure	9/1/2018	20
0-6988	Quantification of the Performance of Preventative Maintenance and Rehabilitation Strategies	9/1/2018	21
0-6989	Update Seal Coat Application Rate Design Method	9/1/2018	22
0-7001	Utilizing Steel Fibers as Concrete Reinforcement in Bridge Decks	5/17/2019	23
0-7002	Evaluation of Geogrids for Asphalt Pavement Construction	5/14/2019	24
0-7005	Develop Decision Tree Incorporating Surface Conditions	7/31/2019	25
0-7006	Design, Construction, and Performance Monitoring of Stabilization of Expansive Soils and Cement	4/24/2019	26

0-7008	Advanced Geophysical Tools for Geotechnical Analysis	5/29/2019	27
0-7025	Develop Surface Aggregate Classification of Reclaimed Asphalt Pavement	6/28/2019	28
0-7026	Optimizing Reinforcing Steel in 12-inch and 13-inch Continuously Reinforced Concrete Pavement (CRCP)	8/14/2019	29
0-7027	Accelerating Mix Designs for Base Materials	7/10/2019	30
0-7028	Determine the Effectiveness of TxDOT's HMA QCQA Bonus Penalty Specification as it Relates to Long-term Performance	9/1/2019	31
0-7031	Develop Efficient Prediction Model of Highway Friction on an Annual Basis on Texas Network	9/27/2019	32
0-7060	Measuring Faulting on Jointed Concrete Pavements	12/17/2019	33
0-7061	Optimizing Laboratory Curing Conditions for Hot Mix Asphalt to Better Simulate Field Behavior	12/9/2019	34
0-7062	Synthesis for Quantification of Binder Availability in Recycled Materials	11/1/2019	35
0-7064	Use of Tamper Bar Paver to Place Thick Lift Asphalt Concrete Pavement (ACP)	12/6/2019	36
5-4829-05	Implementation of Geosynthetic-stabilized Roadways for Base Course Reduction: Field Monitoring and Design Recommendations	5/2/2018	37
5-6674-01	Statewide Implementation of New Binder Selection Catalog and New Binder Performance Tests	6/18/2019	38
5-6679-01	Implementation of Performance Life of Various HMA Mixes in Texas	3/9/2018	39
5-6815-01	Implementation of Improved Overlay Tester for Fatigue Cracking Resistance of Asphalt Mixtures	5/23/2017	40
5-6839-01	Implementation of Pavement Rehabilitation and Design Strategy for Heavy Loads in Energy Development Areas	5/6/2019	41

5-6910-01	Implementation of Concrete Overlay Evaluation and Design	5/21/2019	42
5-6925-01	Implementation of Improved Performance Grade (PG) of Asphalt Binders	9/1/2019	43
5-6940-01	Implementation of Portable Weigh-In Motion (WIM) Technology on Texas Highways	4/19/2019	44
5-6963-01	Implementation of Seal Coat Binder Rate Adjustments Using LiDAR Data	5/7/2019	45

*Note: In the following Project Descriptions, the Receiving Agency is TxDOT and the Performing Agency is the University conducting the research.

Construction, Maintenance and Materials Projects

0-6875-03-Automated and Connected Vehicle (AV/CV) Test Bed to Improve Transit, Bicycle, and Pedestrian Safety - Phase III

Start Date: 5/14/2019 End Date: 5/31/2021

Project Description

Crashes involving transit vehicles, bicyclists, and pedestrians are a concern in Texas, especially in urban areas. In research project 0-6875 (hereafter referred to as "Phase I"), the Performing Agency explored the potential for the use of automated and connected vehicle (AV/CV) technology to reduce or eliminate these crashes. The Performing Agency identified concept applications, along with public and private sector partners, and developed a concept of operations plan for designing, testing, piloting, demonstrating, and deploying candidate applications through an AV/CV Test Bed to Improve Transit, Bicycle, and Pedestrian Safety. In research project 0-6875-01 (hereafter referred to as "Phase II"), the Performing Agency designed, developed, and pilot tested the Smart Intersection application using a test bed at the Texas A&M University System (TAMUS) RELLIS Campus proving ground. The Smart Intersection application included a bus equipped with a dedicated short-range communication (DSRC) radio, which automatically communicated with a smart traffic signal, providing a visual and audio warning to bicyclists and pedestrians. A prototype Android smartphone app was also designed, developed, and pilot tested as part of the pilot test at the RELLIS Campus. In research project 0-6875-03 (hereafter referred to as "Phase III"), the Performing Agency shall deploy the Smart Intersection at George Bush Drive and Penberthy Boulevard in College Station, which is adjacent to the Texas A&M University Campus. The deployment will include southbound buses turning left from Penberthy Boulevard onto George Bush Drive, automatically communicating with a smart traffic signal and providing visual and audio warnings to pedestrians and bicyclists who are waiting to cross the intersection. The Performing Agency shall monitor and evaluate the deployment to assess the technical capabilities of the system and to obtain feedback from pedestrians and bicyclists about the visual and audio warnings.

Total Project Budget	Research University	FY 2020 Budget
$586,215.00	Texas A&M Transportation Institute	$299,745.00

Project Manager	Research Supervisor
Wade Odell, RTI	Katherine Turnbull, TTI

Project Advisors	Organization
Steven Copley	BRY
Bonnie Sherman	PTN
Darla Walton	PTN

0-6880-Full Depth Reclamation in Maintenance Operations Using Emerging Technologies

Start Date: 7/24/2015 **End Date: 8/31/2021**

Project Description

As documented in project 0-6271, Full Depth Recycling (FDR) is the main approach used in Texas to rehabilitate thin roadways that are structurally damaged. In the FDR process, the existing surface and base materials are pulverized, mixed together, and treated with a stabilizer. The type and amount of stabilizer is designed in the laboratory to provide sufficient strength and moisture resistance. The compacted treated base then receives a thin surfacing. This project shall identify and use these emerging FDR technologies in maintenance operations of districts, to design and construct experimental sections with a range of new stabilizers, most notably cement slurries, foamed asphalt and engineered emulsions. These sections will typically be short, distressed high-profile roadways in TxDOT districts, in which the Performing Agency can work with the TxDOT district lab and construction personnel to design, construct and monitor the experimental FDR sections with these emerging technologies. Guidelines for using these emerging FDR technologies in maintenance operations will also be developed.

Total Project Budget	Research University	FY 2020 Budget
$5,075,781.00	Texas A&M Transportation Institute	$200,000.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Tom Scullion, TTI

Project Advisors	Organization
Dalton Pratt	FOD
Feng Hong	MNT
James Stevenson	MNT
John Bilyeu	AUS
Miguel Arellano	AUS
Richard Izzo	MTD
Ricky Nieman	FOD
Roberto Trevino Flores	MNT
Rod Bliss	FOD
Stephen Kasberg	WAC

0-6906-Chemical Solutions to Concrete Durability Problems

Start Date: 1/1/2016 **End Date: 12/31/2019**

Project Description

The state of Texas has been plagued by various durability-related issues in recent years, including deterioration from alkali-silica reaction (ASR), delayed ettringite formation (DEF), corrosion of reinforcing steel, and volume changes (plastic shrinkage, drying shrinkage, thermal effects, etc.), to name a few. These durability-related issues, coupled with other factors, contribute to reductions in service life (e.g., service loads, defects, etc.). For many of these problems, fly ash (primarily Class F) has been the remedy of choice; however, with changes in fly ash quality and quantity, spurred by new emissions standards, there is a major concern that fly ash will not be able to fill these needs in the long term. The goal of this project will be to evaluate chemical alternatives to fly ash, such as the use of chemical admixtures, aimed specifically at improving concrete durability.

Total Project Budget	Research University	FY 2020 Budget
$590,226.00	Center for Transportation Research, The University of Texas at Austin	$31,145.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Kevin J. Folliard, CTR

Project Advisors	Organization
Andy Naranjo	MTD
Rachel Cano	MTD
Cliff Coward	MTD
Michael Botzaritch	AUS

0-6923-Develop Guidelines and Design Program for Hot-Mix Asphalts Containing RAP, RAS, and Other Additives Through a Balanced Mix-Design Process

Start Date: 6/22/2016 **End Date: 8/31/2020**

Project Description

The Performing agency shall provide the Receiving Agency with an Asphalt Concrete (AC) mix design program and guidelines to determine the optimum recycled asphalt pavement (RAP), recycled asphalt shingles (RAS), and additives content for designing balanced mixes without compromising the quality and performance of the final product. During this project, the Performing Agency shall: 1. Evaluate current mix designs, design processes and guidelines for use of RAP, RAS, and additives on AC mixes in Texas and worldwide to identify weaknesses and strengths of current practices, for balanced mix designs involving RAP, RAS, and other additives. 2. Gather laboratory and field performance of sections studied under Research Project 0-6679. These sections are identified as historical and in-service sections, (sections to be determined by Receiving Agency) constructed with and without RAP, RAS, and additives. 3. Determine correlation of laboratory results to pavement sections studied under Research Project 0-6679 (chosen by Receiving Agency), using performance indicators from tests such as the overlay tester (OT) and Hamburg wheel tracking device (HWTD), as well as strength parameters like the Indirect Tensile strength from past research projects, in order to implement a protocol for a balanced cracking and rutting resistant mix containing RAP, RAS, and other additives. 4. Evaluate at least 15 mixes used by Receiving Agency through a factorial experiment to assess the influence of RAP, RAS, and additives on the performance of balanced Hot Mix Asphalt (HMA) mixes. 5. Evaluate the feasibility of an AC mix design process that not only considers the raw and recycled materials but also incorporates the structural design of the pavement section, for the end goal of reliably characterizing the performance of the designed AC mix. 6. Develop a design program for Receiving Agency pavement designers and engineers to determine the optimum RAP, RAS, and additive contents on AC mixes with varying aggregate type, asphalt content, grade, and (if feasible) structural design of the pavement.

Total Project Budget	Research University	FY 2020 Budget
$664,350.00	The University of Texas at El Paso	$140,600.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Soheil Nazarian, UTEP

Project Advisor	Organization
Alejandro Miramontes	AUS
James Robbins	BRY

Project 0-6923 Cont'd

Project Advisor	Organization
Ramon Rodriquez	LRD
Ryan Barborak	MTD
Enad Mahmoud	MTD
Daniel Garcia	PHR
Gisel Carrasco	AUS
Miguel Arellano	AUS
Stephen Kasberg	WAS
Travis Patton	MTD

0-6949-Establishing Best Practices for Design and Construction of Cement Treated Materials

Start Date: 9/1/2017 **End Date: 8/31/2020**

Project Description

TxDOT has been constructing pavement structures with cement-treated materials for many years; however, premature failures, such as rutting and cracking, occasionally occur during or shortly after construction. To ensure cement-treated base (CTB) durability and adequate performance over the pavement design life, it is critical to have a better understanding and knowledge of the significance of material mixture designs, construction, and inspection techniques. This project shall look at the existing TxDOT guidelines and provide a comprehensive evaluation of how they compare to other published guidelines and recent literature. Particularly, this project shall evaluate the potential benefits of new technologies such as inverted pavement structure and super slurry on the properties of the CTB. This evaluation includes developing new rheological testing standards and specifications for evaluating best slurry mixes, to maximize performance of the most common TxDOT recycled base material. The project shall include an extensive laboratory evaluation of CTB material performance and durability, prepared using traditional on-site and in-plant mixing, with a comparison to the newly proposed slurry-based mixing. These tests shall provide the basis for the new mix design specifications and laboratory testing, and develop baseline curves for in-situ inspection and field performance evaluation.

Total Project Budget	Research University	FY 2020 Budget
$449,202.00	The University of Texas at El Paso	$137,498.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Reza Ashtiani, UTEP

Project Advisor	Organization
Roberto Trevino Flores	MNT
Armando Ramirez	ELP
Diana Rogerio	SAT
Gisel Carrasco	AUS
James Robbins	BRY
Jimmy Si	MTD
Robert Moya	SAT
Wade Blackmon	PAR
Miles Garrison	MTD

0-6959-Documenting the Impact of Aggregate Quality on Hot Mix Asphalt (HMA) Performance

Start Date: 9/1/2017	End Date: 10/31/2019

Project Description

In Texas, the Surface Aggregate Classification (SAC) system is currently used to qualify aggregates for hot mix asphalt (HMA). The SAC system ranks aggregates into SAC A, B, or C based on their magnesium soundness and acid insolubility values. Only SAC A aggregate is recommended on high volume roads. However, this classification has led to both shortages of surfacing aggregates and increment in the cost of premium HMA surfacings because limestone, a main Texas aggregate source, is designated as SAC B, due to the acid insolubility requirement. It is the Receiving Agency's long-term goal to revise and possibly replace the existing SAC system with a system that is more related to in-service field performance. The main objective of this study is to provide the fundamental laboratory and field performance data required to provide guidelines for the enhancement of the Texas aggregate screening/selection criteria. To accomplish these objectives, the Performing Agency shall use the existing databases (mainly the Project 0-6658 database with over 70 in-service highway test sections across the State and other in-house district databases) to correlate field performance in terms of skid resistance, as well as rutting and cracking, with the aggregate properties – supplemented with limited field data (skid) collection.

Total Project Budget	Research University	FY 2020 Budget
$250,000.00	Texas A&M Transportation Institute	$25,000.00
	The University of Texas at Tyler	$0.00

Project Manager	Research Supervisor
Phillip Hempel, RTI	Lubinda Walubita, TTI

Project Advisor	Organization
Edward Morgan	MTD
Jeffrey Perabo	MTD
Jim Grissom	MTD
Michael Dawidczik	MTD
Richard Izzo	MTD
Travis Patton	MTD

0-6966-Assessment of Test Methods for Supplementary Cementitious Materials

Start Date: 9/1/2017 **End Date: 8/31/2020**

Project Description

Supplementary cementitious materials (SCMs) are a critical component of many concrete mixtures, with Class F fly ash being the most widely used in Texas, due to its ability to reduce concrete cost and improve long-term strength and durability. Increasingly, power plants are blending coals, producing fly ash with potentially different properties than the previously common Class F fly ash from Texas lignite coal. Further, fly ash suppliers can blend fly ashes from different sources and are increasingly interested in reclaiming ashes from landfills, as well as remediating ashes that do not meet specifications. The changing landscape for fly ash demands rigorous testing to ensure that fly ashes still perform as expected, based on their ASTM C618 Class F classification. This project shall evaluate a variety of fly ashes from blended, reclaimed, and remediated sources for chemical and physical characteristics and performance in cement paste, mortar, and concrete mixtures. In addition, since ASTM C618 has been shown to be inadequate for qualifying SCMs, new tests shall be developed and evaluated to characterize the reactivity of SCMs and their performance in concrete.

Total Project Budget	Research University	FY 2020 Budget
$433,012.48	Center for Transportation Research, The University of Texas at Austin	$112,906.49

Project Manager	Research Supervisor
Joanne Steele, RTI	Maria Juenger, CTR

Project Advisor	Organization
Andy Naranjo	MTD
Rachel Cano	MTD
Cliff Coward	MTD
Michael Botzaritch	AUS

0-6985-Perform Feasibility Study on Use of Innovative Tools and Techniques to Accelerate Pavement Construction

Start Date: 9/1/2018 **End Date: 8/31/2021**

Project Description

The Receiving Agency is facing an increase in pavement reconstruction projects over the next 10 years especially with the passage of Proposition 7 funding. However, most of the roadways needing reconstruction and widening are in the metro areas where traffic handling and user delay costs are a major expense. The Performing Agency shall investigate innovative tools and techniques to accelerate pavement construction. In coordination with the Receiving Agency districts, the Performing Agency shall identify four upcoming major roadway projects (two rigid pavement and two flexible pavement projects), that are scheduled for reconstruction and widening. The Performing Agency shall extensively test these four projects and recommend innovative approaches for district consideration. The Performing Agency shall employ advanced planning tools, such as Construction Analysis for Pavement Rehabilitation Strategies (CA4PRS) to document the optimal construction scheduling and identify time and cost savings. The Performing Agency shall prepare training materials or guidance to include their methodology, testing procedures and other tools used in the selection and design of pavement for candidate projects. The Performing Agency shall present these findings to the participating districts.

Total Project Budget	Research University	FY 2020 Budget
$480,843.00	Texas A&M Transportation Institute	$173,391.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Darlene Goehl, TTI

Project Advisor	Organization
Boon Thian	DAL
Brenda Guerra	AUS
Eduardo Acosta Jr	CST
Paul Wong	ATL
Ryan Phillips (James)	MNT

0-6986-Proper Selection of Ride Quality Pay Adjustment Schedule and Re-evaluation of Current Bonus/Penalty Structure

Start Date: 9/1/2018 **End Date: 8/31/2020**

Project Description

The smoothness of a road's riding surface is a primary performance attribute readily perceived by TxDOT's (hereafter referred to as Receiving Agency) customers, the traveling public. In light of this, the Receiving Agency has included ride quality as an element monitored in construction projects through a standard specification since 1993. The process for measuring pavement smoothness has evolved over the past quarter century, as has paving equipment. While expectations of the traveling public continue to increase and paving equipment continues to improve, the application, enforcement, and understanding of the ride quality specification and selection of pay schedule varies throughout the state. Through this project, the Performing Agency shall summarize current practices within the Receiving Agency. Also, the Performing Agency shall determine the improvement that can be obtained for various construction projects with different surface types. Using this data driven analysis, the Performing Agency shall develop new guidance for the selection of pay schedule for all types of projects. The Performing Agency shall also use the data to determine if changes in the specification are warranted and if the changes should be surface specific.

Total Project Budget	Research University	FY 2020 Budget
$202,190.00	Texas A&M Transportation Institute	$100,442.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Charles Gurganus, TTI

Project Advisor	Organization
Andy Naranjo	MTD
Ben Engelhardt	AUS
Enad Mahmoud	MTD
James Robbins	BRY
Jesus Noriega	PHR
Miles Garrison	MTD
Ruben Carrasco	AUS
Travis Patton	MTD

0-6988-Quantification of the Performance of Preventative Maintenance and Rehabilitation Strategies

Start Date: 9/1/2018 **End Date: 8/31/2020**

Project Description

TxDOT has implemented Pavement Analyst Enterprise Software (PA) as the most ambitious and significant improvement for the management of their highway infrastructure. The implementation of PA has been a great success and some of the benefits are already evident. However, most of the benefits will be realized in the medium-term and long-term by cost-effective and objective pavement management. Critical to this implementation is a large number of pavement performance models that are used to predict pavement distresses and Condition Score. Current performance models have been inherited from the former PMIS and are not accurate, resulting in suboptimal project selection and resource allocation. Additionally, current models do not incorporate construction work history. These are two significant limitations that make current performance predictions unreliable and inaccurate. In this project, the Performing Agency shall deliver two implementation-ready outcomes: 1) we will calibrate existing models, using advanced analytical techniques, incorporating historical data and capturing the effect of maintenance and rehabilitation activities, and 2) we will propose alternative models that do not have the limitations of the current models but that could be directly programmed into PA as easily as the current models. These alternative models will use specification forms that respond to each distress and pavement type.

Total Project Budget	Research University	FY 2020 Budget
$349,884.78	Center for Transportation Research, The University of Texas at Austin	$148,557.98
	The University of Houston	$27,789.30

Project Manager	Research Supervisor
Joanne Steele, RTI	Jorge Prozzi, CTR

Project Advisor	Organization
Enad Mahmoud	MTD
Jenny Li	MNT
John Bilyeu	MNT
Lacy Peters	ATL

0-6989-Update Seal Coat Application Rate Design Method

Start Date: 9/1/2018 **End Date: 8/31/2021**

Project Description

The Performing Agency shall investigate improvements to the seal coat application rate design method and perform the following: 1) Survey current seal coat design methods used by the Receiving Agency districts. 2) Evaluate current seal coat application rate design methods. 3) Evaluate materials used in seal coat construction and their influence on application rates. 4) Recommend a new design procedure or modified existing procedure to set application rates for binder (including, but not limited to, Asphalt Cement, emulsion, and Cutback) and aggregate.

Total Project Budget	Research University	FY 2020 Budget
$125,000.00	Texas A&M Transportation Institute	$6,949.00

Project Manager	Research Supervisor
Wade Odell, RTI	Darlene Goehl, TTI

Project Advisor	Organization
Sergio Cantu	PHR
Jace Lee	BRY
Enad Mahmoud	MTD
Arash Motamed	MTD
Shannon Ramos	LFK
James Robbins	BRY

0-7001-Utilizing Steel Fibers as Concrete Reinforcement in Bridge Decks

Start Date: 5/17/2019 **End Date: 8/31/2022**

Project Description

The Performing Agency shall perform work aimed toward the development of steel fiber reinforced concrete (SFRC) mix designs and optimized top mat reinforcement detailing, for use in fiber-reinforced cast-in-place (CIP) slabs constructed on top of stay-in-place precast concrete panels (PCP). The findings from this research shall be developed through the performance of targeted SFRC mixture design and material testing activities, numerical modeling activities used to assess SFRC CIP-PCP bridge deck structural performance, and the execution of idealized and full-scale SFRC bridge deck structural testing programs, in order to validate the suitability of the crack control and load carrying elements of proposed SFRC CIP slab design recommendations.

Total Project Budget	Research University	FY 2020 Budget
$997,929.72	Center for Transportation Research, The University of Texas at Austin	$277,442.31

Project Manager	Research Supervisor
Joanne Steele, RTI	Oguzhan Bayrak, CTR

Project Advisor	Organization
Andy Naranjo	MTD
Christina Gutierrez	MTD
Joe Roche	MTD
Lianxiang Du	BRG
Rachel Cano	MTD
Steven Austin	BRG
Trenton Ellis	BRG

0-7002-Evaluation of Geogrids for Asphalt Pavement Construction

Start Date: 5/14/2019 **End Date: 5/31/2022**

Project Description

Geogrids have been used in several Receiving Agency Districts to reinforce Hot-Mix Asphalt (HMA) with the objective of minimizing reflective cracking. Recent field evaluations have revealed that polymeric geogrids within HMA resulted in an additional promising benefit; increasing structural capacity and consequently, a reducing of the required thickness of hot-mix overlays. Despite strong field evidence, important questions remain concerning proper geogrid selection criteria for this new application, what properties to specify, and how to quantify the increased structural capacity. The Performing Agency shall: (1) evaluate different types of polymeric and glass geogrids; (2) instrument field test sections along SH21 to validate constructability and assess long-term field performance; and (3) translate the research findings into practical specifications.

Total Project Budget	Research University	FY 2020 Budget
$698,544.04	Center for Transportation Research, The University of Texas at Austin	$175,032.62

Project Manager	Research Supervisor
Chris Glancy, RTI	Jorge Zornberg, CTR

Project Advisor	Organization
Alejandro Miramontes	AUS
Ed Goebel	LBB
Enad Mahmoud	MNT
Gisel Carrasco	AUS
Melissa Benavides	AUS
Miguel Arellano	AUS
Roberto Trevino Flores	MNT
Ryan Phillips	MNT

0-7005-Develop Decision Tree Incorporating Surface Conditions

Start Date: 7/31/2019 **End Date: 11/30/2021**

Project Description

Pavement Analyst Enterprise Software (PA) has enhanced effectiveness and efficiency in the planning, construction, and management of the state highway infrastructure. PA facilitates the making of informed and objective decisions about maintenance and rehabilitation activities. Historically, these decisions have been based on structural conditions (e.g., condition, ride and/or distress scores). This project shall define and incorporate surface condition elements (i.e., macrotexture, microtexture, friction, skid number, cross-slope, etc.) into decision trees to improve safety conditions when low levels are detected, particularly in areas that have been identified as problematic.

Total Project Budget	Research University	FY 2020 Budget
$349,522.00	Center for Transportation Research, The University of Texas at Austin	$141,142.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Jorge Prozzi, CTR

Project Advisor	Organization
Boon Thian	DAL
Feng Hong	MNT
Hui Wu	AUS
Jenny Li	MNT
Miguel Arellano	AUS
Soojun Ha	HOU

0-7006-Design, Construction, and Performance Monitoring of Stabilization of Expansive Soils and Cement

Start Date: 4/24/2019 End Date: 8/31/2022

Project Description

The Receiving Agency is actively looking for alternatives to stabilize expansive soils and cement treated bases with polypropylene fiber. Polypropylene fiber, hereafter is referred to as fiber. Many areas in Texas have problems stabilizing expansive soils with traditional stabilizers (i.e. lime, cement, fly ash, or in combination) because of the high levels of sulfates in the soil. Many major pavement failures have occurred due to lime/cement-induced sulfate heaves. In addition, reflection cracks from cement treated bases have been reported in numerous projects. Expansive soils have caused extensive pavement heaves, bumps and longitudinal cracks. Repetitive shrinking and swelling is responsible for the development of cracks, heaves and bumps on Texas roads. Roadway surface cracks allow water intrusion which degrades underlying pavement layers, and prematurely fails the pavement structure. Surface heaves and bumps are a driver safety issue. Cracks, heaves, and bumps are extremely expensive to repair over the life of the pavement, and it would be more economical and safer to the public to mitigate their occurrences during construction. Previous research results indicate that fiber-reinforced cement treated bases have shown increased performance. Significant improvements in both shear and compressive strengths, as well as flexibility, have been reported in fiber reinforced soils and fiber reinforced cement treated bases. Also, fiber reinforced clays and sands were able to reduce volumetric shrinkage strains and swell pressures. It is expected that these types of improvements would directly mitigate the aforementioned distresses. The Performing Agency shall document optimal construction techniques and identify time and cost savings.

Total Project Budget	Research University	FY 2020 Budget
$584,000.00	Texas A&M Transportation Institute	$175,000.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Dar Hao Chen, TTI

Project Advisor	Organization
Aaron Bloom	PAR
Chad Ingram	PAR
Jerry Hale	PAR
Noel Paramanantham	PAR
Tommy Henderson	PAR
Wade Blackmon	PAR

0-7008-Advanced Geophysical Tools for Geotechnical Analysis

Start Date: 5/29/2019 **End Date: 5/31/2021**

Project Description

The TxDOT Geotechnical Manual does not provide guidelines for advanced geophysical subsurface exploration. The objectives of this project are to (1) conduct an overview analysis of the Federal Highway Administration (FHWA) Every Day Counts (EDC)-suggested advanced geophysical tools that are not used (or commonly not used) in Texas, (2) identify and recommend advanced geophysical tools that can improve the Receiving Agency's geotechnical analyses for a variety of applications designed to fit the Texas geotechnical and operational environment, (3) develop decision flowcharts to help select recommended methods based on different applications (e.g., investigation of buried utilities, depth of foundations, geological formation, preliminary design parameters such as plasticity index, liquidity index, sulfate content, moisture variations, and forensic evaluations) and operational conditions of different Receiving Agency districts, (4) develop a manual for implementing electrical resistivity profiling, either for inclusion in a best practices guide or as a stand-alone manual, (5) create educational materials, such as brochures and demonstrative videos to train various Receiving Agency workforces (e.g., district engineers, area engineers, maintenance supervisors, and investigation crews), and (6) implement and demonstrate electrical resistivity profiling on five ongoing projects (located in 5 different districts in North, South, East, West, and Center of Texas), suitable for different geotechnical conditions and operational environments and to be used for regional training workshops in these districts.

Total Project Budget	Research University	FY 2020 Budget
$269,523.00	The University of Texas at Arlington	$129,824.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Mohsen Shahandashti, UTA

Project Advisor	Organization
Boon Thian	DAL
Natnael Asfaw	FTW

0-7025-Develop Surface Aggregate Classification of Reclaimed Asphalt Pavement

Start Date: 6/28/2019 **End Date: 10/31/2021**

Project Description

The use of Surface Aggregate Classification A (SAC-A) aggregates has increased significantly, to over 1.9 million tons annually, to meet the friction demand of pavements. The challenge to the Receiving Agency is to develop specifications, methods, and means to conserve our existing SAC-A resources. The goal of this project is to determine if potential exists to conserve SAC-A resources by adding friction value to reclaimed asphalt pavements (RAP) without incurring detrimental effects to mix quality. This project will synthesize the state-of-the practice for use of RAP in surface mixes and associated skid resistance and durability. This project will also evaluate field test sections to identify how RAP affects skid resistance. Furthermore, this project will select and characterize multiple RAPs and then evaluate the impact of different RAP types and amount on both skid resistance and durability of different types of asphalt mixes. Based on the results of both laboratory and field work, this project will develop an SAC rating for RAP and guidelines for using RAP in surface mixes. To foster technology transfer, this project will develop a training presentation and perform two (2) workshops for Receiving Agency engineers.

Total Project Budget	Research University	FY 2020 Budget
$377,280.00	Texas A&M Transportation Institute	$161,898.00
	The University of Texas at Tyler	$9,544.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Sheng Hu, TTI

Project Advisor	Organization
Ed Morgan	MTD
Enahd Mahmoud	MTD
Jeffrey Perabo	MTD
Lewis Nowlin	SJT
Michael Dawidczik	MTD
Richard Izzo	MTD

0-7026-Optimizing Reinforcing Steel in 12-inch and 13-inch Continuously Reinforced Concrete Pavement (CRCP)

Start Date: 8/14/2019 **End Date: 8/31/2022**

Project Description

The distresses observed lately in thick CRCP sections in Texas are quite different from typical distress types that have long been recognized in CRCP – namely punchouts and spalling. The new distress type is characterized by segmentation of slabs at transverse cracks, generally under the wheel paths. Forensic investigations conducted to identify the cause(s) of those distresses indicate delamination of the slab at the depth of longitudinal steel. It appears that thicker slabs with longitudinal steel placed at mid-depth of the slab result in longer transverse crack spacing, which increases warping stresses. The increased warping stresses in concrete induce horizontal cracking at the steel depth, and wheel loading applications in this area cause segmentation of the upper half of concrete slabs, resulting in serious distresses. This project shall investigate the mechanism of this distress type, and develop optimum steel designs. The investigation shall consist of evaluating structural responses of CRCP through theoretical analyses as well as field experiments where various steel designs (different steel depths for one-mat and configurations for two-mat) are employed. The results of data analyses from both mechanistic analyses and field experiments will be used to develop optimum steel designs in CRCP.

Total Project Budget	Research University	FY 2020 Budget
$501,031.00	Center for Multidisciplinary Research in Transportation, Texas Tech University	$177,989.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Moon Won, TECH

Project Advisor	Organization
Andy Naranjo	MTD
Pan Gil Choi	MTD
Rachel Cano	MTD
Roberto Trevino Flores	MNT

0-7027-Accelerating Mix Designs for Base Materials

Start Date: 7/10/2019 **End Date: 10/31/2021**

Project Description

Stabilization of roadway or stockpile materials allows for enhancing strength and stiffness properties of pavement base layers as well as the meeting of structural requirements in a cost-effective and sustainable manner. Historically, stabilization mixture design criteria relied on compressive strength results and, depending on the treatment and test method, could take nearly a month to complete. Additionally, the different treatments currently require different preparation, curing, and acceptance criteria. This project will develop a harmonized, accelerated design procedure for base materials, with the objective of producing an acceptable design recommendation within seven (7) days. This project will include stabilizer types such as cement, lime, lime-fly-ash, asphalt emulsion, and foamed asphalt, and will focus on rapid test turnaround time, lab curing techniques to rapidly simulate cured field conditions, inclusion of moisture susceptibility in the mix design, and performance-related design criteria. This project will develop recommended harmonized test procedures, suggested specification modifications as applicable, and will include performance of training workshops.

Total Project Budget	Research University	FY 2020 Budget
$381,164.00	Texas A&M Transportation Institute	$161,535.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Stephen Sebesta, TTI

Project Advisor	Organization
Antonio Reyna Jr	LRD
James Robbins	BRY
Richard Izzo	MTD
Roberto Trevino Flores	MNT

0-7028-Determine the Effectiveness of TxDOT's HMA QCQA Bonus Penalty Specification as it Relates to Long-term Performance

Start Date: 9/1/2019 **End Date: 11/30/2021**

Project Description

As part of its quality control and quality assurance (QC/QA) process, Receiving Agency maintains pavement-related data in several databases: mixture design and QC/QA data in SiteManager (SMGR), construction, bid, and project related information in the Design and Construction Information System (DCIS), pavement performance history in the Pavement Management Information System (PMIS), and maintenance activities in Compass or Maintenance Management Information System (MMIS). Even though a significant amount of data and information are available in these databases, the relational effect of material design factors and QC/QA efforts on the long-term project performance is not well understood. The primary objective of this project is to investigate the relationship between the Receiving Agency's material design specifications, QC/QA effort and long-term pavement performance. The Performing Agency shall first extract relevant data from the Receiving Agency databases and integrate them into an efficient internal working database for conducting analyses on this research. Various data analysis techniques shall be employed to explore relationships between the construction records and pavement performance. Findings from the data analysis shall be validated through site visits and discussions with local experts from the Receiving Agency. Finally, recommendations and modifications shall be developed and provided, so that the Receiving Agency can improve its existing construction practices.

Total Project Budget	Research University	FY 2020 Budget
$367,510.80	Center for Transportation Research, The University of Texas at Austin	$166,148.34

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Zhanmin Zhang, CTR

Project Advisor	Organization
Andre Smit	MTD
Enad Mahmoud	MTD
Jorge Hernandez	MNT
Ryan Barborak	MTD
Sarah Horner	FTW
Travis Patton	MTD

0-7031-Develop Efficient Prediction Model of Highway Friction on an Annual Basis on Texas Network

Start Date: 9/27/2019 **End Date: 12/31/2021**

Project Description

Texas roads see a significant number of wet-weather crashes; therefore, ensuring adequate skid resistance (skid number) is of utmost importance for public safety. Recent laser technology allows quick, efficient, and high-resolution skid resistance measurement. However, contractors collect macrotexture only in terms of mean profile depth—a poor predictor of skid. Consequently, Receiving Agency personnel have to collect the additional skid data necessary, covering about 33% of the network on an annual basis (approximately 50% of the Interstate System and 25% of the non-Interstate system). This project shall develop an instrument that can collect high-resolution surface profiles to determine macrotexture and microtexture under different conditions and on different surface types. This information will be used to develop equations for predicting friction and skid numbers, with a high degree of accuracy. This instrument will be able to collect data at highway speed, allowing accurate texture data collection on the entire network, on an annual basis. Because this instrument will be small enough to attach to any surveying vehicle, texture data can be collected as part of other operations, eliminating the need for an independent data collection effort. The resulting process will not only provide savings; it will also enhance operational safety.

Total Project Budget	Research University	FY 2020 Budget
$348,740.00	Center for Transportation Research, The University of Texas at Austin	$173,940.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Jorge Prozzi, CTR

Project Advisor	Organization
Andre Smit	MTD
Enad Mahmoud	MTD
Feng Hong	MNT
Hui Wu	AUS
Jenny Li	MNT

0-7060-Measuring Faulting on Jointed Concrete Pavements

Start Date: 12/17/2019 **End Date: 8/31/2022**

Project Description

On an annual basis, the Receiving Agency collects most of its required distress information through a contracted vendor. However, faulting, one of the essential distresses, is estimated from longitudinal profile data, which is neither reliable nor accurate enough for establishing performance measures. Recent reforms enacted by MAP-21 (Moving Ahead for Progress in the 21st Century Act) include transitioning to a performance-based program, including establishing national performance goals for Federal-aid highway programs. The FAST Act (Fixing America's Surface Transportation Act) continues this performance management approach, within which states invest resources in projects that will collectively make progress toward national goals. The FAST Act shortens the timeframe for states and metropolitan planning organizations to make progress toward meeting performance targets under the National Highway Performance Program and clarifies the significant progress timeline for the Highway Safety Improvement Program performance targets. It is under this framework that the Performing Agency shall develop a reliable measurement system to identify, measure, and calculate faulting on all jointed concrete pavements (JCP). In particular, this project seeks to develop a system that collects and verifies faulting data of JCP accurately, at highway speeds, during daylight conditions. This project shall deliver end products to meet a TRL (Technology Readiness Level) 8.

Total Project Budget	Research University	FY 2020 Budget
$499,769.03	Center for Transportation Research, The University of Texas at Austin	$119,363.65

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Jorge Prozzi, CTR

Project Advisor	Organization
Jenny Li	MNT
Todd Copenhaver	MNT
Wade Blackmon	PAR

0-7061-Optimizing Laboratory Curing Conditions for Hot Mix Asphalt to Better Simulate Field Behavior

Start Date: 12/9/2019 **End Date: 1/31/2023**

Project Description

The Performing Agencies shall 1) investigate existing and novel laboratory methods to determine protocols simulating the two critical aging states needed to design an asphalt mixture that will resist rutting and cracking, and 2) provide information on how curing effects the physical and engineering performance of binders and mixtures. The Performing Agencies shall provide findings that can be used to cure asphalt mixtures as their rutting and cracking resistance is being evaluated, as a part of a mix design process (e.g., as in the case of a balanced mix design).

Total Project Budget	Research University	FY 2020 Budget
$900,499.00	Center for Transportation Research, The University of Texas at Austin	$104,161.05
	The University of Texas at El Paso	$101,000.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Soheil Nazarian, CTR

Project Advisor	Organization
Travis Patton	MTD
Ryan Barborak	MTD
Enad Mahmoud	MTD
Gisel Carrasco	AUS
Lacy Peters	ATL
Alejandro Miramontes	AUS

0-7062-Synthesis for Quantification of Binder Availability in Recycled Materials

Start Date: 11/1/2019 End Date: 10/31/2020

Project Description

Increasing recycled materials content in asphalt mixtures provides economic and environmental benefits; but, each unique materials combination of virgin and recycled materials and additives must be engineered to ensure adequate performance and proper selection of component materials, balanced proportioning, and consideration of recycled binder availability. The design of mixtures with recycled materials often assumes that 100 percent of the recycled binder is available to blend with the virgin binder, and the virgin binder content is reduced accordingly. In reality, when recycled binder availability is less than 100 percent for heavily aged materials, total binder contents are less than optimum from mix design, resulting in dry mixtures with insufficient coating, inadequate durability and cracking performance. Additionally, recycled binder availability can be utilized to assess aging state and preclude the use of large quantities of materials with stiff, brittle binders that contribute negatively to performance, even if available. The Performing Agency shall address these concerns and revise the Receiving Agency's Standard and/or Special Specifications to incorporate recycled binder availability as part of mix design. It will also revise the allowable maximum recycled binder ratio (RBR) limits, as appropriate, in a synthesis project based only on literature and available data.

Total Project Budget	Research University	FY 2020 Budget
$64,988.00	Texas A&M Transportation Institute	$59,966.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Amy Epps Martin, TTI

Project Advisor	Organization
Cathey Galbreath	SJT
Ryan Barborak	MTD
Stephen Kasberg	WAC
Travis Patton	MTD

0-7064-Use of Tamper Bar Paver to Place Thick Lift Asphalt Concrete Pavement (ACP)

Start Date: 12/6/2019 **End Date: 1/31/2022**

Project Description

Asphalt concrete placement specifications have maximum allowable lift thicknesses to ensure adequate mixture compaction. When the design thickness exceeds this limit, placement must be phased in multiple lifts, creating other problems:

A) Increased construction time, traffic exposure, and traffic disruption.

B) Potentially worse performance from poor stiffness/bonding at the lift interface.

In 2018, an Atlanta District contractor experimented with a tamper bar paver for single-lift placement of Superpave Type C at four (4) to six (6) inches thick. Both the top and bottom of the lift had acceptable air void contents.

Further study of tamper bar pavers for thick-lift construction is warranted. The Performing Agency shall: 1) Review the literature for performance of tamper bar pavers in thick-lift placement and recommended maximum lift-thicknesses. 2) Develop a field-based testing plan that considers different construction scenarios, paver types, number of lifts, total thickness, tamper bar settings, and roller patterns. 3) Construct test sections and evaluate in-place air voids with traditional methods and innovative methods like full-coverage Ground Penetrating Radar (GPR)-based density testing and Computed Tomography (CT) X-ray scanning. Also evaluate pavement profile roughness, stiffness and cracking performance of cores. 4) Statistically analyze the data. 5) Develop guidelines for the use of tamper bar pavers, highlighting best practices and limitations.

Total Project Budget	Research University	FY 2020 Budget
$301,657.00	Texas A&M Transportation Institute	$116,422.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Bryan Wilson, TTI

Project Advisor	Organization
Enad Mahnoud	MTD
Kevin Plumlee	AUS
Ray Brady	ATL
Ryan Barborak	MTD
Travis Patton	MTD

5-4829-05-Implementation of Geosynthetic-stabilized Roadways for Base Course Reduction: Field Monitoring and Design Recommendations

Start Date: 5/2/2018 **End Date: 8/31/2021**

Project Description

The Performing Agency shall conduct this implementation project, supporting the ongoing reconstruction of segments of IH10 near San Antonio. The Receiving Agency shall use geogrid stabilization to aid in design of roadway sections, allowing for reduced base course thickness. The Performing Agency shall support the design, construction, monitoring and data interpretation of pavement test sections to be constructed in IH10, using multiple geogrid products.

Total Project Budget	Research University	FY 2020 Budget
$571,833.57	Center for Transportation Research, The University of Texas at Austin	$106,777.12

Project Manager	Research Supervisor
Chris Glancy, RTI	Jorge Zornberg, CTR

Project Advisor	Organization
Andres Gonzalez	SAT
Gisel Carrasco	AUS
Miguel Arellano	AUS
Miles Garrison	MTD
Richard Izzo	MTD
Seve Sisneros	LBB

5-6674-01-Statewide Implementation of New Binder Selection Catalog and New Binder Performance Tests

Start Date: 6/18/2019 **End Date: 10/31/2021**

Project Description

The Performing Agency shall assist Receiving Agency with implementing the new binder selection catalog, developed in research project 0-6674-01, and expanding the existing statewide binder properties database with new binder performance tests. The Performing Agency shall implement the new binder selection catalog in five (5) Receiving Agency Districts, including, but not limited to Amarillo, Dallas, Austin, Bryan, and Paris. In each Receiving Agency District, the Performing Agency shall work with Receiving Agency District design engineers and laboratory staff to design a mix with the binders in the new catalog and construct and monitor selected test sections in each Receiving Agency District. The Performing Agency shall then use the data generated in these test sections to develop and teach implementation workshops for Receiving Agency District design engineers, in a minimum of five (5) Receiving Agency Districts. The Performing Agency shall present the results at the Receiving Agency's annual Construction Conference or Short Course.

Total Project Budget	Research University	FY 2020 Budget
$425,000.00	Texas A&M Transportation Institute	$190,000.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Fujie Zhou, TTI

Project Advisor	Organization
Arash Motamed	MTD
Enad Mahmoud	MTD
Gisel Carrasco	AUS

5-6679-01-Implementation of Performance Life of Various HMA Mixes in Texas

Start Date: 3/9/2018 **End Date: 2/28/2021**

Project Description

Pavement engineers in Texas subjectively estimate the service lives of various hot-mix asphalt (HMA) mixtures as part of the life-cycle cost analysis, considering the staged design and rehabilitation of flexible pavements. In project 0-6679, *Performance Life of Various HMA Mixes in Texas*, which ended on August 31, 2014, the Performing Agency recommended the performance lives for various dense-graded (conventional) mixtures, stone-matrix asphalts (SMA), permeable friction courses (PFC), performance design mixtures, and other mixtures placed in Texas. A necessary and significant aspect of the approach involved data mining and merging several pavement management databases - i.e., Letting Database, Design and Construction Information System (DCIS), and Pavement Management Information System (PMIS) - to obtain mixture longevity data, along with historical PMIS information. The merged database resulted in the development of an online-tool, Performance Life of Mixes in Texas (PERMIT). The longevity data obtained from PERMIT allowed for estimating the probabilistic performance lives of the HMA mixtures through an integrated survivability analysis that considers the historical longevity of mix types, the age of the HMA surface course, distress history-based life predictions, and Receiving Agency personnel perceived service lives. The Performing Agency shall expand PERMIT by incorporating the statewide Site Manager construction data into it. The Performing Agency shall also focus on training the Receiving Agency Construction Division and the Receiving Agency district personnel on how to properly use PERMIT to monitor the performance of different mixes, as well as compare their performance with similar mixes, regionally to statewide.

Total Project Budget	Research University	FY 2020 Budget
$329,500.00	The University of Texas at El Paso	$125,000.00

Project Manager	Research Supervisor
Wade Odell, RTI	Matthew Yarnold, UTEP

Project Advisor	Organization
Jenny Li	MNT
Enad Mahmoud	MTD
Travis Patton	MTD
Ryan Barborak	MTD
Gisel Carrasco	AUS
Melissa Benavides	AUS

5-6815-01-Implementation of Improved Overlay Tester for Fatigue Cracking Resistance of Asphalt Mixtures

Start Date: 5/23/2017 **End Date: 8/31/2020**

Project Description

The goals of this implementation project are 1) to assess the effectiveness of an alternative data analysis methodology proposed for overlay tester (OT) by the Performing Agency that considers two parameters to quantify AC mixes, critical fracture energy and crack progression rate and 2) to establish specifications and guidelines for designing AC mixes with reproducible cracking potential that can be successfully utilized by the District personnel of the Receiving Agency. In this project, the Performing Agency shall address the following technical objectives: 1. Provide assistance and training to Receiving Agency personnel for the proper use of the proposed OT test methodology and corresponding specifications in the laboratory setting. 2. Improve specifications for the proper use of AC mixes in flexible pavements based on their cracking properties. 3. Demonstrate the potential of the alternative data analysis methodology proposed under Project 0-6815 *"Improved Overlay Tester for Fatigue Cracking Resistance of Asphalt Mixtures",* which concluded on June 30, 2016, for balanced mix design, along with the Hamburg wheel tracking (HWT) test results. 4. Assess the impact that different mix-design parameters such as aggregate type, aggregate gradation, asphalt binder content and performance grade (PG), recycled material content, and additives may have on the performance indices, critical fracture energy and crack progression rate, proposed in Project 0-6815. 5. Gather field performance data to correlate the lab and field cracking life of AC mixtures and establish limits of acceptable cracking properties using the OT performance indices proposed in Project 0-6815. 6. Generate guidelines to improve the cracking resistance of underperforming AC mixes based on the influence of AC mix-design parameters.

Total Project Budget	Research University	FY 2020 Budget
$591,500.00	The University of Texas at El Paso	$175,000.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Matthew Yarnold, UTEP

Project Advisor	Organization
Enad Mahmoud	MTD
Gisel Carrasco	AUS
Ryan Barborak	MTD
Travis Patton	MTD

5-6839-01-Implementation of Pavement Rehabilitation and Design Strategy for Heavy Loads in Energy Development Areas

Start Date: 5/6/2019 **End Date: 8/31/2021**

Project Description

The Performing Agency shall assist the Receiving Agency's Pavement Analysis and Design Branch, providing support to Receiving Agency Districts that are requiring pavement designs in areas known to experience a high volume of overloaded trucks. The Performing Agency shall perform the following support activities - 1) Compare the advanced design recommendations with those obtained using traditional methods (FPS21) and 2) Complete at least five (5) projects for various impacted Receiving Agency Districts around Texas, including, but not limited to, Laredo, Corpus Christi, Odessa and Austin. In each of the needed designs, the Performing Agency shall use realistic load spectra along with advanced materials characterization data as well as performance prediction models, developed and partially validated in the research studies. The Performing Agency shall use the data generated in the five (5) projects to develop and teach implementation workshops for Receiving Agency District designers. The Performing Agency shall teach training schools in a minimum of four (4) Districts and have the results readily available for presentation at the Receiving Agency Annual Construction and Maintenance Conferences.

Total Project Budget	Research University	FY 2020 Budget
$300,000.00	Texas A&M Transportation Institute	$145,000.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Fujie Zhou, TTI

Project Advisor	Organization
Andres Gonzalez	SAT
Andy Naranjo	MTD
Antonio Reyna Jr	LRD
Diana Rogerio	SAT
Eduardo Deleon	LRD
Miguel Arellano	AUS
Ramon Rodriguez	LRD
Roberto Trevino Flores	MNT

5-6910-01-Implementation of Concrete Overlay Evaluation and Design

Start Date: 5/21/2019 **End Date: 8/31/2021**

Project Description

The primary tasks in this implementation project are to train Receiving Agency Staff (1) to evaluate existing Portland Cement Concrete (PCC) pavements and develop appropriate optimum overlay strategies and (2) to conduct early-age performance evaluations of PCC overlays. This implementation project also includes the development of training materials and other documents that shall be used to modify the PCC overlay portion of TxDOT Pavement Manual. The Receiving Agency has many miles of concrete pavement that have already passed or are approaching the end of their design lives, and will require some form of rehabilitation in the near future. The PCC overlay design program developed under previous research project #0-6910, represents significant improvements over existing PCC overlay design programs, primarily because the new program is based on the "mechanistic" condition of the existing pavement, not "visual condition" of the pavement. The findings from this implementation project shall help the Receiving Agency in deploying cost-effective, pavement rehabilitation programs.

Total Project Budget	Research University	FY 2020 Budget
$148,168.25	Center for Multidisciplinary Research in Transportation, Texas Tech University	$58,646.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Moon Won, TECH

Project Advisor	Organization
Andy Naranjo	MTD
Pan Gil Choi	MTD
Rachel Cano	MTD
Ryan Phillips	MNT
Wade Blackmon	PAR

5-6925-01-Implementation of Improved Performance Grade (PG) of Asphalt Binders

Start Date: 9/1/2019 **End Date: 8/31/2021**

Project Description

The Performance Agency shall work with the Materials and Test Division of the Receiving Agency to sample and test binders from several different existing road sections (across the state) that have been in service for a few years. The Performing Agency shall also provide assistance to the Receiving Agency in terms of identifying appropriate test equipment, demonstrating the method and assisting lab technicians with running the test in the long-term, as needed. Lastly, the Performing Agency shall provide spreadsheets that facilitate analysis of test data to obtain parameters of interest.

Total Project Budget	Research University	FY 2020 Budget
$262,470.00	Center for Transportation Research, The University of Texas at Austin	$127,379.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Amit Bhasin, CTR

Project Advisor	Organization
Carmen Inglehart	MTD
Enad Mahmoud	MTD
Roberto Trevino Flores	MNT
Ryan Barborak	MTD
Terry Sepulveda	MTD
Travis Patton	MTD

5-6940-01-Implementation of Portable Weigh-In-Motion (WIM) Technology on Texas Highways

Start Date: 4/19/2019 **End Date: 3/21/2021**

Project Description

Due to high costs, there are a limited number of permanent weigh-in-motion (WIM) stations on the Texas highway network, mostly located on interstate highways. As such, it is not feasible to generate accurate load spectra data required for every highway project, other than relying on antiquated estimates, even for the 18-kip equivalent single axle loads (ESALs) used in Flexible Pavement System (FPS) designs. The net result is unoptimized designs or poor performing pavement structures with increased maintenance costs or high construction costs, due to over-designing with high overall life cycle costs. Successful statewide implementation and calibration of the mechanistic-empirically (M-E) pavement design methods are also highly dependent on the availability of accurate axle load spectra data, highlighting the need for rapid quantification of accurate site-specific traffic data. At a fraction of the cost of permanent WIMs, the portable WIM technology offers a practical alternative or supplemental, cost-effective tool to measure and quantify traffic loading (i.e., volume counts, vehicle class distribution, speed, vehicle weights, ESALs, FPS/M-E inputs) for any given highway site. In research project 0-6940, *Develop Systems to Render Mechanistic-Empirical Traffic Data for Pavement Design*, portable WIM technology was successfully explored and demonstrated to accurately measure and collect site-specific traffic data for pavement designs and maintenance or rehabilitation (M/R) purposes, in the following Receiving Agency Districts: Brownwood, Bryan, Corpus Christi, Fort Worth, Laredo, and Odessa.

Total Project Budget	Research University	FY 2020 Budget
$275,316.00	Texas A&M Transportation Institute	$160,254.00

Project Manager	Research Supervisor
Wade Odell, RTI	Lubinda Walubita, TTI

Project Advisor	Organization
Enad Mahmoud	MTD
Gisel Carrasco	AUS
Lacy Peters	ATL

5-6963-01-Implementation of Seal Coat Binder Rate Adjustments Using LiDAR Data

Start Date: 5/7/2019 **End Date: 4/30/2021**

Project Description

Seal coats, used throughout Texas, are a very important preventive maintenance method. Through the preventive maintenance program, about 16,000 lane miles a year are routinely resurfaced with a seal coat by contracts, and about 3,000 lane miles per year of seal coats are placed with state forces. Additionally, seal coats are used in intermediate layers during construction to seal the pavement structure, which is a significant investment of over $300 million annually. For more than 40 years, there has been little change in the design and construction practices, including equipment, used to place the binder or aggregate. Because of this, Texas continues to see the same problems reoccurring, such as rock loss, flushing and bleeding. New technologies are being developed, which could potentially reduce these types of problems. Recently completed research project 0-6963, *Planning the Next Generation of Seal Coat Equipment*, found that the mobile LiDAR system shows much promise for removing a significant amount of subjectivity when determining variations in surface conditions. Identification of the surface conditions is needed in order to adjust the seal coat binder rates during construction, as the conditions change. The objective of this implementation project is to remove subjectivity from the rate adjustment process, which will lead to reduced risk for the Receiving Agency. The Performing Agency shall use LiDAR reflectivity data to describe pavement condition changes through an efficient and effective automated data analysis method. The Performing Agency shall review the projects identified in research project 0-6963 and work with the Bryan District on six projects for the summer 2019 seal coat, to identify pavement condition changes and binder rate adjustments. For the 2020 seal coat projects, the Performing Agency shall work with the Bryan District and two additional districts (either Waco, Brownwood, Lufkin or Tyler) to select five projects each. The Performing Agency shall collect data on the selected locations, apply the algorithm, and provide the district with suggested application rate adjustments.

Total Project Budget	Research University	FY 2020 Budget
$216,517.00	Texas A&M Transportation Institute	$132,500.00

Project Manager	Research Supervisor
Wade Odell, RTI	Darlene Goehl, TTI

Project Advisor	Organization
Mallory Donovan	WAC
Erik Lykins	BWD
James Robbins	BRY
Jenny Li	AUS

Projects by Functional Area Committees
Planning and Environmental

Project	Title	Start Date	Page
0-6804	Life Cycle Cost and Performance of Lightweight Noise Barrier Materials Along Bridge Structures	1/29/2013	47
0-6837-03	Assessment of Innovative and Automated Freight Systems and Development of Evaluation Tools - Phase III	6/13/2019	48
0-6970	Daily and Seasonal Movements of Brown Pelicans in the Bahía Grande Wetland Complex	9/1/2017	49
0-6973	Predictive Mapping of Potentially Listed Rare Plant Species	6/6/2018	50
0-6983	North Texas Bicycle and Pedestrian Crash Analysis	9/1/2018	51
0-7014	Sequencing and Placement of Noise Walls and Retaining Walls on Complex TxDOT Projects	11/1/2019	52
0-7022	Evaluating Fall Monarch Butterfly Roadkill Hotspot Incidence and Potential Roadkill Mitigation	7/31/2019	53
0-7023	Determining Downstream Ecological Impacts of Sediment Derived from Bridge Construction	9/1/2019	54
0-7024	Assessing Ozone Impacts on Electric Vehicle (EV) Adoption in Texas	11/1/2019	55
0-7053	Quantify the Valuation of Right-of-Way	11/1/2019	56
0-7063	Guidance for the Use of UAS During Suboptimal Environmental Conditions	1/3/2020	57
0-7066	Developing a Small Airport Economic Impact Estimator	11/1/2019	58
5-6665-01	Native Grassland Implementation	9/1/2018	59
5-6865-01	Evaluating the Efficacy of Mussel Relocation in Texas with In-Situ Field Studies and the Development of a Texas Mussel Database	3/7/2017	60

*Note: In the following Project Descriptions, the Receiving Agency is TxDOT and the Performing Agency is the University conducting the research.

Planning and Environmental Projects

0-6804-Life Cycle Cost and Performance of Lightweight Noise Barrier Materials Along Bridge Structures

Start Date: 1/29/2013 End Date: 8/31/2020

Project Description

The site of this study is on elevated eastbound sections of IH-30, west of downtown Dallas. They are located north of the Kessler Park Neighborhood where the CTR team conducted a major sound project in 2010/2011, on westbound sections of an extensive retaining wall.

Two locations in the Dallas District are segments between Sylvan Avenue and Edgefield Avenue, with an approximate length of 2,500 ft., possessing a concrete sound wall approximately 8-ft. in height. The second segment is from Sylvan Avenue to Beckley Avenue, which has a traditional safety barrier rather than a dedicated concrete reflective sound wall and is approximately 4,000-ft. long. The research team shall evaluate the performance of a light-weight traffic noise wall for both sections, which will extend the height of the existing walls, both attenuating sound propagation and blocking the current line of sight from the adjacent neighborhood to the highway.

The CTR team shall conduct a feasibility study, using Dallas District staff and industry contacts. This study will develop the comprehensive work plan needed to answer the issues raised and identify research components, integrating the research activities with the sound wall bidding, construction and related maintenance activities (which will be managed separately by the Dallas District). The subsequent study will capture sound measurements and life cycle impacts at key locations, before and after construction of the project's lightweight sound walls.

Total Project Budget	Research University	FY 2020 Budget
$783,649.00	Center for Transportation Research, The University of Texas at Austin	$133,518.00

Project Manager	Research Supervisor
Wade Odell, RTI	Manuel Trevino, CTR

Project Advisor	Organization
Ray Umscheid	ENV
Dan Perge	DAL
Daniel Salazar	DAL
Sandra Williams	DAL

0-6837-03-Assessment of Innovative and Automated Freight Systems and Development of Evaluation Tools - Phase III

Start Date: 6/13/2019 **End Date: 8/31/2022**

Project Description

In research project 0-6837 (Phase I), the Performing Agency conducted a comprehensive review of innovative and automated freight strategies and technologies (S/T) used, worldwide. The Performing Agency initially identified a total of 57 different S/T from this review. In consultation with the Receiving Agency, the Performing Agency selected nine S/T areas, that could improve future freight distribution in Texas, to advance to research project 0-6837-01 (Phase II). In Phase II, the Performing Agency conducted an analysis which used the Systematic Technology Reconnaissance, Evaluation, and Adoption Methodology (STREAM) process from National Cooperative Highway Research Program Report 750, Volume 3, to evaluate each S/T's effectiveness. In Project 0-6837-03 (Phase III), the Performing Agency shall evaluate innovative strategic freight operational changes and technology applications, recommended by the Receiving Agency at the conclusion of Phase II, to ensure continued timely flow of commercial freight through the Texas transportation system. Phase III was planned to consist of seven distinctive project activities, based upon the results of Phases I & II of the project. The activities advanced for Phase III research were selected by the Receiving Agency, and address four of the nine freight S/T areas that were examined during Phase II. The selected S/T areas are: 1) Port Area Intelligent Transportation Systems (ITS) 2) Separation of Trucks from Automobiles/Truck-Only Infrastructure 3) Truck Parking Information 4) Border Advanced Traveler Information. Multiple Port Area ITS-related activities were chosen while the other three S/T areas produced one activity each. Phase III examines freight traffic changes near seaports after ITS equipment implementation, communication of rail blockages at a port entrance to approaching trucks, modeling of truck-only lane impacts within a major freight corridor, truck parking-related sensing and communication at existing Receiving Agency rest areas, and border crossing enhancement, through coordinated information exchange. Each Phase III activity furthers implementation goals of the Texas Freight Mobility Plan (TFMP).

Total Project Budget	Research University	FY 2020 Budget
$2,331,767.00	Texas A&M Transportation Institute	$796,868.00

Project Manager	Research Supervisor
Wade Odell, RTI	Curtis Morgan, TTI

Project Advisor	Organization
Loretta Brown	TPP
Chad Coburn	RRD
Tricia Hasan	MRD
Caroline Mays	TPP

0-6970-Daily and Seasonal Movements of Brown Pelicans in the Bahía Grande Wetland Complex

Start Date: 9/1/2017 **End Date: 6/30/2020**

Project Description

This project deals with the collection of data, to understand and therefore predict, the movements of Brown Pelicans in the Bahía Grande Wetland Complex, Texas. The goal of the project is to deliver data and models that the Receiving Agency will use for predicting and mitigating pelican mortality events, associated with roadways in the region. The Performing Agency shall conduct data collection and develop a model using a strong conceptual framework of pelican mortality risk. This framework involves breaking down the problem into: a) the frequency with which pelicans cross or interact with local roads and bridges; and b) existing, ongoing work that describes the likelihood that mortality events shall occur at specific sites because of bridge/road design and weather events. To accomplish this, the Performing Agency, along with local ornithologists, U.S. Fish and Wildlife Service personnel, scientists, and other interested parties shall capture, band, collect physiological/morphological data, and attach Global Positioning System (GPS) trackers, to the birds. The GPS tracking system shall enable the Performing Agency to track individual birds in the region with high resolution; while a distributed citizen science monitoring program shall assemble a complementary database of broader scale pelican activity and movement. The data collection efforts shall be driven by wildlife ecologists specializing in seabird ecology, physiology, and population dynamics. The complimentary data collection methods, undertaken over a two-year period, shall provide high-quality data essential for the development of quantitative pelican mortality risk models. The Performing Agency shall develop these risk models which will be useful for predicting current and future pelican mortality, and therefore for developing novel, cost-effective solutions that will reduce pelican-road mortality incidents in the region.

Total Project Budget	Research University	FY 2020 Budget
$490,441.00	Texas A&M Transportation Institute	$148,315.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Andrew Birt, TTI

Project Advisor	Organization
Edward Paradise Jr	PHR
John Maresh	ENV
John Young Jr	ENV
Kenneth Mora	DES
Robin Gelston	PHR
Stirling Robertson	ENV

0-6973-Predictive Mapping of Potentially Listed Rare Plant Species

Start Date: 6/6/2018 **End Date: 10/31/2021**

Project Description

Predictive models for spatial distributions have been effective tools for managing a variety of organisms that respond to various environmental factors. However, predicting distribution of rare plant species has been formidable for several reasons, including 1) Paucity of data on presence; 2) Lack of data on "true absence"; 3) Paucity of data in general for each species; 4) Issues associated with the accuracy of available data, and; 5) Challenges in identifying predictive models to predict spatial distribution, given the circumstances mentioned above. The Performing Agency shall collate data on 17 identified rare plant species in Texas from multiple sources, including databases, herbarium collections, and citizen science data. It will aggregate the data within the defined grid units across Texas, identify environmental predictors that may explain species distributions, and adopt appropriate statistical predictive models, pertaining to rare plant species spatial distribution. This project shall compare the models, based on ecological niche factor analysis, generalized linear models (GLM) with pseudo absences, ordination techniques such as the Principal Component Analysis (PCA) or the canonical counterpart of the PCA, or other available techniques, depending on the data obtained on the candidate species, to develop the most appropriate predictive spatial distribution models for all of the candidate rare plant species.

Total Project Budget	Research University	FY 2020 Budget
$322,051.12	Tarleton State University	$125,422.55

Project Manager	Research Supervisor
Chris Glancy, RTI	Hemanta Kafley, TARL

Project Advisor	Organization
Andrew Blair	AUS
Becki Perkins	SJT
John Moravec	BRY
Mark Fisher	ENV
Matt Buckingham	LFK

0-6983-North Texas Bicycle and Pedestrian Crash Analysis

Start Date: 9/1/2018 **End Date: 8/31/2020**

Project Description

The scope of this project involves a holistic investigation of the causes of pedestrian and bicycle crashes in the 12-county North Central Texas area. An extensive review of literature will be carried out to assess the state-of-art knowledge in crash reporting and analysis, safety countermeasures, safety target setting, crash databases and tools. Five years of North Central Texas crash data from TxDOT's Crash Records Information System (CRIS) and Texas Peace Officer's Crash Reports (Form CR-3) will be coded according to the FHWA's Pedestrian and Bicycle Crash Analysis Tool (PBCAT) methodology. Other existing and readily available databases will be considered for supporting information, to gain a better understanding of why crashes happened. Geospatial statistical modelling will be employed to determine the unsafe actions and conditions contributing to crashes, and to identify high-incidence crash corridors within the study area. A comprehensive list of countermeasures will be assembled, detailing the effectiveness of each countermeasure for each evaluated crash type and crash attribute. A pilot version of an on-line application will be developed, in order to visually present the results of this project and to communicate safety needs in North Central Texas.

Total Project Budget	Research University	FY 2020 Budget
$249,500.00	The University of Texas at El Paso	$106,055.00
	Texas A&M AgriLife Research	$19,945.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Marketa Vavrova, UTEP

Project Advisor	Organization
Bonnie Sherman	PTN
Bradley Peikert	BRY
Cary Karnstadt	TPP
Dustin Wiggins	TRF
Mark Poage	BRY
Noah Heath	PTN
Phillip Hays	FTW
Tamara Gart	TRF
Tonya Wiley	ATL

0-7014-Sequencing and Placement of Noise Walls and Retaining Walls on Complex TxDOT Projects

Start Date: 11/1/2019 **End Date: 1/31/2021**

Project Description

Difficulties arise when constructing noise walls and retaining walls, due to conflicts with utilities, construction phasing conflicts, and inadequate access. Design manuals and design guides from the Receiving Agency and various other Department of Transportations (DOTs) around the United States mention items to consider during design. These manuals mention utilities and other aspects of construction as potential issues when designing noise and retaining walls, but fail to provide details about how to avoid or address these issues. The purpose of the research is to provide guidance on the sequencing and placement of noise walls and sound walls for complex projects. The research includes examining issues such as noise and retaining wall selection, standards and specifications, preferred methods and best practices for sequencing and placement, and design and construction procedures. In addition to the report, the deliverables of the research include a guidebook for the sequencing and placement of design features as well as recommendations for additions to the Receiving Agency manuals.

Total Project Budget	Research University	FY 2020 Budget
$250,000.00	Texas A&M Transportation Institute	$137,841.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Kris Harbin, TTI

Project Advisor	Organization
Christen Longoria	SAT
Danny Gallegos	SAT
Fernando Flores	SAT
Jeffrey Bush	DAL
Morgan Neill	DAL
Ray Umscheid	ENV
Susana Ceballos	AUS

0-7022-Evaluating Fall Monarch Butterfly Roadkill Hotspot Incidence and Potential Roadkill Mitigation

Start Date: 7/31/2019 **End Date: 8/31/2021**

Project Description

The monarch butterfly (Danaus plexippus) was petitioned for protection under the federal Endangered Species Act in 2014. The listing decision is pending. This action was triggered by the observation that overwintering populations of the eastern migrating monarchs in central Mexico had declined by 82 percent in the 23 years from 1995 to 2018. This rate of decline is compelling evidence that monarch populations have been reduced to the point where persistence of the migratory phenomenon is endangered. Recent research identified that roadkill mortality occurring on Texas roadways is a major mortality factor associated with both the coastal and central flyways used in migration through Texas to the overwintering sites in Mexico. Migrating monarch become more concentrated as they travel south, amplifying the effects of roadkill on populations. Mortality occurs in hotspots associated with landscape and infrastructure features of Texas roadways. Accordingly, this project shall identify hotspot locations, zones, and regions for monarch roadkill mortality and investigate mitigation actions that could be implemented and reduce monarch/vehicle collisions. To accomplish this goal, the Performing Agencies shall conduct research surveys that will enable them to identify hotspot locations, correlate hotspot locations with environmental and road infrastructure features, develop maps of roadkill mortality over major Texas highways, and evaluate potential mitigation options.

Total Project Budget	Research University	FY 2020 Budget
$348,294.75	Texas A&M AgriLife Research	$112,227.50
	Texas A&M Transportation Institute	$50,395.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Robert Coulson, TAR

Project Advisor	Organization
Becki Perkins	SJT
Chris Kloss	LRD
Holly Brady	ODA
Jane Lundquist	DES
John Maresh	ENV
Stirling Robertson	ENV
Travis Jez	MNT

0-7023-Determining Downstream Ecological Impacts of Sediment Derived from Bridge Construction

Start Date: 9/1/2019 **End Date: 11/30/2021**

Project Description

Sediment release from bridge construction may change the sediment regime of the receiving streams, causing habitat degradation downstream of bridges. One of TxDOT's responsibilities is to address potential effects of sediment release on aquatic species listed under the federal Endangered Species Act. As sedentary, bottom-dwelling filter feeders, mussels are susceptible to habitat destabilization activities such as bridge construction. Several Texas freshwater mussel species are expected to be added to the list of the U.S. Endangered Species Act. To date, guidelines for determining the areas within streams that are likely to be impacted by bridge construction are not well supported by empirical data. Nor is a predictive model available to quantify such effects, and provide information required for habitat suitability assessment. The Performing Agencies shall develop a predictive tool and validate its performance in the field. The objectives of this project are to: 1) develop a predictive model that can be used to estimate the quantity, size, and accumulation depths of sediment derived from bridge construction; 2) evaluate the model predictions of a bridge construction site by collecting field data; 3) obtain the FHWA Technology Readiness Level 7; and 4) create educational materials, user manuals, and demonstrative videos, to be utilized in training the Receiving Agency's workforce.

Total Project Budget	Research University	FY 2020 Budget
$291,608.50	The University of Texas at Arlington	$94,636.00
	Texas A&M AgriLife Research	$36,962.50

Project Manager	Research Supervisor
Chris Glancy, RTI	Habib Ahmari, UTA

Project Advisor	Organization
Adrienne Boer	ENV
Charlie Reed	BRY
Devon Humphrey	IMD
James Norment	BRY
Jason Kord	ENV
Jorge Carrasco	AUS
Mark Fisher	ENV

0-7024-Assessing Ozone Impacts on Electric Vehicle (EV) Adoption in Texas

Start Date: 11/1/2019 **End Date: 7/31/2022**

Project Description

Plug-in Electric Vehicles (PEVs) are expected to overtake conventional vehicles by mid-2030s. PEVs have considerably lower tailpipe pollutant emissions, which react to each other and form ground-level ozone, a criteria pollutant known to be harmful to human health and the environment. However, when the overall wheel-to-well emissions are considered, characterizing the net impact of PEVs on ozone is a complex task that involves capturing the influence of factors such as PEV technology, energy sources of electricity generation, and location and time of electricity generation. The Performing Agency shall use the most recent available data and methods to develop forecasts of changes in ground-level-ozone as a result of PEV activities in three non-attainment areas of Texas (Houston, Dallas-Fort Worth, and San Antonio) for multiple scenarios, representing different plausible changes in key influence factors by years 2023 and 2028. The Performing Agency shall develop a series of scenarios for PEV activity levels, energy sources, and charging profiles. The Performing Agency shall then estimate the changes in emissions from PEVs and power generation, by location and time. The Performing Agency shall use the Environmental Protection Agency's (EPA) Community Multi-scale Air Quality Model (CMAQ) photochemical modeling, along with Texas-specific emission inputs prepared and used by the Texas Commission on Environmental Quality (TCEQ), to estimate hourly levels of ground-level ozone in the study areas.

Total Project Budget	Research University	FY 2020 Budget
$455,171.00	Texas A&M Transportation Institute	$151,311.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Reza Farzaneh, TTI

Project Advisor	Organization
Jackie Ploch	ENV
Tim Wood	ENV
Michael Chamberlain	TPP

0-7053-Quantify the Valuation of Right-of-Way

Start Date: 11/1/2019 **End Date: 10/31/2021**

Project Description

The Receiving Agency manages over one (1) million acres of right-of-way, which is used by a variety of third parties to install facilities such as utilities, saltwater pipelines, and small cell nodes. Third parties include common carriers, who install facilities for public use, and private parties, who install facilities for private use. Common carriers access the right-of-way via permit, for which the Receiving Agency does not have the authority to charge a fee. Private parties lease the right-of-way, and the associated fees are intended to cover administrative costs and the value of the right-of-way. This research shall develop a valuation framework to assess the value of the right-of-way for leases of various longitudinal distances and durations. The research shall also assess whether common carriers are violating their permits by installing additional facilities and leasing them to private parties. The research shall document instances where violations occur and identify companies that are common carriers who lease facilities that were installed by permit.

Total Project Budget	Research University	FY 2020 Budget
$321,353.00	Texas A&M Transportation Institute	$176,667.00

Project Manager	Research Supervisor
Chris Glancy, RTI	William Holik, TTI

Project Advisor	Organization
Beverly West	STR
Katelyn Kasberg	STR
Mark Johnson	MNT
Naomi Young	ROW
Stephen Dodge	ROW

0-7063-Guidance for the Use of UAS During Suboptimal Environmental Conditions

Start Date: 1/03/2020 **End Date: 8/31/2021**

Project Description

The Receiving Agency uses unmanned aircraft systems (UAS) for various applications in Texas such as highway mapping, bridge inspection, crash site data collection and real-time traffic monitoring. Environmental conditions including wind, rain, mist, smoke, and ambient lighting affect both the flight operations of the UAS aircraft and the quality of the data being collected. However, due to logistics, scheduling, and urgency, UAS flights may need to be performed during suboptimal conditions. To better understand these effects, this research shall address key challenges of UAS operations in suboptimal conditions, provide guidance for UAS flight operations in suboptimal conditions, and recommend settings, procedures and workflows to ensure data quality collected by UAS in suboptimal conditions. This research includes a literature review of the state of the art and the state of the practice, simulation and laboratory tests, preliminary field testing of UAS flight operations and data collection in different suboptimal environmental scenarios, post-flight analytics and assessments, and the development of recommendations and guidance for UAS operations in suboptimal conditions.

Total Project Budget	Research University	FY 2020 Budget
$655,148.00	Texas A&M Transportation Institute	$249,212.00
	Texas A&M University-Corpus Christi	$86,955.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Cesar Quiroga, TTI

Project Advisor	Organization
David McDonald	TRF
Jonathan Martin	DES
Jorge Hernandez	MNT
Yvette Flores	STR

0-7066-Developing a Small Airport Economic Impact Estimator

Start Date: 11/1/2019 **End Date: 10/31/2020**

Project Description

Knowing the current economic impact of your airport is critical to airport sponsors, stakeholders and the Receiving Agency. While the Receiving Agency periodically commissions a statewide economic impact study of the Texas Airport System, for many airports, a further need to determine their individual economic impact exists. The factors contributing to this need are:

1. Some airports not being included in the statewide study (or incomplete information being used)

2. Privacy concerns with respect to the financial/economic data because the airport may only have one business making it identifiable

3. Changes in an airport's activity levels since the last statewide study was performed; and

4. Airport's desire to have a more detailed analysis than that which is allowed when looking at 300 airports at one time.

Having updated and current numbers is important because many local officials use the airport's economic impact values to justify the authorization of grant-matching funds for state and federal airport grants. This project will aid officials in leveraging local funds for airport improvements.

Total Project Budget	Research University	FY 2020 Budget
$130,000.00	Texas A&M Transportation Institute	$124,100.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Jeffrey Borowiec, TTI

Project Advisor	Organization
Kari Campbell	AVN
Katheryn Cromwell	AVN

5-6665-01-Native Grassland Implementation

Start Date: 9/1/2018 **End Date: 8/31/2021**

Project Description

This implementation project will work to commercialize native seed sources from central and west Texas for TxDOT's use and develop native seed sources for east Texas and coastal TxDOT Districts. As a result of methods tested in TxDOT research projects 0-4570 and 0-6665, regionally adapted native seed sources of short stature grasses, forbs, and legumes will be developed, commercialized, and made available for TxDOT specification and use on roadsides to meet revegetation mandates throughout Texas. Objectives will include the collection, evaluation increase, and commercialization of seed sources of regionally adapted native seeds. Resulting native seed mixes will enable TxDOT to achieve permanent vegetation cover, resulting in timely notice of termination following construction projects. Implementation and use of native seeds will also enable TxDOT to meet current and proposed federal mandates for native plant use on highway rights-of-way throughout Texas. Native seeds made available through this work will also greatly improve TxDOT's ability to restore pollinator plants, including milkweeds, in all regions of the state by ensuring commercial availability of plant centers. Seed sources developed will be commercialized through private seed companies. The project team will work cooperatively with TxDOT Maintenance Division Vegetation Management personnel to develop and implement the new standard specification item 164, *Seeding for Erosion Control Specifications,* utilizing native seeds made available by the project. This implementation project will enable TxDOT to meet Federal Clean Water Act mandates for erosion control while providing diverse native habitats, supporting native plants, pollinators, and wildflowers on roadsides, and reducing impacts to adjacent private lands throughout Texas.

Total Project Budget	Research University	FY 2020 Budget
$1,500,000.00	Texas A&M University-Kingsville	$500,000.00

Project Manager	Research Supervisor
Wade Odell, RTI	Forrest Smith, TAMUK

Project Advisor	Organization
Dennis Marquardt	MNT
Travis Jez	MNT

5-6865-01-Evaluating the Efficacy of Mussel Relocation in Texas with In-Situ Field Studies and the Development of a Texas Mussel Database

Start Date: 3/7/2017 **End Date: 1/31/2020**

Project Description

The Texas Department of Transportation (TxDOT) is responsible for mitigating impacts to natural resources at road and bridge construction sites. For freshwater mussels, environmental assessments are done to ensure compliance with state (Texas Parks and Wildlife Code Title 5, Subtitle B, Chapter 68) and federal (16 U.S. Code Chapter 35) endangered species laws. These assessments determine whether sensitive species occur within the project area. If mussels are found, they are translocated to in-stream refugia to prevent or minimize impacts from construction activities. However, it remains unknown whether translocation is an effective conservation tool. Another issue facing TxDOT is how to best prioritize or identify projects that require mussel surveys or relocations. Currently, information from the TPWD Texas Natural Diversity Database is used to determine whether an in-stream survey is warranted; however, this database is not kept up-to-date and the information provided is often too coarse for determining whether threatened species actually occur near a proposed bridge project. As a result, TxDOT continues to expend valuable resources for surveys where state-listed mussels are not present. The Performing Agency shall conduct several experimental mussel relocations to evaluate lethal and sublethal impacts to translocated mussels and to provide TxDOT with an online mussel database that can be used for planning mussel surveys and translocations.

Total Project Budget	Research University	FY 2020 Budget
$380,000.00	Texas A&M AgriLife Research	$14,252.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Charles Randklev, TAR

Project Advisor	Organization
Andrew Blair	AUS
Mark Fisher	ENV
Charrish Stevens	FWS
Clint Robertson	TPWD
Gary Pandolfi	FWS
Jacob Lewis	FWS
Laura Zebehazy	TPWD
Lauren Pulliam	TCEQ

Projects by Functional Area Committees
Safety and Operations

Project	Title	Start Date	Page
0-6946	Establishing Comprehensive Manual on Assessing Safety Hardware (MASH) Compliance for Roadside Safety Systems in Texas	5/16/2017	63
0-6968	Roadside Safety Device Analysis, Testing, and Evaluation Program	9/1/2017	64
0-6969	Traffic Control Device Analysis, Testing, and Evaluation Program	9/1/2017	65
0-6976	Concrete Median Barrier for Flood-Prone Areas	9/1/2018	66
0-6990	Development of MASH Test Level 3 (TL-3) Compliant Transition between Median Guardrail and Median Concrete Barrier	9/1/2018	67
0-6991	Evaluation of Roadside Treatments to Mitigate Roadway Departure Crashes	9/1/2018	68
0-6992	Traffic Safety Improvements at Low Water Crossings	9/1/2018	69
0-6994	Retrofit Design of Guard Fence System to Accommodate Motorcycle Safety	9/1/2018	70
0-6995	Alternative RPMs on Highways with Centerline Rumble Strips and Winter Weather Pavement Marking Improvements	9/1/2018	71
0-6997	Capacity and Cost Benefits of Super 2 Corridors	9/1/2018	72
0-6998	Work Zone Traffic Engineering Strategies at Flagger Stations and Lane Closures	9/1/2018	73
0-7004	Improve System Emergency Response Performance in the Houston District Using Connected Vehicle Technology	7/18/2019	74
0-7007	Weather-Responsive Management Strategies	6/3/2019	75
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*Note: In the following Project Descriptions, the Receiving Agency is TxDOT and the Performing Agency is the University conducting the research.

Safety and Operations Projects

0-6946-Establishing Comprehensive Manual on Assessing Safety Hardware (MASH) Compliance for Roadside Safety Systems in Texas

Start Date: 5/16/2017 End Date: 12/31/2019

Project Description

Since the 1940s, the United States has been crash-testing highway safety appurtenances. National guidelines for testing roadside appurtenances originated in 1962. Guidelines for testing and evaluating the impact performance of roadside safety features are periodically updated to stay current with improvements in technology and changes in the vehicle fleet and impact conditions. In 2009, the American Association of State Highway and Transportation Officials (AASHTO) published a document, entitled Manual for Assessing Safety Hardware (MASH), which supersedes the previous crash test and evaluation guidelines. Changes incorporated into MASH include new design test vehicles, revised test matrices, and revised impact conditions. A MASH implementation agreement was jointly developed and adopted by the Federal Highway Administration (FHWA) and AASHTO. It establishes various implementation dates for different categories of roadside safety features. On projects led after the specified dates, only MASH compliant hardware is eligible for new installations on the National Highway System (NHS). In response to the implementation requirements, the Texas Department of Transportation's Bridge, Design, Maintenance, and Traffic Operations Divisions reviewed their standards for roadside safety devices and identified those devices that require testing and evaluation to assess MASH compliance. A total of 36 roadside safety systems will be crash tested in accordance with MASH criteria, in three phases, over a three-year period.

Total Project Budget	Research University	FY 2020 Budget
$3,317,945.00	Texas A&M Transportation Institute	$57,049.00

Project Manager	Research Supervisor
Wade Odell, RTI	Roger P. Bligh, TTI

Project Advisor	Organization
Mark Johnson	MNT
Chris Lindsey	DES
Taya Retterer	BRG
Jon Reis	BRG
Doug Skowronek	TRF

0-6968-Roadside Safety Device Analysis, Testing, and Evaluation Program

Start Date: 9/1/2017 **End Date: 10/31/2020**

Project Description

Roadway departure crashes represent over 50% of fatalities on Texas roadways each year. Roadside safety devices shield motorists from roadside hazards such as non-traversable terrain and fixed objects, thereby reducing injuries and fatalities associated with roadway departure crashes. There is a need to develop new or improved roadside safety devices, which will accommodate a variety of site conditions, placement locations, and a changing vehicle fleet, including motorcycles, to further enhance the safety of the motoring public. The second edition of the American Association of State Highway and Transportation Officials (AASHTO) Manual for Assessing Safety Hardware (MASH) published in December 2016 will be used to evaluate the impact performance of the devices developed under this project. This project provides the Receiving Agency with a mechanism to quickly and effectively address high priority issues related to roadside safety devices.

Total Project Budget	Research University	FY 2020 Budget
$2,312,266.00	Texas A&M Transportation Institute	$778,615.00

Project Manager	Research Supervisor
Wade Odell, RTI	Roger P. Bligh, TTI

Project Advisor	Organization
Mark Johnson	MNT
Chris Lindsey	DES
Ken Mora	DES
Taya Retterer	BRG
Jon Reis	BRG
Doug Skowronek	TRF

0-6969-Traffic Control Device Analysis, Testing, and Evaluation Program

Start Date: 9/1/2017 **End Date: 10/31/2020**

Project Description

This project will provide the Receiving Agency a mechanism to quickly and effectively conduct high priority evaluations of traffic control devices (TCD), assessing factors such as human performance, vehicle technology performance (for sensors used in new vehicles), safety effects, policies, and specifications. The TCD issues to be evaluated in this project may represent new devices or technologies, new applications of an existing device or technology, traffic control device material performance, changes in the Receiving Agency's practices regarding a TCD, or other TCD related needs. Examples of various evaluations include human factors, machine vision performance, safety effects, visibility assessments, and cost/benefit analyses. The activities conducted through this project shall support the development of TCD related policy, standards, guidelines, handbooks, and training. This project is intended to support the Receiving Agency's District needs, primarily in the Traffic Operations, Maintenance, and Construction Divisions, but also the Engineering Divisions. In each year of the project, TCD issues will be identified and prioritized for investigation. The selected issues shall be evaluated and addressed with a separate work plan, and the results will be presented with technical memorandums, to include findings and recommendations that can support the implementation of the new guidelines or policy, as appropriate.

Total Project Budget	Research University	FY 2020 Budget
$1,511,290.00	Texas A&M Transportation Institute	$516,909.00

Project Manager	Research Supervisor
Wade Odell, RTI	Paul Carlson, TTI

Project Advisor	Organization
Nick Aiello	TRF
John Bassett	MTD
America Garza	CRP
James Keener	HOU
Jose Madrid	ELP
Kassondra Munoz	CRP
Doug Skowronek	TRF
Rebecca Wells	ATL

0-6976-Concrete Median Barrier for Flood-Prone Areas

Start Date: 9/1/2018 **End Date: 2/28/2020**

Project Description

Concrete median barriers are used to prevent serious cross-median crashes by preventing penetration of passenger vehicles and trucks into on-coming traffic. These solid concrete barriers are used on highways with high speed and high traffic volume, not only to provide positive containment of vehicles, but also, to help reduce maintenance and repair needs.

When implemented in flood-prone areas, however, solid concrete median barriers can act as a dam for flood waters, as recently occurred in the Houston and Beaumont areas during Hurricane Harvey, or in Louisiana, following a severe storm. This raises the height of the flood waters and increases the severity of flooding on both the highway and the surrounding roads and communities. These situations required significant repair before the highways could be reopened and the level of safety for motorists restored. There is a need to develop and evaluate an appropriate Manual for Assessing Safety Hardware (MASH) Test Level (TL)-4, compliant median barrier, for implementation in flood-prone areas. To meet this objective, the Performing Agencies shall design such a barrier to accommodate the passage of flood water during severe weather events, reduce the severity of flooding, and decrease risk to motorists and others in the area, as well as reduce the level of damage to the highway and surrounding area.

Total Project Budget	Research University	FY 2020 Budget
$445,921.00	Texas A&M Transportation Institute	$254,496.00
	Center for Transportation Research, The University of Texas at Austin	$50,157.00

Project Manager	Research Supervisor
Wade Odell, RTI	Chiara Silvestri Dobrovolny , CTR

Project Advisor	Organization
Ab Maamar-Tayeb	DES
Sauda Ahmed	DES
Prassana Chebbi	HOU
Ken Mora	DES
Taya Retterer	BRG

0-6990-Development of MASH Test Level 3 (TL-3) Compliant Transition between Median Guardrail and Median Concrete Barrier

Start Date: 9/1/2018 **End Date: 8/31/2020**

Project Description

The Receiving Agency is moving to implement Manual for Assessing Safety Hardware (MASH) compliant safety hardware. This is a great step forward in terms of enhancing the safety of Texas roadways. The Receiving Agency already has a MASH TL-3 double face guardrail; however, this system does not work alone, without end termination or connectivity to other barriers. Most often, a connectivity to a MASH compliant median concrete barrier is needed. The connectivity is a transition section and thus, must be MASH compliant, in order to maintain the MASH compliancy of the overall installation. Hence, there is a safety need for developing a MASH compliant transition between the double face median guardrail and the concrete parapet.

Total Project Budget	Research University	FY 2020 Budget
$378,726.00	Texas A&M Transportation Institute	$245,656.00

Project Manager	Research Supervisor
Wade Odell, RTI	Akram Abu-Odeh, TTI

Project Advisor	Organization
Geetha Chandar	PEPS
Chris Lindsey	DES
Jon Ries	BRG

0-6991-Evaluation of Roadside Treatments to Mitigate Roadway Departure Crashes

Start Date: 9/1/2018 **End Date: 2/29/2020**

Project Description

The recently completed Texas Strategic Highway Safety Plan (SHSP) identifies roadway departure crashes as one of the seven emphasis areas for the next 5 years. Texas roads experienced 61,973 roadway departure crashes in 2016 alone, with 92 percent of these crashes occurring on two-lane, two- way highways. Furthermore, 37 percent of all fatal crashes in the state were roadway departure crashes. There is a renewed interest in identifying high-risk locations and low-cost countermeasures to reduce the frequency and severity of these crash types. In this research project, the Performing Agency shall collect data that can be used to pilot-implement a systemic approach to roadway departure crashes in Texas. Additionally, this research shall revise and update current Work Codes for guardrails, barriers, and safety-treating roadside fixed objects in Texas as appropriate, given that current Work Codes could be dated and may have different implications today, now that Texas has higher speed limits and is considering improved vehicle technologies. The research products shall facilitate better matching of candidate sites and countermeasures to implement, especially on low volume, local and rural roadways where network screening of crash history is limited.

Total Project Budget	Research University	FY 2020 Budget
$219,656.00	Texas A&M Transportation Institute	$66,314.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Raul Avelar, TTI

Project Advisor	Organization
Bradley Peikert	BRY
Christina Trowler	ATL
Mark Poage	BRY
Rebecca Wells	ATL

0-6992-Traffic Safety Improvements at Low Water Crossings

Start Date: 9/1/2018 **End Date: 5/31/2020**

Project Description

Texas has been reported to lead the nation in flood-related deaths, with the majority of deaths caused by motorists attempting to drive through moving water. Motorists might attempt to cross a flooded roadway not realizing its depth or, especially at nighttime, during heavy storms that make it difficult to see the flooded road. The same report established that it only takes 18-24 inches of moving water to sweep away a truck, and 6 inches to carry away a small car. Many accidents, rescues, and deaths occur at low water crossings, and most accidents occur at night. While it may be impractical to raise or remove all low water crossings across the state, there are low-cost means to better alert the driving public to the risks of low water crossings. The Performing Agency shall investigate low-cost approaches to improve low water crossings, with a focus on easy-to-install-and-maintain features, such as: 1) Reflective pavement markings and markers, 2) Flood-detection sensors, 3) Active/passive warning devices, and 4) Infrastructure-to-Infrastructure (I2I) and Infrastructure-to-Vehicle (I2V) technologies.

Total Project Budget	Research University	FY 2020 Budget
$445,069.00	Texas A&M Transportation Institute	$211,137.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Chiara Silvestri Dobrovolny, TTI

Project Advisor	Organization
Ab Maamar-Tayeb	DES
Adam Jack	BMT
Adam Kaliszewski	AUS
Arturo Perez	MTD
Chris Cowen	BRY
Jianming Ma	TRF
John Bassett	MTD
John Gianotti	SAT
Joseph Muck	AUS
Kenneth Mora	DES
Steve Chiu	HOU

0-6994-Retrofit Design of Guard Fence System to Accommodate Motorcycle Safety

Start Date: 9/1/2018 **End Date: 8/31/2020**

Project Description

Motorcyclists are among the most vulnerable users of the road system, and the appropriate design of roadside safety systems plays an important role in the severity of motorcycle crashes. Data show that from 2004 to 2017, the number of fatalities related to motorcycle impact against safety barriers was greater than the number of fatalities recorded from the impact of passenger car users against same roadside safety devices.

Although there are no guidelines addressing proper test and use of motorcycle retrofit barriers, there is a need to develop an appropriately designed guardrail system retrofit to address motorcycle-rider fatalities associated with barrier impacts, which can happen with the rider being either in a sliding or upright position. The Performing Agency shall consider such a retrofit system for placement on appropriate high-speed roadways, at locations that are more likely to be associated with motorcycle impact fatalities and severe injuries. The Performing Agency shall develop an appropriate motorcycle-friendly retrofit guard fence system for evaluation, to determine its compliance with the 2016 Manual for Assessing Safety Hardware (MASH), per Federal Highway Administration (FHWA) requirement.

Total Project Budget	Research University	FY 2020 Budget
$361,432.00	Texas A&M Transportation Institute	$249,548.00

Project Manager	Research Supervisor
Wade Odell, RTI	Chiara Silvestri Dobrovolny, TTI

Project Advisor	Organization
John Bilyeu	MNT
Jane Lundquist	DES
Ken Mora	DES
Ryan Sales	ABL

0-6995-Alternative RPMs on Highways with Centerline Rumble Strips and Winter Weather Pavement Marking Improvements

Start Date: 9/1/2018 **End Date: 2/28/2020**

Project Description

The use of snow plows in northern Texas frequently results in loss of retro-reflective pavement markers (RPMs). The loss of RPMs is not only costly, but also creates unsafe driving conditions during inclement weather. Pavement sections in these districts often use a center-line rumble strip for safety. Traditionally, these rumble strips have precluded the use of metal-encased RPMs (i.e., snow-plowable RPMs). This project evaluates two innovative approaches to arrive at a cost-effective and snow-plowable configuration for roadways containing rumble strips: (i) use of existing commercially available RPMs inset within the trough regions of rumble strips (referred to as rumble inserts) and (ii) use of polymers with reflective beads similar to raised stripes, located inside the rumble strip recess at the appropriate height required for safety (referred to as rumble stripe). The work plan explores variations of both options as well as possible design adjustments to accommodate retro reflection requirements, while preventing loss of RPMs due to snow plows. This project evaluates all options for their reflective properties and resistance to the action of snow plows using a full-scale test section. The Performing Agency shall conduct a cost analysis and the results from full-scale testing evaluation shall be used to provide the final recommendations to TxDOT.

Total Project Budget	Research University	FY 2020 Budget
$159,578.29	Center for Transportation Research, The University of Texas at Austin	$47,765.70

Project Manager	Research Supervisor
Chris Glancy, RTI	Raissa Ferron, CTR

Project Advisor	Organization
Darwin Lankford	CHS
David Baroi	AUS
Glenn Allbritton	WFS
Jason Person	TRF
John Bassett	MTD
Rebecca Wells	ATL

0-6997-Capacity and Cost Benefits of Super 2 Corridors

Start Date: 9/1/2018 **End Date: 8/31/2020**

Project Description

Super 2 corridors with passing lanes bring operational benefits to traditional two-lane highways by creating additional passing opportunities and reducing delay and crashes, leading to their increased use, across Texas. Specific benefits in improving capacity, related to reductions in percent time following, are not well known. In addition, as more passing lane length is added to a Super 2 corridor, it may resemble a traditional four-lane alignment and reduce the unique benefits of a Super 2 treatment. The Performing Agency shall investigate the incremental, operational and economic benefits of Super 2 corridors, compared to traditional four-lane alignments, according to the premise that a Super 2 treatment on a two-lane rural highway with high ADT provides capacity benefits approaching those of a four-lane alignment, but at greatly reduced costs. In this project, the Performing Agency shall analyze the operational performance of Super 2 corridors with varying average daily traffic (ADT), heavy vehicle volumes, length, number, and spacing of passing lanes, access, and terrain, to identify operational benefits, in key scenarios. The Performing Agency shall then use the operational benefits with other cost-benefit inputs, to quantify the economic incremental benefits of Super 2 corridors, compared to a traditional four-lane alignment.

Total Project Budget	Research University	FY 2020 Budget
$299,846.00	Texas A&M Transportation Institute	$149,987.00

Project Manager	Research Supervisor
Wade Odell, RTI	Marcus Brewer, TTI

Project Advisor	Organization
Ana Mijares	LFK
Andrew Holick	BRY
Cathy Kratz	AUS
Mark Wooldridge	HOU
Matt Evans	FTW
Rebecca Wells	ATL

0-6998-Work Zone Traffic Engineering Strategies at Flagger Stations and Lane Closures

Start Date: 9/1/2018 **End Date: 2/29/2020**

Project Description

In 2016, Texas had 153 fatal crashes in work zones. Of these 153 crashes, 33 percent were believed to be impacted by work zones and an additional 8 percent could have been impacted by work zones. Thus, the potential exists to prevent 63 work zone crashes per year in the state of Texas. The Receiving Agency has identified two areas where work zone safety could be improved: at flagger stations on two-lane, two-way facilities; and at stationary lane closures on multi-lane facilities. In both of these applications, there are situations where either a slowed or stopped vehicle is hit from behind by another vehicle because of failure to control speed or react in time. Consequently, temporary traffic control solutions are needed that alert approaching drivers in advance of the queue. The objectives of this research are to:

(1) Identify and evaluate temporary traffic control devices and/or strategies that could potentially reduce the risk of queue end crashes in work zones, and (2) Develop guidelines for implementation by the Receiving Agency.

Total Project Budget	Research University	FY 2020 Budget
$300,000.00	Texas A&M Transportation Institute	$92,940.00

Project Manager	Research Supervisor
Wade Odell, RTI	LuAnn Theiss, TTI

Project Advisor	Organization
Andrew Holick	BRY
Tommy Abrego	AUS
John Bassett	MTD
Matt Mitchell	TYL
Dana Moore	ATL

0-7004-Improve System Emergency Response Performance in the Houston District Using Connected Vehicle Technology

Start Date: 7/18/2019 **End Date: 8/31/2021**

Project Description

Emergency response services play a vital role in saving lives and minimizing property damage when major events or incidents happen. The Dedicated Short-Range Communication (DSRC) and Bluetooth Low Energy (BLE) technologies have the potential to improve efficiency and roadway safety, related to emergency management services. The primary objective of this project is to develop and test DSRC and BLE-based prototype systems for enhancing emergency pre-emption and notification. Another objective is to provide the Receiving Agency with guidelines for implementing DSRC and BLE technologies, to use in supporting emergency response services. To this end, the Performing Agency shall: (1) Identify methodologies for improving emergency vehicle signal pre-emption in a connected environment; (2) Develop and test prototype DSRC-based and BLE-based systems to broadcast Signal Phase and Time (SPaT) messages, Emergency Vehicle Alerts (EVAs), and other notifications to emergency vehicles and other roadway users in the vicinity; (3) Enhance signal pre-emption performance; (4) Assist the Receiving Agency in implementing the prototype systems at selected Houston field sites; and (5) Identify anticipated cost and benefit of the connected emergency response system. The key products of the project include DSRC and BLE prototype systems that operate with the Receiving Agency's infrastructure and guidelines for implementing the system.

Total Project Budget	Research University	FY 2020 Budget
$377,920.00	Texas A&M Transportation Institute	$183,070.00

Project Manager	Research Supervisor
Wade Odell, RTI	Hongmin Zhou, TTI

Project Advisor	Organization
Steve Chiu	HOU
Kialee Gbosi	HOU
Dyane Santander	HOU
Jianming Ma	TRF
Kevin McConnell	ITD
Lei Bu	HOU

0-7007-Weather-Responsive Management Strategies

Start Date: 6/3/2019 **End Date: 5/31/2021**

Project Description

Weather-responsive management and maintenance strategies are innovative approaches to traffic operations management and roadway maintenance that mitigate the effects of adverse weather on the transportation system. Desired outcomes of these strategies include reduced weather-related vehicle crashes, decreased delays, improved mobility, and environmental benefits. This project shall demonstrate a strategy to improve safety and reliability, reduce costs and improve dissemination of information to travelers via roadway ice maintenance and traffic operations integrations. The demonstrated strategy leverages mobile and connected vehicle data, as well as weather-related data sources, to closely track Receiving Agency ice prevention and response activities, public driving patterns, and regional precipitation. The outcome will optimize the application of anti-icing agent and ice removal activities, as well as inform travelers of road conditions and treatment progress. With this demonstration, this project enhances the value of current and future strategy implementation by showcasing 1) data archiving and analysis processes that fit within the Receiving Agency IT architecture and cybersecurity model, 2) actionable choices presented through decision support systems, 3) better public awareness through relevant information dissemination strategies, 4) system robustness through data quality checking, and 5) better understanding through performance metrics. All of these elements are critical for any well-developed weather-responsive management and maintenance strategy.

Total Project Budget	Research University	FY 2020 Budget
$429,894.09	Center for Transportation Research, The University of Texas at Austin	$228,189.99

Project Manager	Research Supervisor
Wade Odell, RTI	Chandra Bhat, CTR

Project Advisor	Organization
Barbara Russell	TRF
John Nevares	AUS
David McDonald	TRF
Dan Richardson	ABL
Ab Maamar-Tayeb	BRG

0-7009-Exploration of Automated Traffic Signal Performance Measures

Start Date: 8/8/2019 **End Date: 7/31/2021**

Project Description

Based on the concept of "what gets measured gets managed," Automated Traffic Signal Performance Measures (ATSPMs) use a suite of performance measures, data collection and data analysis tools to support objectives and performance-based approaches to traffic signal operations, maintenance, management and design. ATSPMs provide the data that the Receiving Agency needs to adopt an objectives-driven, performance-based approach for managing traffic signal operations. In this project, Performing Agency shall conduct a review of the state-of-practice related to the implementation and use of ATSPMs, to enhance traffic signal performance. The Performing Agency shall then compare and contrast the use and implementation requirements of a minimum of three ATSPM software suites, commonly available to the Receiving Agency. Based on this assessment, the Performing Agency shall develop prototype data-analysis techniques and tools to assist the Receiving Agency in identifying strategies and techniques for enhancing traffic signals. The Performing Agency shall use the lessons learned and results of the assessment to develop recommendations and guidelines for the Receiving Agency Districts, to be utilized while deploying and using ATSPMs for assessing, and improving, traffic signal performance and operations.

Total Project Budget	Research University	FY 2020 Budget
$389,603.00	Texas A&M Transportation Institute	$181,332.00

Project Manager	Research Supervisor
Wade Odell, RTI	Srinivasa Sunkari, TTI

Project Advisor	Organization
America Garza	CRP
Barbara Russell	TRF
Brent Eastman	ITD
Jeremy Dearing	LBB
Kelli Williams	ODA
Matt Sneed	SAT
Matthew McCarty	FTW
Miguel Palos	FTW
Robert Guydosh	AUS
Steve Chiu	HOU

0-7018-Development and Enhancement of In Service Performance Evaluation (ISPE) Process for Roadside Safety Devices

Start Date: 7/16/2019 **End Date: 4/30/2021**

Project Description

The purpose of roadside safety hardware is to reduce the risk of serious and fatal injuries to motorists in inadvertent road departures. Currently in Texas, the performance criteria of these safety hardware, as detailed in MASH standards, are solely based on full-scale crash testing evaluation. TxDOT does not have a formalized process to perform in-service performance evaluation (ISPE) of roadside safety features. It is crucial to monitor roadside safety devices on Texas highways to ensure proper functioning after installation. This project shall support TxDOT with setting and evaluating its level of safety risk and use quantitative information in the decision-making process. The project shall (1) perform literature review of other transportation agency ISPE procedures; (2) determine level of ISPE being performed with existing information in possession by TxDOT; (3) develop design recommendations for changes or improvements to perform ISPE; and (4) assess technology readiness level, and develop a guidance document.

Total Project Budget	Research University	FY 2020 Budget
$249,695.00	Texas Southern University	$63,466.00
	The University of Houston	$82,133.00

Project Manager	Research Supervisor
Wade Odell, RTI	Fengxiang Qiao, TSU

Project Advisor	Organization
Harsh Doshy	MNT
Ken Mora	DES
Joe Seago	BRY
Chris Lindsey	DES
Rebecca Wells	ATL

0-7019-Development of a MASH Test-Level 4 Compliant Guardrail

Start Date: 6/29/2019 **End Date: 12/30/2020**

Project Description

Currently, there is a lack of public domain, Manual for Assessing Safety Hardware (MASH) Test Level 4 (TL-4) guardrail systems. These guardrail systems require testing of the guardrail with a single unit truck, a pickup truck, and a small passenger sedan. Several corridors in Texas are known to experience a larger percentage of freight and truck traffic. In these corridors, the safety of the motoring public can greatly benefit from the use of a MASH TL-4 compliant guardrail system. Some concrete barrier designs are MASH TL-4 compliant; however, being significantly more expensive than metal beam guardrails, these designs are generally very cost prohibitive for large scale implementation. The Receiving Agency desires to develop a metal guardrail system that meets the testing requirement of MASH TL-4. In this project, the Performing Agency shall design and test a MASH TL-4-compliant metal guardrail system. The Performing Agency shall first develop three preliminary design concepts of the guardrail systems that are likely to meet MASH TL-4 requirements. The Project Team will select one of the three concepts for further development. The Performing Agency shall develop full-scale, finite element models of the selected system and perform impact simulation under MASH TL-4 conditions. Using the results of these impact simulations, the Performing Agency shall make further improvements to the guardrail design and make recommendations for the final design to be used in crash testing. The Performing Agency shall construct the guardrail system and perform MASH Test 4-12 (with single unit truck), Test 4-11 (with pickup truck) and Test 4-10 (with small car) to meet new guardrail system testing and MASH compliance requirements.

Total Project Budget	Research University	FY 2020 Budget
$288,933.00	Texas A&M Transportation Institute	$131,715.00

Project Manager	Research Supervisor
Wade Odell, RTI	Nauman Sheikh, TTI

Project Advisor	Organization
Ken Mora	DES
Canaan Cavitt	BWD
Dan Perry	PAR
Alberto Guevara	DES
Rachel Larcom	AUS

0-7020-Guidelines for Work Zone Barrier Use on Freeways

Start Date: 7/26/2019 **End Date: 8/31/2020**

Project Description

Longitudinal continuous barriers are often used in long-term work zones on Texas freeways to protect workers from the travelling public. Although their use provides clear safety benefits, their placement very near or at the edge of the travel lanes and for long stretches, can create difficulties in navigation for certain road users, especially large trucks and emergency personnel. Therefore, a need exists for understanding the state-of-the-practice, pertaining to what specific features and factors are being used by work zone designers in positive protection use decision-making. Additionally, various stakeholders' input needs to be gathered to determine the key issues that road users are experiencing when navigating through work zones. The objectives of this research are to: 1) Conduct a crash investigation to identify crash-contributing factors associated with work zone barrier use, 2) Conduct interviews with key construction personnel to identify the state-of-the-practice in barrier use and other design criteria for freeway work zones, 3) Conduct interviews with trucking industry and law enforcement representatives to identify these road users' perceived difficulties in travelling through various types of work zones with barriers, and 4) Develop a set of guidelines for work zone barrier practice, for implementation by the Receiving Agency.

Total Project Budget	Research University	FY 2020 Budget
$150,013.00	Texas A&M Transportation Institute	$130,895.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Emira Rista, TTI

Project Advisor	Organization
Carmen Grasoi Garcia	PFD
Christopher Lindsey	DES
Colby Langley	CST
Doug Skowronek	TRF
Harsh Doshy	MNT
Jennifer Mascheck	BRY
Susan Icke	DAL
Tyler Brudnick	AUS

0-7021-Protection of Median Openings Between Parallel Bridge Structures

Start Date: 6/28/2019 **End Date: 7/31/2021**

Project Description

When divided highways span over a hazard, engineers often design two separate bridges with ends protected by guardrail installations. However, the opening between the parallel bridge structures may result in a gap in roadside protection. The combination of the sloped median ditch and the approach guardrail can direct errant motorists between the two bridge structures and into the underlying hazard. The risk increases when the spanned hazard is another roadway with motorists traveling below the parallel bridges. Unfortunately, these median openings have resulted in fatal crashes in Texas and across the country. For example, the National Transportation Safety Board investigated a motor coach crash between two parallel bridge structures near Loxley, Alabama, that resulted in one fatality and 46 injuries. This type of median opening is a roadside safety issue that deserves further attention. The Performing Agency shall address this safety issue as follows: ○ Develop a median opening protection system (MOPS) that prevents errant motorists from crashing between two parallel bridge structures, ○ Identify characteristics of high-risk locations that can benefit from implementation of a MOPS, ○ Develop a solution from currently available technologies, and ○ Evaluate the MOPS with full-scale crash testing.

Total Project Budget	Research University	FY 2020 Budget
$440,951.00	Texas A&M Transportation Institute	$307,750.00

Project Manager	Research Supervisor
Chris Glancy, RTI	James Kovar, TTI

Project Advisor	Organization
Bradley Peikert	BRY
Falon Renfroe	AMA
Glenn Allbritton	WFS
Jon Ries	BRG
Kenneth Mora	DES
Paul Rollins	BRG
Susana Ceballos	AUS
Taya Retterer	BRG
Vincent Shovlin	MNT

0-7029-Evaluation of the Performance of Rumble Strips on Pavements Where Seal Coats Have Been Applied

Start Date: 7/10/2019 **End Date: 8/31/2021**

Project Description

The repeated application of seal coats on pavements with rumble strips may reduce the effectiveness of the rumble strips for alerting drivers of inadvertent lane departures. The goal of this project is to determine how many layers of seal coat can be applied on a pavement with rumble strips before rumble strip performance, and consequently, driver safety, is compromised. The Performing Agency shall:

1) Review the literature for rumble strip performance thresholds for safety, specifically relating to noise and vibration.
2) Develop a field-based testing plan using a statistical D-optimal design methodology.
3) Identify test sections according to the plan.
4) Measure interior noise and vibration of sections before and after seal coat application.
5) Measure texture with a laser profiler on select sections.
6) Determine how many seal coats result in an unacceptable drop in rumble strip performance.
7) Develop guidelines for the application of seal coat over existing rumble strips.

Total Project Budget	Research University	FY 2020 Budget
$303,647.00	Texas A&M Transportation Institute	$155,305.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Bryan Wilson, TTI

Project Advisor	Organization
Mike Arellano	AUS
Mark Johnson	MNT
Matthew Herbstritt	CHS
Solomon Thomas	WAC
Rebecca Wells	ATL
Blake Stembridge	BWD
Donald Maddux	LFK
Hui Wu	AUS

0-7035-Examine Trade-Offs Between Center Separation and Shoulder Width Allotment for a Given Roadway Width

Start Date: 7/19/2019 **End Date: 1/31/2021**

Project Description

The purpose of this project is to provide a practical framework that the Receiving Agency can use for evaluating and choosing cross-sectional design alternatives for optimizing operational and safety performance on rural highways. This framework will incorporate variables such as traffic volume, heavy vehicle mix, speed, and access point density. Studies have shown that four-lane undivided roadways have poor safety performance compared to four-lane divided and two-lane cross-sections. Four-lane undivided rural highways experience relatively high crash frequencies —especially as traffic volumes increase—resulting in conflicts with high-speed, opposite-direction vehicles. However, there isn't always sufficient space within the available right-of-way to accommodate a traditional four-lane, divided cross-section. Some states, including Texas, have started providing a narrow centerline buffer area that is separated by longitudinal pavement markings. This additional buffer area shifts the lateral placement of vehicles and introduces a greater physical separation between approaching vehicles. However, the provision of a centerline buffer comes at a cost of reduced lane or shoulder widths. A better understanding of the benefits of center separation, lane and shoulder combinations would provide useful information to designers who make decisions about cross-sections for new and resurfaced roadway segments. The Performing Agency shall collect and analyze data for four-lane sites with centerline buffers and compare their safety and operational performance with traditional four-lane undivided sites. Additionally, this research shall quantify the difference in the performance of four-lane undivided highways when compared to other cross-sectional designs. The Performing Agency shall use observed data and simulation to achieve the project objectives.

Total Project Budget	Research University	FY 2020 Budget
$258,085.00	Texas A&M Transportation Institute	$129,970.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Srinivas Geedipally, TTI

Project Advisor	Organization
John Speed	ODA
Khalid Jamil	DES
Sharlotte Teague	DES

0-7036-Use of Roundabouts and Innovative Intersection Designs at High-Speed Intersections in Texas

Start Date: 8/6/2019 **End Date: 7/31/2021**

Project Description

Rural high-speed roads continue to see increased traffic volume, statewide. Traditionally, roads with these speeds and volume might be converted to limited-access highways, but a mass level of systematic conversion is not feasible. As a result, there are numerous at-grade access points on rural high-speed roads that introduce potential operational delays and safety concerns. Traditional at-grade intersections may not efficiently accommodate the demands that are increasingly found in many locations across Texas, particularly with increases in oversize/overweight (OSOW)- vehicle volumes. Newer alternatives, such as modern roundabouts and innovative intersection designs may be more suitable for improving safety and operations at many locations. However, guidance is needed to identify suitable alternatives and develop appropriate design details for specific intersections. The Performing Agency shall investigate the operational and safety benefits of modern roundabouts and selected innovative intersection designs for high-speed locations, as well as best practices for designing these intersection alternatives. In this project, the Performing Agency shall compile proven results from designs in other states and collect/analyze operational and safety data within Texas to develop design guidance that the Receiving Agency can use. This guidance will aid the implementation of roundabout designs, meant to accommodate OSOW vehicles, and innovative intersections that provide appropriate access in rural areas.

Total Project Budget	Research University	FY 2020 Budget
$499,968.00	Texas A&M Transportation Institute	$272,858.00

Project Manager	Research Supervisor
Wade Odell, RTI	Marcus Brewer, TTI

Project Advisor	Organization
Jed Irwin	PAR
Andrew Holick	BRY
Pauline Morrel	DAL
Cody Jolley	DAL
Heather Lott	TRF
Rebecca Wells	ATL
Minh Tran	FTW

0-7043-Addressing Bicyclist Safety through the Development of Crash Modification Factors for Bikeway Facilities

Start Date: 11/5/2019 **End Date: 10/31/2021**

Project Description

According to the Receiving Agency's Crash Record Information System (CRIS) database, there have been 26,148 crashes involving bicyclists (pedalcyclists) from 2010 to 2018 in Texas, resulting in 2,885 fatalities and suspected serious injuries, and 22,937 non-incapacitating and possible injuries. Overall, bicycle crashes as well as fatal and suspected serious injury crashes involving bicyclists, have been on the rise. This trend could continue to grow, partly due to the increasing demographics of millennials and active populations in major metroplex areas and energy sector corridors. Bicyclist safety concerns exist not only in cities and metropolitan areas, but also for the overall state highway network. On-system highways are usually in better condition than local roads in terms of riding surface, shoulder presence, driveway spacing, etc.; hence, more bicyclists use these roadways for training, recreational, and even commuting purposes. This shift has very daunting safety implications; it is estimated that 33% of all bicyclist fatalities occur on state highways.

In this project, the Performing Agency shall develop crash reduction factors for bikeway facilities, assessing their safety and economic effectiveness for implementation on Texas roadways. Bikeway facilities include but are not limited to bike lanes, buffered bike lanes, advisory bike lanes, through bike lanes, sharrows (shared bike lanes), two-way cycle tracks, protected bike lanes, and so on. This research will address the development of crash reduction factors for target crash types, where sufficient bicycle facility information and crash information is available. To enable future cost-benefit assessments, the research will include an estimate of service life, installation, and maintenance costs of such facilities.

Total Project Budget	Research University	FY 2020 Budget
$250,000.00	Texas A&M Transportation Institute	$107,696.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Bahar Dadashova, TTI

Project Advisor	Organization
Bonnie Sherman	PTN
Carol Campa	TRF
Heather Lott	TRF
Khalid Jamil	DES
Rebecca Byford	DES
Sharlotte Teague	DES

0-7046-Developing Guide Signing for Long Term Work Zones

Start Date: 11/1/2019 **End Date: 10/31/2020**

Project Description

Part 6 of the Texas Manual on Uniform Traffic Control Devices provides standards and guidance for work zone devices, including signing. Section 6F.55 states that temporary guide signs shall have a black legend on an orange background. In 2017, the Receiving Agency issued new standard sheets for Temporary Large Roadside Signs, including details on how to construct crashworthy skids for large guide signs. In practice, a variety of temporary large guide sign designs are seen on freeways, in areas of long term construction projects. A variety of fonts, font sizes, sign sizes, route marker plaque designs, arrow designs, and placement standards are seen. Many of these projects last for multiple years. Suggested sign design and placement recommendations are needed to create uniformity for the traveling public. In addition to freeway guide signs, temporary guide signs on conventional highways are sometimes needed as well. The main benefit of this research will be improved operations through work zones as drivers will be better able to identify their needed exit or turn, then maneuver into the correct lane in advance. This will lead to reduced crashes in work zone areas. The objective of this research is to develop recommendations for long term work zone guide sign design and placement, to create uniformity for the traveling public.

Total Project Budget	Research University	FY 2020 Budget
$150,000.00	Texas A&M Transportation Institute	$129,418.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	LuAnn Theiss, TTI

Project Advisor	Organization
Bradley Peikert	BRY
Delmy Reyes	BRY
Doug Skowronek	TRF
Flor Tamez	TRF
Jennifer Vorster	DAL
Matthew Kelly	AUS
Travis Herrel	WFS

0-7047-Establish Guidelines for Designing Auxiliary Lanes on Frontage Roads

Start Date: 12/1/2019 **End Date: 10/31/2021**

Project Description

Auxiliary Lanes (ALs) are used on frontage roads to help facilitate safe weaving, merging, and diverging traffic movements when traveling to and from the frontage roads, as well as between freeway ramp terminals. They help balance the traffic load and provide transitions, vehicle storage, acceleration/deceleration to and from driveways, turnaround lanes, interchange approaches and departures. Acceleration and deceleration lanes, climbing lanes, and right-and left-turn lanes are examples of AL types that serve different purposes. There is limited guidance for designing ALs on frontage roads at and between freeway ramp terminals. The goal of this project is to identify gaps in existing guidelines and develop design criteria for ALs on frontage roads. To address this goal, the Performing Agency shall: a) review the literature and the state-of-practice in Texas; b) determine the conditions under which a certain type of AL design improves traffic operations; and c) conduct safety analyses to identify influential factors and develop crash prediction models that practitioners can use to determine how the addition of an AL with certain characteristics can affect safety.

Total Project Budget	Research University	FY 2020 Budget
$330,627.00	Texas A&M Transportation Institute	$127,770.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Ioannis Tsapakis, TTI

Project Advisor	Organization
Aaron Arroyo	TPD
Clayton Ripps	SAT
Gregg Granato	SAT
Khalid Jamil	DES
Sharlotte Teague	DES

0-7048-Identify Risk Factors that Lead to Increase in Fatal Pedestrian Crashes and Develop Countermeasures to Reverse Trend

Start Date: 12/17/2019 **End Date: 8/31/2021**

Project Description

The Performing Agency shall assemble a suite of relevant data sets from across the state to deliver both aggregate and highly disaggregate analyses of pedestrian-crash data, reflecting exposure pattern variations of the following types: site and city, county and region, roadway and intersection design decisions, local economic and demographic conditions, climate and context. Using traditional econometric and artificial intelligence methods, the Performing Agency shall anticipate which factors are at play in fatal and severe pedestrian crashes and identify all factors that increase such risks. It will then deliver a suite of cost-effective countermeasures and treatments to dramatically reverse the rise in pedestrian deaths across Texas.

Total Project Budget	Research University	FY 2020 Budget
$360,131.65	Center for Transportation Research, The University of Texas at Austin	$82,623.65

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Kara Kockelman, CTR

Project Advisor	Organization
Carol Campa	TRF
Khalid Jamil	DES
Noah Heath	PTN
Sharlotte Teague	DES
Solomon Thomas	WAC

0-7051-Develop a Real-Time Decision Support Tool for Rural Roadway Safety Improvements

Start Date: 12/2/2019 **End Date: 10/31/2021**

Project Description

Roadway departure and speeding-related crashes are the dominant types of crashes on rural roadways. As a result, the Texas Strategic Highway Safety Plan (SHSP) has identified them as two of the seven research emphasis areas for 2017-2022. Conventional crash risk analysis typically omits real-time speed, real-time volume, and weather data, significantly limiting safety predictive methods. To mitigate this research gap, the following three national databases can be combined: (1) National Performance Management Research Data Set (NPMRDS) with passenger and freight travel time data sets for the National Highway System (NHS) and other roadways; (2) Travel Monitoring Analysis System (TMAS) data with traffic volume data through both temporary traffic counting and continuous traffic counting programs; and (3) Real-time weather data from the National Oceanic and Atmospheric Administration (NOAA). Rural traffic crashes account for a disproportionate number of fatalities in comparison to urban crashes. In 2017, 53 percent of Texas crash fatalities occurred on rural roadways. Further research is necessary to reduce rural roadway crashes and allocate resources for rural roadway safety improvements; particularly, research focusing on the SHSP areas of emphasis, including roadway departure and speeding-related crashes. The findings of such research should be integrated into TxDOT's future vision plans. To achieve the project goals, the Performing Agency shall leverage ongoing staff leadership and engagement with research from both the Rural Speed Safety Project for USDOT Safety Data Initiative (SDI) as well as the National Cooperative Highway Research Program (NCHRP 17-76). This research will provide updated safety performance functions for rural roadways and a decision support tool for exploring crash risk at both segment and segment-temporal levels.

Total Project Budget	Research University	FY 2020 Budget
$300,000.00	Texas A&M Transportation Institute	$146,950.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Subasish Das, TTI

Project Advisor	Organization
Lewis Nowlin	SJT
Christopher Weber	ELP
Heather Lott	TRF

0-7059-Develop Guidelines for Inspection, Repair, and Use of Portable Concrete Barrier

Start Date: 11/1/2019 **End Date: 10/31/2021**

Project Description

The Manual for Assessing Safety Hardware (MASH) Implementation agreement allows State Transportation Agencies to continue the use of Portable Concrete Barriers (PCBs) manufactured on or before December 31, 2019 and successfully tested to NCHRP Report 350 or the 2009 edition of MASH, throughout their normal service life. Damage to the precast barriers can occur in transit, in storage, or due to vehicular impact. Often, damage to the connections occurs, cracks form in the barrier, corners become broken and many other forms of damage may be sustained by the barrier. No federal guidance, however, has been developed to determine life expectancy for PCBs. There is a need to develop a guideline that addresses the type and extent of barrier damage that would constitute replacement of the segment. To meet the research objective, the Performing Agency shall 1) document best practices with respect to management of repairing or replacing PCB segments and 2) utilize a combination of engineering evaluation, dynamic component testing and full-scale crash testing to develop guidelines for aid in developing a process to determine the useful service life. Defining the service life of PCBs is important to reduce the risk of inferior, unsafe barriers being used on Texas roadways.

Total Project Budget	Research University	FY 2020 Budget
$353,455.00	Texas A&M Transportation Institute	$202,580.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Chiara Silvestri Dobrovolny, TTI

Project Advisor	Organization
Christopher Lindsey	DES
Jennifer Vorster	DAL
Ken Mora	DES
Matthew Herbstritt	CHS
Teresa Michalk	MTD

0-7067-Enhancing Freeway Safety Prediction Models

Start Date: 1/1/2020 **End Date: 12/31/2021**

Project Description

Safety prediction models have been developed for urban freeway segments in Texas and elsewhere to apply to cross sections up to 10 lanes wide. These models come in the form of documented resources such as the Receiving Agency's Roadway Safety Design Workbook and the Highway Safety Manual (HSM), and are applied in several spreadsheet-based analysis tools. These tools are acknowledged in the Project Development Process Manual and have been used by various district personnel, particularly in the evaluation of project alternatives or analysis of design exceptions. However, additional research is needed to address knowledge gaps as well as to develop updated local calibration factors for the models. Specifically, safety prediction models do not exist for 12-lane freeway segments or freeway segments with managed lanes (such as high-occupancy-vehicle or high-occupancy-toll lanes). This research project shall develop new safety prediction models for 12-lane freeway segments and segments with managed lanes, and derive local calibration factors for models pertaining to urban freeway segments with 4-10 lanes. The project shall also develop an analysis tool to help practitioners implement the new models and facilitate thorough review of complex urban freeway configurations, such as cases where an urban freeway widening project requires challenging tradeoffs between narrowing lanes and inside/outside shoulders.

Total Project Budget	Research University	FY 2020 Budget
$275,000.00	Texas A&M Transportation Institute	$106,347.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Mike Pratt, TTI

Project Advisor	Organization
Farhan Khan	DES
Khalid Jamil	DES

5-6927-01-Implementation of Pedestrian and Bicyclist Count Database and Monitoring Process

Start Date: 9/1/2019 **End Date: 6/30/2020**

Project Description

Project 0-6927 developed a statewide pedestrian and bicyclist count database, as well as guidance for collecting additional count data and requirements for submitting additional count data to the statewide database, in anticipation of eventual mandatory reporting to the federal Travel Monitoring Analysis System (TMAS). Training on data collection and analysis is needed to effectively disseminate the information developed in this project to TxDOT District and regional/local agency staff and to utilize bicycle/pedestrian data in day-to-day operations.

Total Project Budget	Research University	FY 2020 Budget
$150,778.00	Texas A&M Transportation Institute	$150,778.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Shawn Turner, TTI

Project Advisor	Organization
Ana Ramirez Huerta	HOU
Bonnie Sherman	PTN
Brigida Gonzalez	TPP
Karen Peoples	TRF
Michelle Couden	TPP
Noah Heath	PTN
Robert Steigleder	SAT

5-6960-01-Implementation of Enhancing Curve Advisory Speed and Curve Safety Assessment Practices

Start Date: 6/22/2019 **End Date: 8/31/2020**

Project Description

The Receiving Agency's engineering study methods for setting curve advisory speeds were recently updated in Receiving Agency Research Project 0-6960, *Enhancing Curve Advisory Speed and Curve Safety Assessment Practices*. The update included extending the guidance to more types of rural highways (i.e., four-lane highways and freeways) and updating the software suite used to implement the Global Positioning System (GPS)-based engineering study method for setting advisory speeds. The Performing Agency shall assist Receiving Agency practitioners in their application of these new resources for checking and updating Texas' curve advisory speeds, in time for the December 31, 2019 compliance date of the Texas Manual on Uniform Traffic Control Devices (TMUTCD). The Performing Agency shall develop and present webinars and workshops for Receiving Agency practitioners who are responsible for traffic operations and signing and marking rural highways. The Performing Agency shall also provide technical support and guidance for the software suite, which consists of the executable Texas Roadway Analysis and Measurement Software (TRAMS) program and the spreadsheet-based Texas Curve Evaluation Suite (TCES) program.

Total Project Budget	Research University	FY 2020 Budget
$91,936.00	Texas A&M Transportation Institute	$45,283.00

Project Manager	Research Supervisor
Wade Odell, RTI	Mike Pratt, TTI

Project Advisor	Organization
Alex Choy	TRF
Tamara Gart	TRF

Projects by Functional Area Committees
Strategy and Innovation

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0-7033	Defining Operational Design Domains (ODDs) for the Safe Blending of Levels 0-4 Connected and Autonomous Vehicles (CAVs) in the Traffic Stream	9/1/2019	96
0-7034	Exploring the Use of Artificial Intelligence to Leverage TxDOT's Data for Enhanced Corridor Management and Operations	8/1/2019	97
15512	TX Alliance IAC	9/1/2017	98

*Note: In the following Project Descriptions, the Receiving Agency is TxDOT and the Performing Agency is the University conducting the research.

Strategy and Innovation Projects

0-6984-Evaluate Potential Impact of Truck Platooning on Texas Infrastructure

Start Date: 9/1/2018 End Date: 8/31/2020

Project Description

The Texas economy depends on the movement of goods within and across its state borders, resulting in the transport of billions of tons of goods per year. Additionally, trucks are a key element in the just-in-time (JIT) (or lean) manufacturing process, which uses efficient delivery timing of components to reduce the amount of inventory warehouse space. Consequently, trucks become mobile warehouses. If arrival times are missed due to congestion, the production and delivery delay costs are many times the value of the truck delay times; this significant cost will eventually be passed to the end user. New truck automation and truck platooning technologies have improved fuel efficiency and delivery time reliability while decreasing emissions. The Performing Agency shall assess the potential impacts, benefits, impediments, and solutions of autonomous trucks and truck platooning on the Texas highway infrastructure, including- 1) Identification of any needed infrastructure hardening decisions and potential changes in road and bridge design specifications, 2) Impact on the Texas Freight Mobility Plan and the wider designated Texas Highway Freight network, 3) Impact on Statewide Planning/Texas Transportation, 4) Impact on MPO and Other Local/ Regional Plans, 5) Overall Impact on the Receiving Agency's Planning Process, 6) Identification and documentation of national/state/local level planning/policy impediments, 7) Potential need for separate/specialized freight transportation facilities, 8) Vulnerability analysis at the asset and network levels to understand the wider impacts of these new technologies on Texas highway infrastructure, and 9) Overall infrastructure costs and benefits.

Total Project Budget	Research University	FY 2020 Budget
$448,240.00	Texas A&M Transportation Institute	$214,406.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Bjorn Birgisson, TTI

Project Advisor	Organization
Casey Wells	TPP
Chad Dabbs	FTW
Curtis Rokicki	BRG
Loretta Brown	TPP
Natnael Asfaw	FTW
Neil Welch	ABL
Susan Chavez	TPP

0-6999-Preparing and Utilizing Emerging Technologies and Innovative Research in Transportation

Start Date: 9/1/2018 **End Date: 8/31/2020**

Project Description

To ensure the Receiving Agency remains at the forefront of transportation, the Performing Agency shall organize a cross-functional body of transportation thought leaders and subject matter experts (SMEs), forming a task force dedicated to transportation technology. This will equip the Receiving Agency with essential strategy, innovation, and communication tools. Key deliverables include white papers on critical technologies, an Emerging & Advanced Technology Portfolio, and a Technology Utilization Plan that will serve as the fulcrum between technology discovery and implementation. The Receiving Agency will benefit from insights into industry trends, partnership opportunities, and potential areas for research, as well as strategic deployments, as it continues to develop its transportation innovation strategy.

Total Project Budget	Research University	FY 2020 Budget
$899,406.31	Center for Transportation Research, The University of Texas at Austin	$457,639.41

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Michael Walton, CTR

Project Advisor	Organization
Yvette Flores	STR
Kent Marquardt	STR
Beverly West	STR

0-7033-Defining Operational Design Domains (ODDs) for the Safe Blending of Levels 0-4 Connected and Autonomous Vehicles (CAVs) in the Traffic Stream

Start Date: 9/1/2019 **End Date: 8/31/2021**

Project Description

This project explores the establishment of a robust Operational Design Domain (ODD) framework for automated driving systems. The project will use a hybrid policy and technical process to define, prioritize, simulate and test ODDs for autonomous driving.

Total Project Budget	Research University	FY 2020 Budget
$493,665.00	Center for Transportation Research, The University of Texas at Austin	$212,766.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Kristie Chin, CTR

Project Advisor	Organization
Chad Dabbs	FTW
Eddie Espinoza	DES
Jed Irwin	PAR
Jianming Ma	TRF
Kent Marquardt	STR
Yvette Flores	STR
Zeke Reyna	STR

0-7034-Exploring the Use of Artificial Intelligence to Leverage TxDOT's Data for Enhanced Corridor Management and Operations

Start Date: 8/1/2019 **End Date: 7/31/2021**

Project Description

This project will develop a thorough understanding of the concrete and tangible benefits that artificial intelligence (AI) may offer to the Receiving Agency when considering the vast volumes of data currently collected. It will also explore emerging planning and operations applications. A twofold research approach will provide both a broad, high-level summary of the state-of-the art/practice in AI and its relevance to the Receiving Agency, as well as an in-depth analysis of one or two selected applications. The review of the state-of-the art will include a literature and data survey and creation of a prospectus, summarizing the techniques and tools relevant to the Receiving Agency, given data availability and planning/operation priorities. For the use cases, the Performing Agency shall consider applications involving system performance estimation and system control using Markov and non-Markov decision processes. After completing a preliminary research phase, the Performing Agency shall host a workshop for the Receiving Agency and its partners to demonstrate the explored concepts and collect feedback that will inform the model application and testing. Project deliverables will include a comprehensive report, including a quantitative and qualitative evaluation of the selected use cases, and access to the datasets and code-base used in this project.

Total Project Budget	Research University	FY 2020 Budget
$318,113.00	Center for Transportation Research, The University of Texas at Austin	$208,938.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Natalia Ruiz Juri, CTR

Project Advisor	Organization
Adam Kaliszewski	AUS
Casey Wells	TPP
David Tidwell	TRF
Farhan Khan	DES
James Kuhr	STR
Jenny Li	MNT
Jianming Ma	TRF
John Bilyeu	MNT

15512-Texas Alliance IAC

Start Date: 9/1/2017 End Date: 8/31/2021

Project Description

Texas Department of Transportation - Research and Technology Implementation Division is in need of administrative support to coordinate collaboration among stakeholders across the state, in order to address local, regional and state mobility challenges. The Performing Agency shall be responsible for coordination of the Texas Innovation Alliance Team, which initiated from the USDOT's Smart City Challenge, was solidified at the Texas Mobility Summit in December 2016, and serves as an outgrowth of the Texas Technology Task Force. Key objectives are to bring together local and state public agencies, research institutions and affiliates, and policymakers into a discussion focused on community, collaboration and choice. Key objectives include enhancing networks, leveraging resources and sharing lessons learned.

Total Project Budget	Research University	FY 2020 Budget
$1,448,443.72	Center for Transportation Research, The University of Texas at Austin	$484,143.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	C. Michael Walton, CTR

Project Advisor	Organization
Yvette Flores	STR

Projects by Functional Area Committees
Structures and Hydraulics

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0-6909	Designing for Deck Stress Over Precast Panels in Negative Moment Regions	1/1/2016	103
0-6922	Evaluating Long-Term Durability/Performance of Prestressed Concrete Beam with Extensive Surface Cracking	1/1/2016	104
0-6936	Development of Integral/Semi-integral Abutments for TxDOT Bridges	9/1/2016	105
0-6950	Evaluating Bridge Behavior Using Ultra-High Resolution Next-Generation Digital Image Correlation (DIC): Applications in Bridge Inspection and Damage Assessment	9/1/2017	106
0-6953	Strut-and-Tie Modeling and Design of Drilled Shaft Footings	9/1/2017	107
0-6955	Development of a Strategy to Address Load Posted Bridges through Reduction in Uncertainty in Load Ratings	9/1/2017	108
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0-7016	Structural Behavior of Tall Haunches in TxDOT Beam and Girder Bridges	7/10/2019	119
0-7017	Use of Rapid Setting Hydraulic Cement (RSHC) for Structural Applications	7/3/2019	120
0-7030	Synthesis of Engineered Cementitious Composites (ECC) for its Applications in Texas	9/16/2019	121
0-7038	Develop Bridge Weigh-in-Motion Approach to Measure Live Loads on Texas Highways	10/21/2019	122
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*Note: In the following Project Descriptions, the Receiving Agency is TxDOT and the Performing Agency is the University conducting the research.

Structures and Hydraulics Projects

0-6872-Use of Geothermal Energy for De-icing Approach Pavement Slabs and Bridge Decks - Phase II

Start Date: 3/27/2015 End Date: 7/31/2020

Project Description

De-icing using geothermal energy can provide TxDOT a better alternative than the existing method of de-icing with sands and/or salts. This research project will address the topic with a primary focus of comprehensive synthesis study. As a part of this synthesis, the available literature on geothermal energy along with success application case studies on the use of geothermal energy for bridge decks and pavement deicing applications will be compiled. The review of geothermal underground structures will be focused on Underground Thermal Energy Storage (UTES,) which is used to inject or extract heat into/from underground soil for seasonal cooling and heating needs. A preliminary finite element analysis of bridge de-icing using geothermal energy will also be performed, using typical Texas soil and climate conditions to demonstrate feasibility, along with potential cost-benefit analysis of the recommended geothermal de-icing system for field application. Recommendations shall be made on candidate geothermal structures and bridge deck/pavement heating systems for field demonstration studies, as a part of follow up validation studies. This Project will enhance safety of the traveling public by alleviating treacherous road conditions during extreme winter conditions.

Total Project Budget	Research University	FY 2020 Budget
$1,430,131.51	The University of Texas at Arlington	$114,203.67
	Texas A&M Transportation Institute	$114,181.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Xinbao Yu, UTA

Project Advisor	Organization
Jim Hunt	ODA/SAT
Anand Puppala	SSD
Justin Thomey	FTW
Cynthia Saldana	LRD

0-6905-Performance of Skewed Reinforcing in Inverted-T Bridge Caps

Start Date: 1/1/2016 **End Date: 8/31/2020**

Project Description

Reinforced concrete inverted-T bridge caps are used extensively in Texas bridges. Many of these bridge structures must be skewed, some in excess of 45 degrees. Faster and easier construction would be possible if skewed transverse reinforcing steel is utilized. There is concern about skewed transverse reinforcement providing reasonable structural behavior for the skewed inverted-T bridge cap in terms of overall cracking occurrence and structural performance. The guidance in current AASHTO code and research of skewed inverted-T bridge caps is limited to the design of typical normal skewed transverse reinforcement. Therefore, it is necessary to analyze the structural performance of the skewed inverted-T bridge caps with skewed transverse reinforcement and compare the performance to typical, normal transverse reinforcement. The Performing Agency shall conduct experimental and analytical investigation on the behavior of the skewed inverted-T bridge caps, utilizing skewed transverse reinforcement, emphasizing the following three aspects: i) skewed angle ii) detailing of transverse reinforcement and iii) amount of transverse reinforcement. Design provisions of existing design codes, especially AASHTO LRFD code, shall be reevaluated through the experimental approach. Finally, a rational design method shall be established for the skewed inverted-T bridge caps with skewed transverse reinforcement.

Total Project Budget	Research University	FY 2020 Budget
$945,361.20	The University of Houston	$110,946.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Y.L. Mo, UH

Project Advisor	Organization
Aaron Garza	AUS
Courtney Holle	BRG
Michael Carlson	HOU
Muhammad Bari	HOU
Walter Fisher III	DAL

0-6909-Designing for Deck Stress Over Precast Panels in Negative Moment Regions

Start Date: 1/1/2016 **End Date: 12/31/2019**

Project Description

One of the leading causes of structural deficiency in the United States Bridge Inventory is related to deterioration and durability issues with concrete bridge decks (NCHRP, 2004). The primary factor that can affect the durability of the concrete deck is cracking, which provides a direct conduit for moisture and other corrosive agents to penetrate the concrete and attack the reinforcing steel. The area of the bridge where deck cracking is likely to be the most predominant is in the negative moment region where the concrete is subjected to tensile stresses from girder flexure. One of the problems faced by designers for continuous girder systems is the lack of clear guidance in the AASHTO LRFD Specifications on reinforcing requirements in the concrete deck. The specifications do provide guidance on the deck steel requirements in the negative moment region of continuous steel girders and recommends the use of two layers of reinforcing. However, the AASHTO Commentary recognizes the difficulty of fitting in two layers with PCPs, and suggests that the Engineer of Record make a decision on the best layout of the steel. For continuous prestressed concrete girders with PCPs, AASHTO does not provide any guidance on the layout of the steel in the negative moment region. The vague AASHTO LRFD Commentary language for continuous steel girders, as well as the lack of provisions for continuous prestressed concrete girders results in a complicated situation for engineers that can create either overly-conservative or unconservative conditions, depending on how an engineer interprets the specification and commentary. The Performing Agency shall develop thorough guidelines for deck reinforcing steel details in the negative moment regions of bridges utilizing precast, prestressed concrete panels (PCPs).

Total Project Budget	Research University	FY 2020 Budget
$994,832.00	Center for Transportation Research, The University of Texas at Austin	$57,999.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Todd Helwig, CTR

Project Advisor	Organization
Jamie Farris	BRG
Justin Thomey	FTW
Leon Flournoy	BRG
Michelle Romage-Chambers	AUS
Taya Retterer	BRG

0-6922-Evaluating Long-Term Durability/Performance of Prestressed Concrete Beam with Extensive Surface Cracking

Start Date: 1/1/2016 **End Date: 3/31/2020**

Project Description

This project focuses on the cracking of concrete beams that has been observed in recent years at most of the large precast plants in Texas. This cracking appears approximately 18–24 months after fabrication, and the exact nature of these cracks is not clearly understood. The overarching goal of this project is to use existing cracked beams to predict whether long-term durability issues will develop. The research team is uniquely equipped to conduct this project, due to the team's expertise and its ability to leverage the efforts of this project with relevant projects underway at the Performing Agency. The research team shall execute a comprehensive program consisting of non-destructive evaluations and core-based tests to determine the effect of the cracks on mechanical properties and durability. The research team shall develop a novel method to evaluate the extent to which the cracks contribute to corrosion of pre-stressing strands, and conduct service life modelling to estimate the effect that the cracks have on the service life of the beams. Successful completion of this project will result in the Performing Agency providing recommendations to the Receiving Agency on the likelihood of long-term material and structural problems, occurring from these cracks.

Total Project Budget	Research University	FY 2020 Budget
$638,137.00	Center for Transportation Research, The University of Texas at Austin	$57,707.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Raissa Ferron, CTR

Project Advisor	Organization
Andy Naranjo	MTD
Frank Estrada III	FTW
Jason Tucker	MTD
Lianxiang Du	BRG
Todd Speck	PEPS

0-6936-Development of Integral/Semi-integral Abutments for TxDOT Bridges

Start Date: 9/1/2016 **End Date: 8/31/2020**

Project Description

While the use of integral and semi-integral bridge abutments has reportedly been increasing nationwide, their construction in Texas has remained limited. These systems have been reported to minimize costs associated with the installation, maintenance, and repair of bridge deck joints and bearings. In addition, they have the potential to minimize the "bump at the end of the bridge," which results in reduced maintenance costs. Although this technology has not been widely adopted in Texas, a reassessment of its potential cost and performance benefits is timely. This requires assessment of key design and construction aspects, including the characteristics of common soils in Texas, the details typically adopted for foundation, superstructure, and substructure, and the local pavement standards. Accordingly, this project proposes to assess the use of this technology in Texas by producing: (1) a review of US and international practices, as well as of existing data, to assess the applicability to conditions prevailing in Texas, (2) a thorough evaluation of structures already constructed in Texas, as well as of an integral bridge that will be constructed in 2016, in Texas, by FHWA Federal Lands, and (3) a set of design details for using this technology in Texas conditions.

Total Project Budget	Research University	FY 2020 Budget
$693,742.56	Center for Transportation Research, The University of Texas at Austin	$198,996.54

Project Manager	Research Supervisor
Chris Glancy, RTI	Jorge Zornberg, CTR

Project Advisor	Organization
Blanca Pattee	BRG
Dina Dewane	BRG
Doug Beer	BRG
Kathleen Newton	AUS
Leon Flournoy	BRG
Michael Hyzak	BRG
Sean Yoon	BRG

0-6950-Evaluating Bridge Behavior Using Ultra-High Resolution Next-Generation Digital Image Correlation (DIC): Applications in Bridge Inspection and Damage Assessment

Start Date: 9/1/2017 **End Date: 12/31/2020**

Project Description

Due to heavy cost burdens, departments of transportation are increasingly seeking new technologies that can facilitate monitoring their bridge portfolios and reduce the need for costly interventions. Deformation measurements, such as bridge deflections, material strains, and crack progression under load and over time, are at the heart of damage and capacity evaluations for bridges. However, measuring the necessary structural deformations is currently time consuming, requires direct access to the structure, and often suffers from user-bias. Digital Image Correlation (DIC) is a non-contact technology that utilizes specialized digital cameras to deliver high-resolution deformation data between successive images and over large areas of a structure. The technology is advancing rapidly and has recently been proven in laboratory settings to possess the unique ability, amongst competing technologies, to deliver the necessary high-resolution deformation data that can greatly improve accuracy and reduce the conservatism of structural evaluations. This project shall deliver a state-of-the-art DIC system that can monitor strains and deformations during bridge load testing, as well as monitor damage progression in concrete and steel bridges over time. The system will accelerate and reduce the cost of bridge inspections, while delivering previously inaccessible data for streamlining bridge capacity evaluations and rehabilitation decisions.

Total Project Budget	Research University	FY 2020 Budget
$419,432.00	The University of Texas at San Antonio	$143,110.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Wassim M. Ghannoum, UTSA

Project Advisor	Organization
Bernie Carrasco	BRG
Biniam Aregawi	BRG
Bonnie Longley	SAT
Drake Builta	BRG
Graham Bettis	BRG
Joshua Gutzwiller	BRG
Leon Flournoy	BRG
Seth Franks	LFK
Zosimo Agrimor	LBB

0-6953-Strut-and-Tie Modeling and Design of Drilled Shaft Footings

Start Date: 9/1/2017 **End Date: 8/31/2020**

Project Description

The design and detailing of reinforced concrete footings supported by a grid of drilled shafts varies greatly on a state, district, and even municipality basis. The Texas Department of Transportation (TxDOT) has attributed the variations to a lack of guidance and standards for the design of shaft-supported footings. Refinement of the two-dimensional, strut-and-tie (STM) provisions of TxDOT Project 0-5253, will provide the guidance necessary for consistent design of three-dimensional column footings. The Performing Agency (PA) shall review at least the following designs and details: 1) Straightforward Design Provisions for Strong, Serviceable Footings: Nodal efficiency factors and reinforcement anchorage requirements are to be derived on the basis of large scale testing and analytical studies. It is anticipated that the recommended design process will consist of stress checks at singular bearings and anchorage checks at critical locations of the STM. 2) Optimal Strut-and-Tie Models for Common Load Combinations: A set of generalized strut-and-tie models are to be developed for the most common load combinations encountered by TxDOT. Empirically based guidance will accompany the generalized strut-and-tie models to ensure the most efficient placement of model elements. Implementation of the three-dimensional STM guidelines, developed during TxDOT Project 18-60, will lead to the construction of highly efficient, durable shaft-supported footings across the State of Texas.

Total Project Budget	Research University	FY 2020 Budget
$999,125.97	Center for Transportation Research, The University of Texas at Austin	$306,748.72

Project Manager	Research Supervisor
Joanne Steele, RTI	Oguzhan Bayrak, CTR

Project Advisor	Organization
Sara Watts	BRG
Seth Cole	BRG
Curtis Rokicki	BRG
Jamie Farris	BRG
Victoria McCammon	BRG

0-6955-Development of a Strategy to Address Load Posted Bridges through Reduction in Uncertainty in Load Ratings

Start Date: 9/1/2017 End Date: 10/31/2019

Project Description

According to the 2015 National Bridge Inventory data, the state of Texas houses over 2300 bridges posted at load levels below the legal limit. While load postings are generally a management issue, there can be commerce, traffic, and emergency egress issues. For this reason, removing postings is always of interest. Posted structures come in all shapes and sizes, built in different eras and environments, and exhibit vastly different structural behaviors. As such, there is no clear-cut single solution for addressing the possibility of removing postings. The Performing Agency's approach to addressing posted bridges is to develop a strategy that will reduce uncertainty in a safe and appropriate manner, targeting the specific details of the bridge and load rating that are easiest to adjust. Examples shall include more accurate material properties, refined modeling for less conservative load distribution modeling, and field testing for verification of acceptable load levels. The American Association of State Highway and Transportation Officials (AASHTO) Manual for Bridge Evaluation allows for refined rating, but does not address the challenge of identifying the appropriate structures. The Performing Agency shall quantify the population of load posted bridges in Texas, identify and examine areas of opportunity, assess the benefits of refined load ratings for Texas bridges, and develop an implementation strategy.

Total Project Budget	Research University	FY 2020 Budget
$444,344.00	Texas A&M Transportation Institute	$21,208.00

Project Manager	Research Supervisor
Phillip Hempel, RTI	Mary Beth Hueste, TTI

Project Advisor	Organization
Aaron Garza	AUS
Courtney Holle	BRG
Graham Bettis	BRG
Jesus Alvarez	BRG
Jonathan Boleware	BRG
Biniam Aregawi	BRG

0-6958-Developing Performance Specification for High Performance Concrete

Start Date: 9/1/2017 **End Date: 8/31/2020**

Project Description

In the past, achieving high strength was considered by the Receiving Agency as the main design criteria for formulating high performance concrete. The Receiving Agency considers mix design options 1-4 in item 421 as high-performance concrete (HPC), and these options were developed for ASR mitigation, not for other durability aspects. Very little work has been done to determine if these options are adequate to provide long-term durability, often needed when HPC is specified. The main objective of this study is to develop performance specification for high-performance concrete to ensure high performance with respect to durability. The Performing Agency shall conduct a combination of both field investigation and laboratory study to achieve this objective. The Performing Agency shall use both conventional and innovative new lab testing methods, to determine key performance characteristics (i.e., prescribing acceptable limits of permeability, shrinkage, surface resistivity, and chloride ingress - basis for developing performance specification), then develop specific prescriptive requirements to formulate wide varieties of prescriptive mixes that can meet the durability requirements suitable for various exposure conditions. A combined approach of relating mix design parameters, lab-based durability test results, mechanical properties, structural dimensions, climatic conditions, and exposure conditions through suitable service life prediction modeling will be used to ensure long term durability (at least 75 years) for the HPCs in typical environments. This will lead to developed performance and prescriptive-based concrete specifications for HPC. This could potentially encourage contractors to effectively use these fine-tuned prescriptive HPC mixtures, eliminating the need for additional long duration testing, facilitating the use of lasting durable concrete and saving taxpayers' dollars.

Total Project Budget	Research University	FY 2020 Budget
$465,436.00	Texas A&M Transportation Institute	$150,329.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Anol Mukhopadhyay, TTI

Project Advisor	Organization
Andy Naranjo	MTD
Christopher Miller	BRG
Jason Tucker	MTD
Kevin Moyer	AUS
Lianxiang Du	BRG
Rachel Cano	MTD

0-6977-Generalized Skew Update and Regional Study of Other Measures of Distribution Shape for Texas Flood Frequency Analyses

Start Date: 9/1/2018 **End Date: 8/31/2021**

Project Description

This project shall investigate and document generalized (regional) skew coefficients (RegSkew) and other measures of distribution shape in and near Texas. RegSkews, which are derived by procedures integrating sample at-site skew values obtained at many stream gages, are important for peak-streamflow frequency (flood frequency) analyses because of the high sampling variability. The measures of distribution geometry are normally derived from study of USGS instantaneous, annual peak streamflow data and ancillary watershed properties. However, identification of applicable time periods of the USGS observational record is complex and critical for execution of this study, and the USGS peak-values database provides only qualitative information to this effect. New RegSkews are therefore needed for hydrologic design because previous studies (nationally c.1982; Texas c.1996) are outdated, relative to Federal guidelines (England and others, 2018 [Bulletin 17C]). Future flood frequency analyses will inherently be more reliable when new RegSkews are used; particularly, when used with the Expected Moments Algorithm of Bulletin 17C, and other settings. Bulletin 17C currently recommends Bayesian generalized least squares (B-GLS) concepts to estimate RegSkews because B-GLS reflects the precision of available estimates, their cross correlations, and the precision of the regional model. This project will report on the results of B-GLS for Texas. The complexity of the Texas flood hydrology, due to a broad spectrum of wide ranging climatic, rural to urban development conditions, and potential flood-flow regulation effects, requires further research of spatial and temporal trends in annual peaks and empirical distributions.

Total Project Budget	Research University	FY 2020 Budget
$448,924.15	Center for Multidisciplinary Research in Transportation, Texas Tech University	$66,623.00
	The University of Texas at Arlington	$54,804.40
	United States Geological Survey	$82,752.82

Project Manager	Research Supervisor
Chris Glancy, RTI	Theodore Cleveland, TECH

Project Advisor	Organization
Ab Maamar-Tayeb	DES
Derek Feil	MNT
Matt Evans	FTW

0-6979-Calibration of Bridge Element Based Deterioration Models

Start Date: 9/1/2018 **End Date: 8/31/2020**

Project Description

This two-year, nine task research project shall start by aggregating the Performing Agency's 23 years of BRINSAP/NBI/PonTex files, plus any additional files supplied by the Receiving Agency, into a historical bridge and culvert research database. The Performing Agency shall use it to analyze variables, prepare statistical summaries, develop families of culverts and bridges, and forecast the probabilities that each family will transition from each observed condition to lesser conditions, within any desired period(s). The Performing Agency shall deliver transition probability models covering the entire Texas bridge and culvert population. To streamline future implementation by the Receiving Agency, the Performing Agency shall deliver an Excel workbook, with pre-coded models, to present future deterioration probabilities and the expected number of structures in each future condition rating at future times. This Excel file shall complement and clarify the Implementation Manual. This project fulfills a 2017 FHWA Rule requiring states to have procedures to forecast bridge and pavement deterioration. Project results will assist in identifying short-term and long-term budget needs. Additionally, future condition forecasts are an indispensable value for meeting the remaining requirements of this FHWA Rule dealing with asset life-cycles.

Total Project Budget	Research University	FY 2020 Budget
$253,363.00	The University of Texas at San Antonio	$128,219.30

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Jose Weissmann, UTSA

Project Advisor	Organization
Chad Dabbs	FTW
Drake Builta	BRG
Mark Wallace	BRG

0-6980-Update Rainfall Coefficients with 2018 NOAA Atlas Rainfall Data

Start Date: 9/1/2018 **End Date: 10/31/2019**

Project Description

Quality and realistic storm water data are essential for efficient designs of hydraulic structures, which contribute to the longevity of highways by reducing their exposure to erosion and moisture damage. In Texas, the EBDLKUP-2015-V2.XLS is the current interim design tool providing rainfall coefficient estimates at the county level. However, recent episodes of roadway flooding in Texas have revealed important inadequacies of hydraulic structures, outdated due to poor site-specific rainfall information contained in the design tool. In reality, using the same rainfall coefficient for an entire county is questionable, since storm patterns can vary greatly within a county. However, NOAA Atlas 14–Texas captures most critical rainfall patterns and provides point-precipitation characteristics estimates with 90% confidence intervals at a high-resolution (0.5-mile x 0.5-mile). Hence, this project shall consider NOAA Atlas 14–Texas for developing a newer EBDLKUP- 2018.XLS, to estimate site-specific design storms in Texas. Compared to the interim tool, EBDLKUP-2018.XLS shall have an additional prompt for 862 county subdivisions across Texas. The net benefits of the EBDLKUP-2018.XLS will be multiple for TxDOT and transportation engineers, as it will enhance site-specific hydraulic structure designs. The Performing Agency shall provide materials to facilitate a rapid implementation of EBDLKUP-2018.XLS.

Total Project Budget	Research University	FY 2020 Budget
$94,745.00	Texas A&M Transportation Institute	$9,745.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Lubinda Walubita, TTI

Project Advisor	Organization
Ab Maamar-Tayeb	DES
Derek Feil	MNT
Matt Evans	FTW

0-6982-Utilization of UHPC Bridge Superstructures in Texas

Start Date: 9/1/2018 **End Date: 2/28/2022**

Project Description

The Receiving Agency has led the nation in developing innovative bridge design and construction solutions for decades through its strong research and development programs. This project aims to extend this progressive tradition. The use of ultra-high-performance concrete (UHPC) in Texas bridges has the potential of producing substantial improvements to bridge construction. For example, the recent Malaysian experience with UHPC proved the fact that bridge superstructure weight can be reduced by 40 percent. For long-span bridges, such self-weight reductions can result in significant design and construction benefits. Within this context, this project aims to identify the applications in which the use of UHPC can be leveraged to develop new structural systems.

The three major technical objectives of this research are outlined in the project statement as follows- 1) Conduct an analytical feasibility study to identify the material properties for which a nonproprietary UHPC mixture design should be developed to deliver optimal design benefits, 2) Develop a nonproprietary concrete mixture design to meet the needs identified in Technical Objective 1, and 3) Conduct experiments (full-scale and material-level) to study long-term mechanical properties (for example tensile creep) in an effort to eliminate or minimize the use of ordinary reinforcing bars in UHPC applications.

Total Project Budget	Research University	FY 2020 Budget
$1,282,823.00	Texas A&M Transportation Institute	$404,618.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Mary Beth Hueste, TTI

Project Advisor	Organization
Andy Naranjo	MTD
Biniam Aregawi	BRG
Chad Dabbs	FTW
Geetha Chandar	PEPS
Igor Kafando	BRG
Jamie Farris	BRG
Jason Tucker	MTD
Joe Roche	MTD
Prapti Sharma	FTW
Rachel Cano	MTD
Robert Owens	BRG

0-7010-Developing Peak Rate Factor (PRF) Guidance in Hydrologic Modeling

Start Date: 7/15/2019 **End Date: 8/31/2020**

Project Description

Hydrologic modeling based on the NRCS dimensionless unit hydrograph uses a standard peak rate factor (PRF) of 484, and the method for developing more appropriate PRF values, which is complex and cumbersome, is not commonly used. The most current or common Texas practice is to adjust PRF after initial modeling has been performed, as a rough calibration to expected values. This current practice lacks guidance and consistency. Further, changes to PRF values have an effect on the peak flow values and resulting sizes for hydraulic structures. Prior research on appropriate PRF values for Texas has been performed in the past, but a relationship of recommended values for varied watersheds and physiographic regions in Texas was not evident, at that time. Additional research is needed to build off of prior Texas research and establish solid guidance for a range of reasonable PRF values, applicable for all areas of Texas. As a step towards addressing these challenges, the Performing Agency shall develop a simple, easy–to–use approach for the estimation of peak rate factors and, as needed by the Receiving Agency, related hydrologic modeling tools.

Total Project Budget	Research University	FY 2020 Budget
$149,427.00	The University of Texas at San Antonio	$48,257.50
	Texas A&M Transportation Institute	$63,745.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Hatim Sharif, UTSA

Project Advisor	Organization
Ab Maamar-Tayeb	DES
Jerry Conner	SJT

0-7011-Evaluation of Seamless Bridges

Start Date: 7/19/2019 **End Date: 8/31/2022**

Project Description

Conventional bridges use expansion joints to accommodate movements primarily caused by temperature changes in the bridge superstructure. However, water and contaminants that pass through the joints tend to accelerate deterioration of girders, bearings and substructure elements. The seamless bridge concept, which was first developed in Australia, eliminates the use of expansion joints between the bridge deck and the continuously reinforced concrete pavement (CRCP). Implementation of this technology has been reported to delay deterioration of bridge elements and totally eliminate the need for routine joint maintenance. In this project, the Research Team shall conduct fundamental and applied research techniques to develop comprehensive design guidelines for implementing seamless bridge technology in Texas. The primary goals of the project include the following: (a) characterize the interaction between CRCP in a transition slab and different base materials with and without bond breakers utilizing full-scale experiments, (b) develop modeling techniques to analyze the structural response of seamless bridge systems, (c) develop guidelines for determining the optimal length of the transition slab and corresponding reinforcing steel, (d) identify design issues associated with the use of a seamless connection for standard bridge structures, and monitor the field performance of a bridge constructed using a seamless transition.

Total Project Budget	Research University	FY 2020 Budget
$810,497.00	Center for Transportation Research, The University of Texas at Austin	$236,432.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Juan Murcia-Delso, CTR

Project Advisor	Organization
Andy Naranjo	MTD
Kevin Pruski	BRG
Lianxiang Du	BRG
Michael Hyzak	BRG
Roberto Trevino Flores	MNT
Trenton Ellis	BRG

0-7012-Development of Non-Fracture Critical Steel Box Straddle Caps

Start Date: 7/9/2019 **End Date: 10/31/2022**

Project Description

Steel box straddle caps are commonly utilized in congested urban environments when intersecting roadways do not permit conventional piers. The high strength-to-weight ratio of steel makes the straddle caps efficient from a construction and performance perspective; however, the members are categorized as fracture-critical, necessitating more stringent design requirements and biennial hands-on inspections—creating significant long-term costs. The Performing Agency shall develop details that allow the straddle box caps to be classified as redundant members, removing the fracture-critical designation on the caps. The study shall not only target new construction, but also evaluate methods of retrofitting existing caps to develop desired redundancy. The Performing Agency shall investigate the use of prestressing tendons/bars to provide redundancy to the steel box straddle caps. The methods of research include full-scale laboratory testing, consisting of fatigue loading to initiate cracks and fracture tests under static loading on post-tensioned straddle box caps. Computational models shall be used to develop a comprehensive design methodology for system redundant straddle caps that are non-fracture-critical. The systems developed shall create significant benefits in both the life-cycle economy and long-term performance of steel straddle caps.

Total Project Budget	Research University	FY 2020 Budget
$989,286.00	Center for Transportation Research, The University of Texas at Austin	$290,251.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Todd Helwig, CTR

Project Advisor	Organization
David Fish	BRG
Jamie Farris	BRG
Moheb Labib	DAL
Paul Rollins	BRG
Tom Fan	HOU
Wanching Huang	HOU
Yongqian Lin	HOU

0-7013-Performance and Improvement of Texas Poor Boy Continuous Bridge Deck Details

Start Date: 6/28/2019 **End Date: 8/31/2023**

Project Description

The majority of bridges in Texas are constructed with girders as simple spans. A simple-span deck requires expansion joints, which are sources for maintenance and durability issues. To avoid this, continuous decks are an attractive option; however, cracks may develop. The Receiving Agency uses a detail that intentionally forms cracks, referred to as the "Texas Poor Boy" detail. Despite a four-decade history of such detailing, a comprehensive evaluation of performance of this detailing has not been conducted.

The Performing Agency shall conduct a multi-tiered survey to identify the performance of the current "Poor Boy" continuous bridge deck details within different environments (high ADT, high rainfall, or high de-icing salt zones), as well as a literature and state-of-the practice survey to establish the detailing and expected performance of alternative connection designs. Using the results of these surveys, the Performing Agency shall develop candidate modifications to the current poor-boy details for new construction and candidate details for rehabilitation of existing bridges. The Performing Agency shall use modeling and full-scale experimental tests to assess the performance of the recommended details. The Performing Agency shall use the results of modeling and experimental tests to make final recommendations for design methodologies and details.

Total Project Budget	Research University	FY 2020 Budget
$727,298.00	Texas A&M Transportation Institute	$124,596.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Anna Birely, TTI

Project Advisor	Organization
Aaron Garza	AUS
Lianxiang Du	BRG
Michael Hyzak	BRG
Taya Retterer	BRG

0-7015-Analyze Shear Capacity of Texas Standard Pre-stressed Beams from Strut-and-Tie Models of Beam Ends

Start Date: 7/17/2019 **End Date: 10/31/2021**

Project Description

Article 5.7.3.2 of AASHTO LRFD includes design guidance for sections near supports. This AASHTO design provision, i.e., the 0.18 f ′c limit, has been put in place to ensure that the complicated nature of stresses is accounted for when transferring the forces from the B-region to the simply supported ends of pretensioned girders. The 0.18 f ′c shear stress limit can be exceeded if load transfer into the supports can be justified by appropriate strut and tie models (STMs). Bridge designers find these STMs to be difficult to create. For Tx-Girders near their span limit, the bottom flange is nearly full of prestressing steel, and the web will have harped strands over a significant height. For U-beams, X-beams, slab beams, decked slab beams, and box beams, there will be many debonded strands to different lengths in addition to strands bonded over the entire beam length. This project aims to create a series of STMs for the end regions of Tx-Girders, U-beams, box beams, X-beams, slab beams, and decked slab beams. These STMs will be used to study the interaction between shear, flexure, and the anchorage of longitudinal tie(s), with the ultimate goal of deriving simplified shear stress limits.

Total Project Budget	Research University	FY 2020 Budget
$399,736.00	Center for Transportation Research, The University of Texas at Austin	$166,156.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Oguzhan Bayrak, CTR

Project Advisor	Organization
Addisu Tilahun	BRG
Laura Garcia	BRG
Victoria McCammon	BRG

0-7016-Structural Behavior of Tall Haunches in TxDOT Beam and Girder Bridges

Start Date: 7/10/2019 **End Date: 10/31/2022**

Project Description

Deck haunches are commonly used on both prestressed concrete and structural steel girder bridges. The haunch is the area between the top of a bridge girder and the bottom of the concrete deck. Haunch geometry can be influenced by a variety of factors. A primary function of the haunch is to maintain a uniform deck thickness. Haunches are often needed to account for camber and cross-slope. Due to unusual geometric situations or design errors, beam and girder bridges sometimes require tall haunches, which calls into question the overall constructability and horizontal shear transfer between the girders and the deck. To date, no testing has been conducted to ensure the effectiveness of current TxDOT detailing practices. The proposed project will develop guidelines for analyzing and designing haunches having different heights and reinforcement detailing. The research will include full-scale laboratory testing of a wide range of haunch details for both prestressed concrete and structural steel girder bridges. Detailed computational models will also be developed. A parametric study will represent the range of dimensions encountered in the vast majority of Texas bridges. Haunch analysis, design, and detailing guidelines will be provided at the conclusion of this project.

Total Project Budget	Research University	FY 2020 Budget
$990,349.00	Center for Transportation Research, The University of Texas at Austin	$307,912.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Eric Williamson, CTR

Project Advisor	Organization
Benjamin Ramirez	SSD
Curtis Rokicki	BRG
Michael Hyzak	BRG
Yongqian Lin	HOU

0-7017-Use of Rapid Setting Hydraulic Cement (RSHC) for Structural Applications

Start Date: 7/3/2019 **End Date: 8/30/2022**

Project Description

The goal of this project is to determine feasibility of using rapid setting cements as a cost-effective solution for structural applications in Texas, specifically in bridge structural components and decks. The PERFORMING AGENCY, or "research team", will (1) synthesize relevant information available on rapid cements in published (and unpublished) literature, (2) conduct a survey of domestically available and structurally feasible rapid setting cements for use in TxDOT bridge deck construction, (3) perform a comprehensive experimental evaluation covering a range of fresh and hardened material properties for calcium sulfoaluminate (CSA) cement, calcium aluminate cement (CAC), Type III cement, and combinations of all three, (4) verify and demonstrate adequate performance characteristics and durability performance based on laboratory testing, (5) correlate performance characteristics with material and placement costs, and (6) develop guidelines and specification for implementation of rapid setting cements for use on bridge structures and decks in Texas.

Total Project Budget	Research University	FY 2020 Budget
$465,000.00	Texas State University-San Marcos	$160,227.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Federico Aguayo, TSUSM

Project Advisor	Organization
Masoud Moradian	MTD
Doug Beer	BRG
Andy Naranjo	MTD
Rachel Cano	MTD

0-7030-Synthesis of Engineered Cementitious Composites (ECC) for its Applications in Texas

Start Date: 9/16/2019 **End Date: 8/31/2020**

Project Description

Among the groups of High-Performance Fiber-Reinforced Cementitious Composites (HPFRCC), Engineered Cementitious Composites (ECC) is a special type that is characterized by high-ductility (3-5% of strain) and moderate tensile strength (4-6 MPa), with 1.5-2% fiber contents by volume. Under tensile deformation, ECC shows a strain-hardening behavior and closely spaced microcracks after the first cracking. ECC has excellent shear capacity, improved damage tolerance, ability to control crack width, and synergistic interaction with reinforcing bars. The initial cost of ECC is higher than the regular concrete, but the use of ECC may reduce the life-cycle cost and corresponding environmental impact, as well as provide improved safety because of the superior ductility. The objective of this project is to identify the applications in which the use of ECC can be utilized in the Texas transportation system. To achieve this goal, the performing agency shall conduct seven tasks, categorized into three activities: (1) a comprehensive literature review with in-depth meta-analyses, (2) a survey for state, federal, and international agencies, and (3) a cost-benefit analysis considering the Texas environment, life-cycle cost, and environmental impact. Based on the collected data and analysis, recommendations on ECC applications in Texas and considerations in mixture-design, production, and constructions of ECC shall be provided.

Total Project Budget	Research University	FY 2020 Budget
$60,000.00	The University of Texas Rio Grande Valley	$60,000.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Philip Parks, UTRGV

Project Advisor	Organization
Andy Naranjo	MTD
Doug Beer	BRG
Masoud Moradian	MTD

0-7038-Develop Bridge Weigh-in-Motion Approach to Measure Live Loads on Texas Highways

Start Date: 10/21/2019 **End Date: 10/31/2022**

Project Description

The primary objective for bridge weigh-in-motion (B-WIM) systems is to characterize the truck loading on a given corridor. B-WIM (compared to pavement weigh-in-motion) is potentially less disruptive to traffic, more durable, more economical, safer to install and able to produce more accurate traffic data. This project aims to realize these potential advantages through the development of a B-WIM system that includes extensive experimental testing. The system shall identify the truck gross weight, axles (weights, number and spacing), speed and vehicle classification. A secondary objective of B-WIM is to evaluate the bridge itself. The Performing Agency shall develop an approach to identify bridge parameters such as distribution factors, percent composite action, dynamic impact factor, and stress cycles from B-WIM data. The Performing Agency shall include site-specific load ratings on the final bridge evaluations. The overall purpose of B-WIM is to aid the Receiving Agency with future decisions. The major technical objectives of this research are to:

1. Develop and finalize the B-WIM approach through preliminary experimental testing.

2. Select three (3) bridges for the installation of B-WIM systems along crucial corridors.

3. Install the B-WIM system along three (3) in-service bridges, to include calibration of each setup.

4. Conduct traffic data analysis and a validation study.

5. Perform an evaluation of each in-service bridge.

Total Project Budget	Research University	FY 2020 Budget
$414,611.00	Texas A&M Transportation Institute	$129,961.00

Project Manager	Research Supervisor
Chris Glancy, RTI	Matthew Yarnold, TTI

Project Advisor	Organization
Bernie Carrasco	BRG
Biniam Aregawi	BRG
David Fish	BRG
Drake Builta	BRG
Mark Wallace	BRG

0-7040-Evaluation of Corrosion Prevention and Mitigation Approaches Used on Texas Bridges

Start Date: 12/1/2019 **End Date: 8/31/2023**

Project Description

Corrosion of steel has been causing millions of dollars of loss in infrastructure to the state of Texas. Corrosion-resistant reinforcement in concrete structures and painting of steel elements have been the most common mitigation strategies. In addition, weathering steel, metalizing of steel and concrete elements, and cathodic protection (sacrificial anode) have also been applied on Receiving Agency bridges. The performances of different approaches vary with different bridges in different geographic areas (i.e., cold, arid, and humid districts). It is imperative for the Receiving Agency to have a decision tool for conducting effective corrosion prevention for new construction and corrosion mitigation for long-term maintenance. The project objectives are to (1) conduct a synthesis of worldwide field investigations of the performance of corrosion mitigation, (2) perform field evaluations statewide to investigate the effectiveness of corrosion mitigation instrumented in the past, and to (3) perform lab tests, as necessary, to verify findings and to obtain a better understanding of corrosion mitigation approaches.

Total Project Budget	Research University	FY 2020 Budget
$856,910.00	Texas A&M Transportation Institute	$185,093.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Stefan Hurlebaus, TTI

Project Advisor	Organization
Johnnie Miller	MTD
Kevin Pruski	BRG
Lianxiang Du	BRG
Rachel Cano	MTD
Robert Owens	BRG
Sydney Newman	PAR
Teresa Michalk	MTD

0-7041-Develop NextGen Texas Bridge Decks

Start Date: 12/9/2019 **End Date: 12/31/2022**

Project Description

The Performing Agency shall conduct a comprehensive experimental and analytical investigation to develop appropriate design criteria for using partial-depth precast panels that can span the full width of bridge superstructure. The Performing Agency shall develop and validate a precast deck panel system with wire trusses that will integrate with precast panel practices in Texas. The Performing Agency shall study the behavior of full-scale bridge superstructure models under design loads, typical overloads, and at ultimate conditions. The Performing Agency shall develop and test standard details for partial-depth deck panels in the laboratory, for use in the Receiving Agency's standards for bridges constructed in Texas. The Performing Agency shall provide design guidelines that reflect the knowledge developed during the course of the project's experimental and analytical investigations.

Total Project Budget	Research University	FY 2020 Budget
$999,393.00	Center for Transportation Research, The University of Texas at Austin	$179,304.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Oguzhan Bayrak, CTR

Project Advisor	Organization
Christopher Miller	BRG
Jorge Carrasco	AUS
Kevin Moyer	AUS
Michael Hyzak	BRG
Rachel Larcom	AUS
Taya Retterer	BRG

0-7042-Use of Larger Diameter Shear Studs for Composite Steel Bridges

Start Date: 12/17/2019 **End Date: 12/31/2022**

Project Description

Efficient steel bridge girder design makes use of composite action between the concrete bridge deck and the steel girders. Shear studs welded to the girder top flange provide the critical link between the deck and girders. Satisfying AASHTO fatigue requirements normally leads to a very large number of shear studs, which makes placing partial-depth precast panels extremely difficult and results in a safety hazard for workers during erection or early construction stages. Using larger-diameter shear studs shall significantly reduce the number of studs required on composite steel girders. This project focuses on the feasibility of using shear stud diameters greater than 7/8 inch for composite steel bridge construction, and the development of design guidelines for evaluating the static and fatigue strength of larger diameter shear studs. The Performing Agency shall perform: 1) laboratory testing using push-out or similar specimens to obtain data to evaluate both the static strength and fatigue strength of larger diameter shear studs. 2) large-scale composite beam tests and associated computational studies to provide an evaluation of the performance of composite steel bridge girders with larger-diameter shear studs.

Total Project Budget	Research University	FY 2020 Budget
$980,914.60	Center for Transportation Research, The University of Texas at Austin	$191,029.62

Project Manager	Research Supervisor
Chris Glancy, RTI	Michael Engelhardt, CTR

Project Advisor	Organization
Addisu Tilahun	BRG
Benjamin Ramirez	SSD
Greg Turco	BRG
Igor Kafando	BRG
Jamie Farris	BRG
Paul Rollins	BRG

0-7068-Identify and Analyze Inundated Bridge Superstructures in High Velocity Flood Events

Start Date: 10/21/2019 **End Date: 10/31/2021**

Project Description

Bridges are designed to withstand flood and debris loads; however, it is reported that 53% of bridge failures in the U.S. are caused by hydraulic events, including floods, scour, debris, and drifts. Receiving Agency's design policy requires shear keys in stream crossings, based on a freeboard 100-year flood level. This design policy is not applicable to bridges with significant stream velocity and debris in 25- and 50-year floods.

Total Project Budget	Research University	FY 2020 Budget
$223,742.50	The University of Texas at Arlington	$108,678.75

Project Manager	Research Supervisor
Chris Glancy, RTI	Habib Ahmari, UTA

Project Advisor	Organization
Ab Maamar-Tayeb	DES
Charlie Reed	BRG
Michael Hyzak	BRG
RoseMarie Klee	BRG
Sean Yoon	BRG

5-6615-01-Implementing the Next Generation of Ultra-thin Slurry Overlays

Start Date: 5/14/2017 **End Date: 2/29/2020**

Project Description

In research project 0-6615, *Use of Fine Graded Asphalt Mixes,* the research team developed a new generation of slurries to be implemented in test sections around Texas. This new generation of slurries has not been evaluated widely by TxDOT, but several TxDOT districts have expressed an interest in placing these extra-thin mixes as monitor sections.

These new slurries require the use of the next generation slurry placement system, which is not widely available in Texas. This has created a situation where the districts want to place test sections, but the local contractors do not own this new equipment. TxDOT will not let large projects until demonstration sections are constructed and monitored, and the contractors will not purchase the equipment until large projects are let.

Through this implementation project, TxDOT shall validate that the lab results obtained with the slurries translates to superior long-term pavement performance in several districts. This will involve placing multiple test sections in a minimum of three districts. The research team shall conduct performance evaluations and cost-effective calculations, and make recommendations for statewide implementation.

Total Project Budget	Research University	FY 2020 Budget
$360,000.00	Texas A&M Transportation Institute	$60,000.00

Project Manager	Research Supervisor
Wade Odell, RTI	Tom Scullion, TTI

Project Advisor	Organization
Gisel Carrasco	AUS
James Robbins	BRY
Diana Rogerio	SAT

5-6652-01-Shear Behavior of Spliced Post-Tensioned Girders with Ungrouted Tendons

Start Date: 5/14/2019 **End Date: 8/31/2021**

Project Description

The objective of this Implementation Project is to test the implementation of the previously developed research products for cases in which ducts are not grouted or are filled with flexible fillers such as wax. By conducting targeted tests on Receiving Agency spliced girders with ungrouted tendons, the implementation of the previously developed design expressions for such cases shall be accomplished. The calibration of shear capacity reduction factors that consider the influence of duct size and duct material shall be necessary. The case of ungrouted tendons is pertinent to intermediate construction stages before bridges are completed, or in cases where Receiving Agency may consider using fillers that have not been tested or used previously.

Total Project Budget	Research University	FY 2020 Budget
$380,489.00	Center for Transportation Research, The University of Texas at Austin	$152,890.00

Project Manager	Research Supervisor
Joanne Steele, RTI	Oguzhan Bayrak, CTR

Project Advisor	Organization
Christina Gutierrez	MTD
Greg Turco	BRG
Jason Tucker	MTD
Joe Roche	MTD
Leon Flournoy	SAT
Michael Hyzak	BRG

5-6916-01-Implementation of TxDOT Seismic Vulnerability Measures and Post-Event Actions

Start Date: 4/23/2019 **End Date: 8/31/2020**

Project Description

Objectives of the Implementation project include: (1) knowledge transfer of complex data including numerical models and dynamic GIS-based data sets; (2) instructions for maintaining and updating shear wave velocities, hazard maps, and fragility curves; (3) automation of post-earthquake response plan; (4) a survey of what other states and agencies have chosen as a "threshold for action"; (5) training for Receiving Agency staff on how to use automated tools, such as the U.S. Geological Survey (USGS) ShakeCast web application, to quickly decide upon immediate post-earthquake inspection measures.

Total Project Budget	Research University	FY 2020 Budget
$150,466.50	Center for Transportation Research, The University of Texas at Austin	$98,523.04

Project Manager	Research Supervisor
Joanne Steele, RTI	Patricia Clayton, CTR

Project Advisor	Organization
Drake Builta	BRG
Frank Estrada III	FTW
Graham Bettis	BRG
Manuel Padron Jr	FTW
Marie Fisk	BRG
Mark Wallace	BRG
Steven Austin	BRG
Trenton Ellis	BRG

5-6957-01-Slope Repair and Maintenance Management System

Start Date: 1/23/2019 **End Date: 8/31/2020**

Project Description

The objectives of this implementation project are to (1) collect data and create layers of an existing Receiving Agency ArcGIS database for assessing conditions of slopes and slope repairs, (2) develop slope failure predictive models, (3) monitor slope failures, calibrate slope failure predictive models and update the location of critical segments of the corridors, (4) recommend rapid, resilient, and sustainable repair methods to prevent recurring failures, and (5) develop a repair and maintenance master plan. The project shall be performed for the Receiving Agency's Paris District.

Total Project Budget	Research University	FY 2020 Budget
$248,722.00	The University of Texas at Arlington	$124,361.00

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Mohsen Shahandashti, UTA

Project Advisor	Organization
Sydney Newman	PAR
Chad Ingram	PAR

Projects by Functional Area Committees
RTI Program Administration and Texas Technology Transfer/Program Support

Project	Title	Start Date	Page
0-6974	Digital Publication and Outreach Services in Support of Research	7/11/2018	132
0-9902-17/15437	Research Library	9/1/2017	133
0-9905-20	Study & Test Safe Integration of Automated Driving Systems on Rural Texas Roadways (70-0XXIA001)	Pending	134
5-0575-16	Texas Local Technical Assistance Program (TxLTAP)	9/29/2015	135

*Note: In the following Project Descriptions, the Receiving Agency is TxDOT and the Performing Agency is the University conducting the research.

RTI Program Administration and Texas Technology Transfer/Program Support Projects

0-6974-Digital Publication and Outreach Services in Support of Research

Start Date: 7/11/2018 End Date: 8/31/2020

Project Description

The Performing Agency shall produce Video Summary Reports (VSRs) for the Receiving Agency, which summarize transportation research and implementation projects. Additionally, the Performing Agency shall produce outreach materials for the Receiving Agency that will be transportation research-related material, and may include additional related subjects of interest.

Total Project Budget	Research University	FY 2020 Budget
$432,575.00	Texas A&M Transportation Institute	$196,706.00

Project Manager	Research Supervisor
Phillip Hempel, RTI	Kelly West, TTI

0-9902-17/15437- Research Library

Start Date: 9/1/2017 **End Date: 8/31/2020**

Project Description

The Receiving Agency's Research and Technology Implementation Division (RTI) is in need of specialized public libraries' effective services for housing and distributing resources, related to research in the transportation industry (hereinafter referred to as "RTI Research Library"). Digitally formatted scientific data, resulting from unclassified research shall be stored and made publicly accessible for searching, retrieval and analysis. The RTI Research Library can support this effort through development of a public access plan, making RTI data available and free to the public, through the on-line catalog, which acts as a digital repository. As an archive, the RTI Research Library shall ensure long-term stewardship of the data. The RTI Research Library currently contains more than 26,000 unique titles of transportation-related reading and reference materials. The Performing Agency shall provide RTI Research Library services, fulfilling and responding to the research needs of the greater transportation community, providing leadership, access to both print and electronic transportation resources, and utilizing both partnerships and collaboration while it offers premier research and knowledge management services. The Performing Agency shall provide the facility to house and facilitate public access to transportation information and results, along with specialized skills that will be required to effectively and responsibly serve as the RTI Research Library.

Total Project Budget	Research University	FY 2020 Budget
$1,127,145.22	Center for Transportation Research, The University of Texas at Austin	$466,254.54

Project Manager	Research Supervisor
Renee Suaste, RTI	Kevyn Barnes, CTR

0-9905-20/70-0XXIA001-Study & Test the Safe Integration of Automated Driving Systems on Rural Texas Roadways

Start Date (Projected): Pending **End Date: 12/31/2024**

Project Description

USDOT awarded federal funds to study and test the safe integration of automated driving systems on rural Texas roadways. Automated Driving Systems (ADS) has the potential to improve safety throughout the roadway system. The main purpose of tests in rural areas is to bring the safety benefits of ADS to the elderly and people with disabilities. The Performing Agency shall study and focus on testing rural roads as well as multimodal driving environments in Texas, to bring the safety benefits of autonomous driving to all Americans. Data collected will be utilized to address issues related to measuring safety, infrastructure needs, ensuring equity and access, developing a reliable human-machine interface, capturing the impact of "safe design" on efficiency, and identifying safe operating conditions. The Performing Agency shall conduct extensive testing and data collection using the Performing Agency's Connected Automated Vehicle (CAV) and conduct simulation studies during the development phase, to ensure the safety and reliability of the design.

Total Project Budget	Research University	FY 2020 Budget
$7,063,087.00	Texas A&M Engineering and Experiment Station	$1,552,265.00

Project Manager	Research Supervisor
Tom Schwerdt, RTI	Natalia Ruiz Juri, TEES

Project Advisor	Organization
Jianming MA	TRF
Akila Thamizharasan	TPP
Lewis Nowlin	SJT
Zeke Reyna	STR

5-0575-16-Texas Local Technical Assistance Program (TxLTAP)

Start Date: 9/29/2015 **End Date: 8/31/2020**

Project Description

This program will demonstrate a nationally recognized standard of excellence for meeting the varied training and technical assistance needs of the large and diverse population of local, city, and county road agencies in Texas, aligning and presenting training and technical assistance services and being known as the training and technical resource for local road agencies in Texas. The program will focus on: 1) preserving and enhancing the local road system; 2) delivering quality training and technical assistance to local, city and county road agencies in Texas; and 3) facilitating the growth and performance of transportation professionals in a safe, efficient, environmentally sound and cost-effective manner, while maximizing benefit from limited fiscal and staffing resources.

Total Project Budget	Research University	FY 2020 Budget
$5,626,801.68	The University of Texas at Arlington	$1,298,676.08

Project Manager	Research Supervisor
Shelley Pridgen, RTI	Bryan Sims, UTA

Project Advisor	Organization
Katie Salter	HRD

FY 2020 Transportation Pooled-Fund Projects

The following are project descriptions of pooled-fund projects, for which Texas is contributing funds. More about these funds can be found here: https://www.pooledfund.org/.

Project	Name	Study Number	Agencies	Start –End Date	TxDOT FY 20 Budget
8-8446	Performing Forensic Evaluations of LTPP Remaining Sections Before They Leave Service	TPF-5 (332)	Washington State Department of Transportation	2016-2020	$20,000.00
8-8449	2016 through 2020 Biennial Asset Management Conference and Training on Implementation Strategies	TFP-5 (335)	Iowa Department of Transportation	2016-2020	$6,000.00
8-8453	Roadside Safety Research for MASH Implementation	TPF-5 (343)	Washington State Department of Transportation	2016-2020	$50,000.00
8-8454	Improving the Quality of Highway Profile Measurement	TPF-5 (354)	South Dakota Department of Transportation	2016-2020	$20,000.00
8-8455	Develop and Support Transportation Performance Management Capacity Development Needs for State DOTs	TPF-5 (326)	Rhode Island Department of Transportation	2017-2022	$283,000.00
8-8456	Transportation Management Center Pooled Fund Study	TPF-5 (319)	Federal Highway Administration	2016-2020	$50,000.00
8-8461	Pavement Surface Properties Consortium - Managing the Pavement Properties for Improved Safety	TPF-5 (345)	Virginia Department of Transportation	2017-2021	$20,000.00
8-8462	Clear Roads Phase II	TPF-5 (353)	Minnesota Department of Transportation	2017-2021	$25,000.00
8-8463	Building Information Modeling (BIM) for Bridges and Structures	TPF-5 (372)	Iowa Department of Transportation	2018-2022	$20,000.00

8-8465	Autonomous Maintenance Technology (AMT)	TPF-5 (380)	Colorado Department of Transportation	2018-2020	$25,000.00
8-8466	Enhanced Traffic Signal Performance Measures	TPF-5 (377)	Indiana Department of Transportation	2018-2020	$30,000.00
8-8467	Accelerated Performance Testing on the 2018 NCAT Pavement Test Track with MnROAD Research Partnership	TPF-5 (374)	Alabama Department of Transportation	2018-2020	$350,000.00
8-8469	Exploring Non-Traditional Methods to Obtain Vehicle Volume and Class Data	TPF-5 (384)	Federal Highway Administration	2018-2020	$25,000.00
8-8470	Improve pavement surface distress and transverse profile data collection and analysis, Phase II	TPF-5 (399)	Federal Highway Administration	2019-2024	$20,000.00
8-8471	National Partnership to Determine the Life Extending Benefit Curves of Pavement Preservation Techniques (MnROAD/NCAT Joint Study – Phase II)	TPF-5 (375)	Minnesota Department of Transportation	2018-2020	$50,000.00
8-8472	Improvements to the Infrastructure Carbon Estimator (ICE)	TPF-5 (362)	Minnesota Department of Transportation	2018-2020	$15,000.00
8-8473	Pavement Structural Evaluation with Traffic Speed Deflection Devices (TSDDs)	TPF-5 (385)	Virginia Department of Transportation	2019-2021	$109,000.00
8-8478	Traffic Disruption-Free Bridge Inspection Initiative with Robotic Systems	TPF-5 (395)	Missouri Department of Transportation	2019-2020	$25,000.00
8-8479	Connected Vehicle Pooled Fund Study	TPF-5 (389)	Virginia Department of Transportation	2019-2020	$50,000.00

8-8481	Development of Criteria to Assess the Effects of Pack-out Corrosion in Built-up Steel Members	TPF-5 (436)	Indiana Department of Transportation	2019-2021	$40,000.00
8-8482	Smart Work Zone Deployment Initiative (FY20-FY24)	TPF-5 (438)	Iowa Department of Transportation	2020-2024	$25,000.00
8-8484	EconWorks - Improved Economic Insight	1500	Arkansas Department of Transportation	2020-2024	$4,000.00
8-8486	Technology Transfer Concrete Consortium (FY20-FY24)	1492	Iowa Department of Transportation	2020-2024	$8,000.00
8-8487	No Boundaries Transportation Maintenance Innovations	1504	Colorado Department of Transportation	2020-2025	$10,000.00
8-8488	Transportation Research and Connectivity (librarian toolkit / knowledge networking / information condition / analysis of resources / digitization efforts / ADA support)	TPF-5 (442)	Oklahoma Department of Transportation	2020-2022	$25,000.00
8-8489	Structural Behavior of Ultra-High Performance Concrete	1510	Federal Highway Administration	2020-2022	$25,000.00
8-8490	Traffic Safety Culture - Phase 2	TPF-5 (444)	Montana Department of Transportation	2020-2024	$50,000.00
8-8491	Center for the Aging Infrastructure: Steel Bridge Research, Inspection, Training and Education Engineering Center - SBRITE	TPF-5 (281)	Indiana Department of Transportation	2020-2021	$50,000.00
Pooled Fund Current Obligation Totals					$1,430,000.00

Pooled Fund Projects

Project Number: 8-8446 **TxDOT Technical Contact:** Roberto Trevino Flores

Study Number: TPF-5(332)

Project Title: Performing Forensic Evaluations of LTPP Remaining Sections Before They Leave Service

Lead Agency: Washington State Department of Transportation

Status: Cleared by FHWA

Project Objectives: Create a pooled fund to rapidly complete forensic evaluations of LTPP sections before going out of service. Approximately 750 sections remain in service.

Financials:	Year	Commitment
TxDOT	2020	$20,000.00

Pooled Fund Projects

Project Number: 8-8449 **TxDOT Technical Contact:** Magdy Mikhail

Study Number: TFP-5(335)

Project Title: 2016 through 2020 Biennial Asset Management Conference and Training on Implementation Strategies

Lead Agency: Iowa Department of Transportation

Status: Contract Signed

Project Objectives:

1. Provide communication and information sharing among member states. Discuss research needs and provide research ideas to TRB.

2. Provide a technology and knowledge exchange forum to enhance the practical knowledge of member states concerning asset management implementation.

3. Enhance the working knowledge of the asset management community.

Financials:	Year	Commitment
TxDOT	2020	$6,000.00

Pooled Fund Projects

Project Number: 8-8453 **TxDOT Technical Contact:** Christopher Lindsey

Study Number: TPF-5(343)

Project Title: Roadside Safety Research for MASH Implementation

Lead Agency: Washington State Department of Transportation

Status: Cleared by FHWA

Project Objectives: The objective of the Roadside Safety Pooled Fund Program is to provide a cooperative approach to conducting research on roadside safety hardware. Emphasis will be placed on assisting State DOTs with their implementation of MASH and addressing other roadside safety needs of common interest. Another objective of this pooled fund research is to provide each participating state an opportunity to send a representative to an annual meeting to collaborate with other state DOT safety engineers to assess best practices, new regulatory issues, risk management strategies, and other matters pertaining to roadside safety. Participation in this meeting is funded through the state's annual program contribution.

Financials:	Year	Commitment
TxDOT	2020	$50,000.00

Pooled Fund Projects

Project Number: 8-8454 **TxDOT Technical Contact:** Feng Hong

Study Number: TPF-5(354)

Project Title: Improving the Quality of Highway Profile Measurement

Lead Agency: South Dakota Department of Transportation

Status: Cleared by FHWA

Project Objectives:
1) Deliver sample procurement specification, maintenance guidelines.
2) Direct and support development and maintenance of pavement profile analysis software.
3) Establish criteria for profile verification and assist with development of validation sites.
4) Develop and deploy pavement profile reference device(s) and a traceable verification process.
5) Provide technical support for the Road Profile Users' Group and conduct annual face-to-face meetings in conjunction with the group.

Financials:	Year	Commitment
TxDOT	2020	$20,000.00

Pooled Fund Projects

Project Number: 8-8455 **TxDOT Technical Contact:** Kent Marquardt

Study Number: TPF-5(326)

Project Title: Develop and Support Transportation Performance Management (TPM) Capacity Development Needs for State DOTs

Lead Agency: Rhode Island Department of Transportation

Status: Cleared by FHWA

Project Objectives: The focus of this pooled fund project will be to research and assess training and educational needs of contributing members, develop and deliver training, and to facilitate the sharing and retention of performance management best practices. Funding will be used to:

1) Identify Gaps in TPM Knowledge, Skills and Abilities - Conduct a needs analysis for learning and capacity development of contributing members resulting in a short and long-term capacity building roadmap;
2) Develop and Deliver Learning and Capacity Development Resources - Develop training and educational material to meet the gaps identified in the knowledge, skills and abilities;
3) Establish a TPM Information Clearinghouse - The TPM Information Clearinghouse will be used to showcase PM best practices, foster collaboration, and serve as a repository for PM resources; and
4) Support Knowledge Transfer Among Pooled Fund States.

Financials:	Year	Commitment
TxDOT	2020	$283,000.00

Pooled Fund Projects

Project Number: 8-8456 **TxDOT Technical Contact:** David McDonald

Study Number: TPF-5(319)

Project Title: Transportation Management Center Pooled Fund Study

Lead Agency: Federal Highway Administration

Status: Cleared by FHWA

Project Objectives: The goal of the TMC PFS is to assemble regional, state, and local transportation management agencies and the Federal Highway Administration (FHWA) to

(1) identify human-centered and operational issues;
(2) suggest approaches to addressing identified issues;
(3) initiate and monitor projects intended to address identified issues;
(4) provide guidance and recommendations and disseminate results;
(5) provide leadership and coordinate with others with TMC interests;
(6) promote and facilitate technology transfer related to TMC issues nationally.

Financials:	Year	Commitment
TxDOT	2020	$50,000.00

Pooled Fund Projects

Project Number: 8-8461 **TxDOT Technical Contact:** Jenny Li

Study Number: TPF-5(345)

Project Title: Pavement Surface Properties Consortium – Managing the Pavement Properties for Improved Safety

Lead Agency: Virginia Department of Transportation

Status: Cleared by FHWA

Project Objectives: The main objective of the pooled-fund program of research has been to conduct applied research focused on enhancing the level of service provided by the roadway transportation system by optimizing pavement surface characteristics. Phase I of the study included regular verification and validation of the participant's equipment, opportunities for technology transfer, and the accumulation of a significant body of knowledge on the measurement of pavement surface properties. Practical and tangible results were documented and disseminated through a large number of publications listed in the Phase 1 Outcomes (see study Documents). Examples of technologies that were evaluated as part of this program include high-friction surfaces (HFS) and Continuous Friction Measuring Equipment (CFME). HFS treatments have been adopted as a low-cost countermeasure as part of the Every-day-Counts FHWA program. CFME's are currently being used to support the development of a new generation of friction management programs. Phase II of the program continues to support the member's effort to produce high-quality surface properties measurements but focuses on supporting the enhancing and adoption of emerging friction and macrotexture measurement technologies and the integration of these measurements into the next generation of pavement asset management systems. The focus will be on developing and deploying asset management approaches and tools that help improve the safety of our road networks by reducing the number of crashes and related fatalities. It will also seek participation of industry through the pooled-fund or an industrial affiliate program.

Financials:	Year	Commitment
TxDOT	2020	$20,000.00

Pooled Fund Projects

Project Number: 8-8462 **TxDOT Technical Contact:** James Stevenson

Study Number: TPF-5(353)

Project Title: Clear Roads Phase II

Lead Agency: Minnesota Department of Transportation

Status: Cleared by FHWA

Project Objectives: Objectives of the new phase of the Clear Roads Pooled Fund project will include:

- Conduct structured field testing and evaluation across a range of winter conditions and different highway maintenance organizational structures to assess the practical effectiveness, ease of use, optimum application rates, barriers to use, durability, safety, environmental impact, and cost-effectiveness of innovative materials, equipment, and methods for improved winter highway maintenance.
- Conduct research that explores the use of innovative materials, equipment, and processes that will promote environmentally sustainable winter maintenance operations.
- Conduct cost-benefit analyses to ensure that new technologies, materials, or methods contribute to operational efficiency.
- Investigate state agency uses of performance measures for winter operations and develop management tools that support effective analysis and reporting of the measures.
- Establish industry standards and develop performance measures for evaluating and utilizing new materials and technologies.
- Support technology transfer by developing and disseminating practical field guides and training curriculum to promote the results of research projects.
- Conduct national surveys to compile and document agency practices on the latest operational issues (for example salt shortages, level of service requirements, or other "hot button" issues).
- Conduct quicker turnaround, lower cost, synthesis projects to investigate the latest research and practices on pressing winter maintenance topics.
- Coordinate with the Aurora Pooled Fund

Project Number 8-8462 Cont.

(http://www.aurora-program.org/) to enhance the impact, and avoid duplication, of winter road weather research.

- Promote public education and outreach related to winter maintenance and winter driving safety.

Financials:	Year	Commitment
TxDOT	2020	$25,000.00

Pooled Fund Projects

Project Number: 8-8463 **TxDOT Technical Contact:** Courtney Holle

Study Number: TPF-5(372)

Project Title: Building Information Modeling (BIM) for Bridges and Structures

Lead Agency: Iowa Department of Transportation

Status: Cleared by FHWA

Project Objectives: The pooled fund project will provide the primary funding mechanism for AASHTO SCOBS T-19 to perform the duties of governance and stewardship of BIM for Bridges and Structures.

Financials:	Year	Commitment
TxDOT	2020	$20,000.00

Pooled Fund Projects

Project Number: 8-8465 **TxDOT Technical Contact:** Barbara Russell

Study Number: TPF-5(380)

Project Title: Autonomous Maintenance Technology (AMT)

Lead Agency: Colorado Department of Transportation

Status: Cleared by FHWA

Project Objectives: The mission of this study is to support and promote collaborative research efforts in the field of autonomous technologies in work zone applications, with the goal of improving the safety, efficiency and quality of work efforts, along with providing better solutions and valuable lessons learned for the integration of new technologies to further these goals. The participation of many transportation related agencies in this study furthers the cooperation in this industry, leading to improved future development of beneficial technologies and improved sharing of information and lessons learned. This is intended to further safety, efficiency, and quality of work done in this field for all relevant agencies.

Financials:	Year	Commitment
TxDOT	2020	$25,000.00

Pooled Fund Projects

Project Number: 8-8466 **TxDOT Technical Contact:** Barbara Russell

Study Number: TPF-5(377)

Project Title: Enhanced Traffic Signal Performance Measures

Lead Agency: Indiana Department of Transportation

Status: Cleared by FHWA

Project Objectives: Enhance and expand the Traffic Signal Performance Measures that were developed under Pooled Fund Project TPF-5(258) and adopted under EDC-4.

This project is to address two needs that have emerged:

1. Traffic Signal Data Logger Update: Update the data logger specification to provide secure file transfer, incorporate new enumerations that have emerged, and logging new connected vehicle messages.
2. Probe Data: Current probe data tools are focused on freeway data. There is a need to build upon the work of Indiana and Pennsylvania DOTs to develop methodologies and tools for using high resolution vehicle trajectory data to compute traffic signal performance measures.

Both of these initiatives would complement the past work the multi-state team has done in the area of traffic signal performance measures.

Financials:	Year	Commitment
TxDOT	2020	$30,000.00

Pooled Fund Projects

Project Number: 8-8467 **TxDOT Technical Contact:** Ryan Barborak

Study Number: TPF-5(374)

Project Title: Accelerated Performance Testing on the 2018 NCAT Pavement Test Track with MnROAD Research Partnership

Lead Agency: Alabama Department of Transportation

Status: Cleared by FHWA

Project Objectives: The primary objectives of the pooled fund project described herein will be:

1. Constructing 200 ft. test sections on the existing 1.7-mile NCAT test oval that are representative of in-service roadways on the open transportation infrastructure. Each section will be built precisely in accordance with the directives of the research sponsor. Consequently, the final experiment design will likely not be determined until just before the summer of 2018;

2. Applying accelerated performance truck traffic in the 2 years following construction, and extending traffic at the discretion of research sponsors on sections built in previous research cycles both on the NCAT test oval and at MnROAD for the duration of the 3-year research cycle. Design traffic for each unique research cycle on the NCAT test oval is 10 million equivalent single axle loadings (ESALs);

3. Assessing/comparing the functional and structural field performance of trafficked sections on a regular basis via surface and subsurface measures. Surface performance measures are comprehensive and MAP-21 compliant. Subsurface high-speed response measurements will be used to document how each structural section responds to passing loads as a function of temperature, age, and damage accumulation;

4. Validating/calibrating new and existing M-E approaches to pavement analysis and design using pavement surface condition, pavement load response, precise traffic and environmental logging, and cumulative damage. Calibration is essential to the successful implementation of AASHTOWare's Pavement ME Design as well as other M-E design programs. Implementation without calibration often results in overly conservative designs;

5. Correlating field results with laboratory data for both mechanistic and preservation applications. Laboratory performance data that can predict

Project Number 8-8467 Cont.

long term preservation outcomes will provide DOTs with an additional mechanism for making rational selection decisions. State-of-the-art laboratory testing will be utilized, with a focus on balanced mix design;

6. Answering practical questions posed by research sponsors through formal (i.e., reports and technical papers) and informal (e.g., one-on-one responses to sponsor inquiries) technology transfer. For example, can the same laboratory tests be used to screen both virgin and high binder replacement (i.e., higher RAP and RAS) mixes for cracking susceptibility for both mix design approval and quality control test applications? Support for implementation through the development of guide specifications, training, and technical support are research products.

Financials:	Year	Commitment
TxDOT	2020	$350,000.00

Pooled Fund Projects

Project Number: 8-8469 **TxDOT Technical Contact:** Chris Didear

Study Number: TPF-5(384)

Project Title: Exploring Non-Traditional Methods to Obtain Vehicle Volume and Class Data

Lead Agency: Federal Highway Administration

Status: Cleared by FHWA

Project Objectives: The objective of this pooled fund project is to develop and deploy methods and approaches to obtain vehicle volume and classification data with passively collected data.

Volume data refers to the annual average daily traffic (AADT) for all vehicles (both passenger and trucks) covering all roadway functional classes by traffic link or finer levels of segmentation with emphasis on functional classes of minor arterials, collectors, and local roads.

Volume data on high volume urban interstates is also highly desired as there is a greater risk for collecting this data in these environments because maintenance of traffic is more expensive and these activities can disrupt normal traffic patterns.

Financials:	Year	Commitment
TxDOT	2020	$25,000.00

Pooled Fund Projects

Project Number: 8-8470 **TxDOT Technical Contact:** Jenny Li

Study Number: TPF-5(399)

Project Title: Improve pavement surface distress and transverse profile data collection and analysis, Phase II

Lead Agency: Federal Highway Administration

Status: Cleared by FHWA

Project Objectives: Improve the Quality of Pavement Surface Distress and Transverse Profile Data Collection and Analysis by assembling SHAs, the FHWA, and industry representatives to:

- Identify data collection integrity and quality issues
- Identify data analysis needs
- Suggest approaches to addressing identified issues and needs

Based on this information, the SHAs and the FHWA will:

- Initiate and monitor projects intended to address identified issues and needs
- Disseminate results
- Assist in solution deployment

Financials:	Year	Commitment
TxDOT	2020	$20,000.00

Pooled Fund Projects

Project Number: 8-8471 **TxDOT Technical Contact:** Feng Hong

Study Number: TPF-5(375)

Project Title: National Partnership to Determine the Life Extending Benefit Curves of Pavement Preservation Techniques (MnROAD/NCAT Joint Study-Ph. II)

Lead Agency: Minnesota Department of Transportation

Status: Cleared by FHWA

Project Objectives: MnROAD and NCAT are seeking organizations to join the partnership for the second phase of research efforts. Main objectives include:

1.Determining the life cycle cost of various pavement preservation alternatives in a highly controlled experiment that will provide state Departments of Transportation (DOTs) with the financial foundation to begin to build a decision tree for their own maintenance program.
2. Develop quality assurance QA field testing protocols to correlate construction practices with long term performance of pavement preservation techniques.
3. Technology transfer - Answering practical questions posed by research sponsors through formal (i.e., reports & technical papers) & informal (e.g., one-on-one responses to sponsor inquiries) technology transfer and determining how these life-extending benefits can be best utilized in each state.

Financials:	Year	Commitment
TxDOT	2020	$50,000.00

Pooled Fund Projects

Project Number: 8-8472 **TxDOT Technical Contact:** Jackie Ploch

Study Number: TPF-5(362)

Project Title: Improvements to the Infrastructure Carbon Estimator (ICE)

Lead Agency: Minnesota Department of Transportation

Status: Cleared by FHWA

Project Objectives: The project intends to make the following improvements to the ICE tool, based on stakeholder feedback:
1. Incorporate new research on infrastructure embodied energy and lifecycle greenhouse gas emissions
2. Add analysis of new/additional project types
3. Address GHG reductions from additional mitigation strategies
4. Tailor outputs to better address the energy and GHG emissions from transportation project alternatives and transportation plans
5. Make the interface more intuitive and easier to use

Financials:	Year	Commitment
TxDOT	2020	$15,000.00

Pooled Fund Projects

Project Number: 8-8473 **TxDOT Technical Contact:** Jenny Li

Study Number: TPF-5(385)

Project Title: Pavement Structural Evaluation with Traffic Speed Deflection Devices (TSDDs)

Lead Agency: Virginia Department of Transportation

Status: Cleared by FHWA

Project Objectives: The objective of the proposed pooled-fund project is to establish a research consortium focused on providing participating agencies guidelines on how to specify collection and use data collected with TSDDs for network- and project-level (if feasible) pavement management applications. Specific tasks within this multi-year program will be developed in cooperation with the consortium participants. In addition, the consortium will also provide participating agencies with a mechanism to conduct pilot demonstration testing in their respective networks.

Financials:	Year	Commitment
TxDOT	2020	$109,000.00

Pooled Fund Projects

Project Number: 8-8478 **TxDOT Technical Contact:** Ryan Eaves

Study Number: TPF-5(395)

Project Title: Traffic Disruption-Free Bridge Inspection Initiative with Robotic Systems

Lead Agency: Missouri Department of Transportation

Status: Cleared by FHWA

Project Objectives: The goals of this pooled-fund initiative are to engage closely with several state departments of transportation (DOTs) in the early stage of technology development at the INSPIRE University Transportation Center, and leverage the center resources to develop case studies, protocols, and guidelines that can be adopted by state DOTs for bridge inspection without adversely impacting traffic. The initiative involves the integration, field demonstration and documentation of a robotic system of structural crawlers, UAVs, NDE devices, sensors, and data analytics. Depending on the interest of participating DOTs, the objectives of this initiative include, but are not limited to:

- Development of inspection protocols for various types of bridges with the robotic system integrated into current practice.

- Comparison and correlation of bridge deck inspections from above and underneath decks to understand the reliability of traffic disruption-free bridge inspection from underneath.

- Design and technical guidelines of measurement devices on a robotic platform for the detection of surface and internal damage/deterioration in structural members, and for the change in lateral support of foundations.

- Data fusion and analytics of measurements taken from various imaging and sensing systems for consistency and reliability.

Financials:	Year	Commitment
TxDOT	2020	$25,000.00

Pooled Fund Projects

Project Number: 8-8479 **TxDOT Technical Contact:** Jianming Ma

Study Number: TPF-5(389)

Project Title: Connected Vehicle Pooled Fund Study

Lead Agency: Virginia Department of Transportation

Status: Cleared by FHWA

Project Objectives: 1) To provide technology transfer to state, local, and international transportation agencies as well as vehicle Original Equipment Manufacturers (OEMs) in preparing for the deployment of connected vehicle infrastructure and to provide input to the AASHTO Connected and Automated Vehicle working group, USDOT Connected Vehicle Program, and other national initiatives.

2) To establish a multi-phase program to facilitate research, field demonstration, evaluation, and technology transfer of connected vehicle infrastructure, vehicles, and applications.

3) To aid transportation agencies and OEMs in justifying and promoting the large-scale use of connected vehicle environment and applications through modeling, development, engineering, and planning activities.

Financials:	Year	Commitment
TxDOT	2020	$50,000.00

Pooled Fund Projects

Project Number: 8-8481 **TxDOT Technical Contact:** Michael Hyzak

Study Number: TPF-5(436)

Project Title: Development of Criteria to Assess the Effects of Pack-out Corrosion in Built-up Steel Members

Lead Agency: Indiana Department of Transportation

Status: Cleared by FHWA

Project Objectives: The objectives of the proposed pooled-fund study are as follows:

1) To develop AASHTO ready specifications for the evaluation of the effects of pack-out corrosion in built-up steel tension, compression, and flexural members.

2) Provide guidance on the need for repairs and corrosion rates that can be expected in various environments to assist owners in programming when repairs may need to be made.

3) Identify the most effective methods of repairs and provide suggesting verbiage that could be used when preparing special provisions for repairs.

4) Develop several case-study examples, including calculations that will be used for training users on the methodologies to be developed. It is anticipated that the research team will host a number of webinars or on-site training sessions to ensure technology transfer and implementation.

5) The impact of this study is obvious considering there is no such quantitative guidance available at present. The results of the work will allow owners to accurately assess the effects of this form of corrosion on various limits states (e.g., strength, fatigue, buckling, etc.) in built-up steel members. Both flexural and truss-type members will be studied. The ability to program repairs based on data-driven models allows for the best possible use of limited maintenance funds and safely extend the life of the existing inventory.

Financials:	Year	Commitment
TxDOT	2020	$40,000.00

Pooled Fund Projects

Project Number: 8-8482 **TxDOT Technical Contact:** Nick Aiello

Study Number: TPF-5(438)

Project Title: Smart Work Zone Deployment Initiative (FY20-FY24)

Lead Agency: Iowa Department of Transportation

Status: Cleared by FHWA

Project Objectives: This program represents an on-going effort among cooperating states' DOTs, the FHWA, universities, and industry to evaluate new products and conduct related research focused on the enhancement of safety and mobility in highway work zones. Over 100 studies and evaluations have been completed since the inception of the SWZDI and final reports are posted in the Smart Work Zone Deployment Initiative web site at https://swzdi.intrans.iastate.edu/.

Financials:	Year	Commitment
TxDOT	2020	$25,000.00

Pooled Fund Projects

Project Number: 8-8484 **TxDOT Technical Contact:** Will Etheridge

Study Number: 1500

Project Title: EconWorks - Improved Economic Insight

Lead Agency: Arkansas Department of Transportation

Status: Solicitation posted

Project Objectives: The focus of this pooled fund project will be to support transportation planners with a better understanding of the economic impact of transportation projects by continuing the overall operation, maintenance and improvement to the EconWorks website, and completing and adding additional case studies to provide more robust economic analysis.

Financials:	Year	Commitment
TxDOT	2020	$4,000.00

Pooled Fund Projects

Project Number: 8-8486 **TxDOT Technical Contact:** Andy Naranjo

Study Number: 1492

Project Title: Technology Transfer Concrete Consortium (FY20-FY24)

Lead Agency: Iowa Department of Transportation

Status: Cleared by FHWA

Project Objectives: The goal of the TTCC is to:

- Identify needed research priorities by region
- Provide a forum for technology exchange between participants
- Develop and fund technology transfer materials
- Provide on-going communication of research needs faced by state agencies to the FHWA, industry, and CP Tech Center
- Provide technical leadership for concrete related national initiatives to advance state-of-the-art construction and material practices

Financials:	Year	Commitment
TxDOT	2020	$8,000.00

Pooled Fund Projects

Project Number: 8-8487 **TxDOT Technical Contact:** Alanna Bettis

Study Number: 1504

Project Title: No Boundaries Transportation Maintenance Innovations

Lead Agency: Colorado Department of Transportation

Status: Cleared by FHWA

Project Objectives Through this pooled fund project, the Colorado Department of Transportation (CDOT) will work with other State Departments of Transportation (DOTs) to facilitate the transfer of knowledge of promising non-snow and ice maintenance innovations and technologies. This project provides a forum for State DOTs to share their maintenance innovations with each other, support technology transfer activities and develop marketing and deployment plans for selected innovations through bi-annual 2-3 day peer exchange meetings at various locations selected by participating members. Resources will be provided for the transfer of knowledge and experience of various innovations that includes travel, training and other technology transfer activities. It is anticipated that this consortium will become the national forum for state involvement in the technical exchange needed for collaboration and new initiatives, and be a forum for advancing the application and benefit of research technologies. In addition, the project will create a searchable database or warehouse where innovations and research done relating to highway maintenance can be found and showcased. State participation in this process will be through the pooled fund. FHWA, industry and others will be invited to participate in the project discussions and activities. Workshops will continue to be provided for the states participating in the pooled fund project. This project will help DOTs to save time and money by not investing in the same research that has already been performed by other state DOTs. Rather than having each DOT identify and conduct research separately, DOTs can work collectively through this pooled fund project. The Colorado DOT will serve as the lead state for the execution of the pooled fund project described in this proposal. The Colorado DOT will handle all administrative duties associated with the project.

Financials:	Year	Commitment
TxDOT	2020	$10,000.00

Pooled Fund Projects

Project Number: 8-8488 **TxDOT Technical Contact:** Renee Suaste

Study Number: TPF-5(442)

Project Title: Transportation Research and Connectivity (librarian toolkit/ knowledge networking/information condition/analysis of resources/ digitization efforts/ADA support)

Lead Agency: Oklahoma Department of Transportation

Status: Cleared by FHWA

Project Objectives To support coordinated development of transportation libraries as well as research organizations without dedicated libraries, the following objectives will be undertaken. These objectives will be accomplished through member activities and partnerships with professional groups such as the Transportation Research Board (TRB) Library and Information Science for Transportation Committee (LIST), the Special Libraries Association (SLA) Transportation Division, and the National Transportation Knowledge Network (NTKN). Completed projects will be stored permanently at the NTKN and the National Transportation Library (NTL) for public use and will be completed within the three-year span of the pooled fund study. The specific objectives are listed below:

1. Develop a toolkit of recommendations and best practices for transportation research organizations that do not have a transportation librarian.
2. Partner with the NTKN to analyze effectiveness of Libguides, identify gaps in coverage, and survey the needs of DOTs.
3. Develop a white paper analyzing the current condition of transportation information infrastructure, including review of pertinent knowledge management resources.
4. Develop a cooperative digitization project among members, in partnership with the NTL, to convert copies of older materials to digital formats, as well as providing ADA compliance support for digital documents.
5. Enhance communication between group members (hold annual pooled fund meeting in conjunction with the AASHTO RAC conference).

Financials:	Year	Commitment
TxDOT	2020	$25,000.00

Pooled Fund Projects

Project Number: 8-8489 **TxDOT Technical Contact:** Robert Owens

Study Number: 1510

Project Title: Structural Behavior of Ultra-High-Performance Concrete

Lead Agency: Federal Highway Administration

Status: Solicitation posted

Project Objectives The objective of the proposed project is to develop knowledge pertinent to the structural performance of ultra-high-performance concrete (UHPC). This knowledge will be of significant value as the AASHTO Committee on Bridges and Structures considers the use of UHPC-class materials in highway bridges and structures.

Financials:	Year	Commitment
TxDOT	2020	$25,000.00

Pooled Fund Projects

Project Number: 8-8490 **TxDOT Technical Contact:** Tracie Mendez

Study Number: TPF-5(444)

Project Title: Traffic Safety Culture – Phase 2

Lead Agency: Montana Department of Transportation

Status: Cleared by FHWA

Project Objectives Only through the growth of a positive safety culture can significant and sustainable reductions in crash fatalities and serious injuries be achieved. Towards that end, this pooled fund program will:
(1) conduct research to identify solutions to specific culture-based traffic safety problems, taking advantage of the implementation opportunities to improve traffic safety;
(2) develop resources to enhance understanding and application of traffic safety culture strategies; and
(3) provide technology transfer of best practices in traffic safety culture strategies.

Financials:	Year	Commitment
TxDOT	2020	$50,000.00

Pooled Fund Projects

Project Number: 8-8491 **TxDOT Technical Contact:** Steven Austin

Study Number: TPF-5(281)

Project Title: Center for the Aging Infrastructure: Steel Bridge Research, Inspection, Training and Education Engineering - SBRITE

Lead Agency: Indiana Department of Transportation

Status: Contract signed

Project Objectives The objective is to develop the Steel Bridge Research, Inspection, Training, and Education Engineering Center (S-BRITE Engineering Center) focused on existing steel highway bridges. This National Center will be the first of its kind and will become the leading education, training, research, and engineering center related to all aspects affecting the existing aging steel bridge and structure inventory. Although the Center will be focused on highway bridges, it will also support stakeholders of steel railroad bridges as well as steel ancillary structures, such as lighting towers and sign supports. The Center will contribute to improved asset management decisions for DOTs, FHWA, and other partners relative to existing steel bridge inventory. This impact will be realized by ensuring existence of the following:

- High quality inspection data
- Advanced predictive models
- Improved management decisions
- Timely and effective execution

This will be accomplished by providing solutions to the following:
- inspection reliability issues
- inadequate technical expertise
- training and education opportunities for students and professionals
- short-term and long-term research needs

Once the center is successfully operational, other materials and systems, such as concrete, prestressed, and post-tensioned structures may be added.

Financials:	Year	Commitment
TxDOT	2020	$50,000.00

Research and Technology Implementation Division

End of report