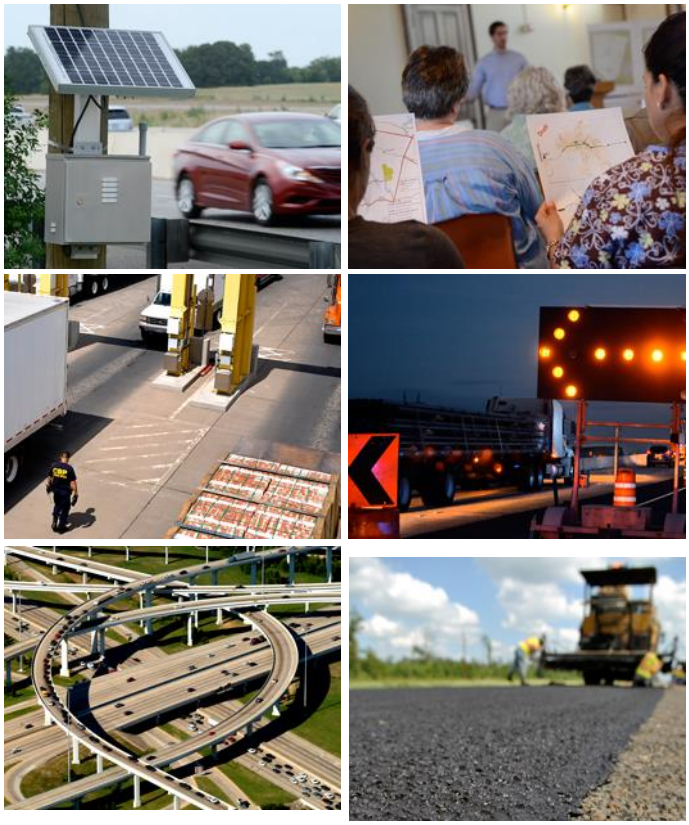
FY 2015 RESEARCH PROGRAM

RESEARCH AND TECHNOLOGY IMPLEMENTATION OFFICE



June 2015

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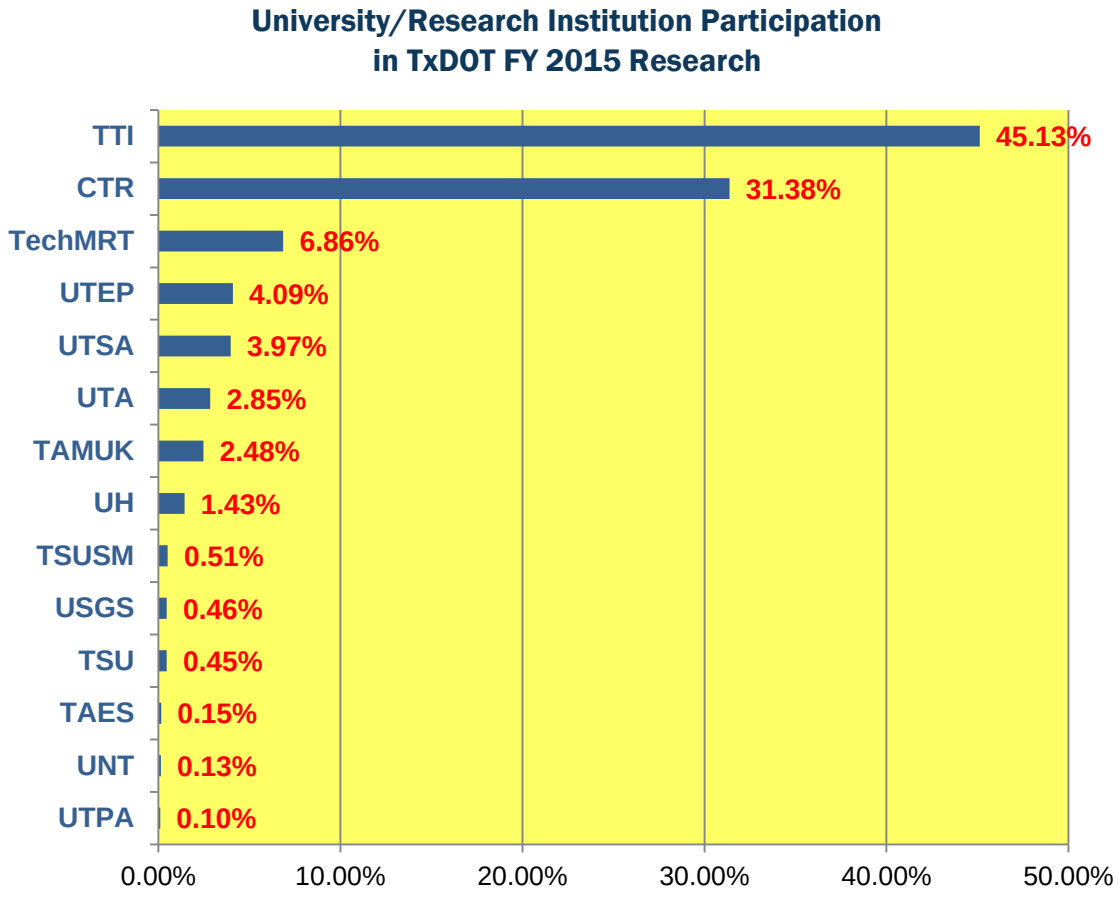
Institutions Active in TxDOT's 2015 Research Program

Acronym	University/Research Institution
CTR	Center for Transportation Research, The University of Texas at Austin
TAES	Texas A&M AgriLife Extension Service
TAMUK	Texas A&M University–Kingsville
TechMRT	Center for Multidisciplinary Research in Transportation, Texas Tech University
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	U.S. Geological Survey
UTA	The University of Texas at Arlington
UTEP	The University of Texas at El Paso
UTPA	The University of Texas–Pan American
UTSA	The University of Texas at San Antonio

Fiscal Year 2015 Research Program

University Participation

TxDOT's fiscal year 2015 research program consists of 101 projects, with budgets totaling $20.2 million. This work is contracted to 12 Texas state-supported universities and the U.S. Geological Survey (USGS). The figure below shows project agreement percentages by university/research institution as of June 22, 2015.



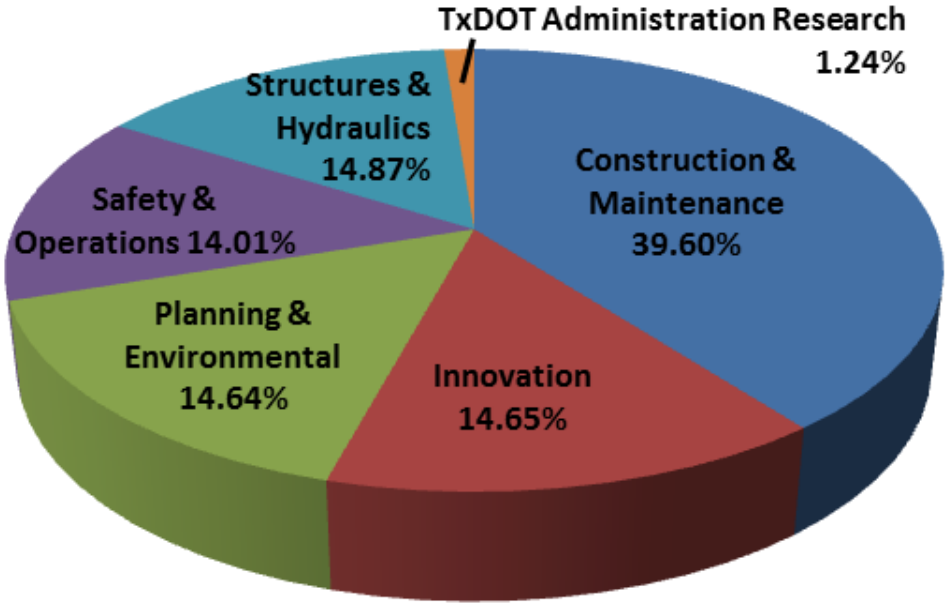
Funding

The table below shows a summary by functional area of the number of continuing/new projects and total funding for fiscal year 2015.

Functional Area	Number of Continuing Projects	Number of New Projects	Total Project Funding
Construction and Maintenance	21	18	$7,982,921
Innovation	0	5	$2,953,058
Planning and Environmental	5	15	$3,154,598
Safety and Operations	5	11	$2,824,387
Structures and Hydraulics	9	10	$2,997,298
TxDOT Administration Research	2	0	$250,000
Total	42	59	$20,162,262

The figure below shows each functional area's proportion of the total fiscal year 2015 program.

Fiscal Year 2015 Program by Functional Area
Total = $20,162,262



Construction and Maintenance

Project	Title	Start Date	Page
0-6656-01	Further Validation of ASR Testing and Approach for Formulating ASR Resistant Mix	3/10/2015	8
0-6658	Collection of Materials and Performance Data for Texas Flexible Pavements and Overlays	11/9/2010	9
0-6665	TxDOT Native Plant Integration Program for South, Central, and West Texas	9/1/2010	10
0-6674-01	Improving Fracture Resistance Measurements in Asphalt Binder Specifications with Verification on Asphalt Mixtures Cracking Performance	12/5/2014	11
0-6738	Performance Studies and Future Directions for Mixes Containing RAP and RAS	9/1/2012	12
0-6746-01	Validation of TxDOT Flexible Pavement Skid Prediction Model	11/9/2012	13
0-6793	Snow and Ice Chemicals for Texas Roads	1/31/2012	14
0-6808	Quantification of the Impact of a Road's Condition on Emissions	7/29/2014	15
0-6812	Updated Testing Procedures for Long Life Heavy Duty Stabilized Bases	4/25/2014	16
0-6813	Evaluation of ASTM C 494 Procedures for Polycarboxylate Admixtures Used in Precast Concrete Elements	8/15/2014	17
0-6814	Performance Evaluation, Specifications, and Implementation of Non-tracking Tack Coat	5/8/2014	18
0-6815	Improved Overlay Tester for Fatigue Cracking Resistance of Asphalt Mixtures	6/30/2014	19
0-6817	Review and Evaluation of Current Gross Vehicle Weights and Axle Load Limits	7/29/2014	20
0-6819	Designing Quieter Pavement Surfaces	2/10/2014	21
0-6823	Testing and Evaluation of RAP and RAS on Experimental Pavement Sections	7/25/2014	22

Project	Title	Start Date	Page
0-6826	Research on Joint Seal Materials to Improve Installation and Performance	7/11/2014	23
0-6832	Improved Crack Sealant Application Methods	9/30/2014	24
0-6833	Use of Geocells in Pavement Design	10/8/2014	25
0-6834	Optimization of the Design of Flexible Pavements with Unbounded Bases Reinforced with Geogrids Using APT	9/1/2015	26
0-6835	Test Procedure for Validation of Automated Distress Data	1/9/2015	27
0-6839	Designing Pavements to Support the Heavy Loads in the Energy Development Areas	1/1/2015	28
0-6843	Evaluating Use of Sub-grade Drains with PFC for Stormwater Drainage	2/17/2015	29
0-6853	Improvements to Ride Specifications	1/23/2015	30
0-6854	Engineering the Properties of Asphalt Mixtures Using Carbon Nanotubes	2/2/2015	31
0-6855	Validation of RAP and/or RAS in Hydraulic Cement Concrete	1/28/2015	32
0-6856	Sustainable Perpetual Asphalt Pavements and Comparative Analysis of Lifecycle Cost to Traditional 20-Year Pavement Design	1/27/2015	33
0-6857	Cost Effective Alternatives to Seal Coats	1/29/2015	34
0-6858	Evaluating Limestone Cements Containing >15 Percent Limestone	1/16/2015	35
0-6860	Develop Metrics for Tire Debris on Texas Highways	1/29/2015	36
0-6868	Novel Material Systems for the Next Generation Flexible Pavement Structures	3/15/2015	37
0-6873	True Road Surface Deflection Measuring Device	4/8/2015	38
0-6874	Develop Nondestructive Rapid Quality Assurance/Quality Control Evaluation Test Methods and Supporting Technology	4/15/2015	39
0-6878	International Center for Partnered Pavement Preservation (ICP3)	3/27/2015	40

Project	Title	Start Date	Page
5-5598-05	Continued Implementation of High Performance Thin Overlays in Texas Districts	2/19/2014	41
5-6048-03	Implementation of Centrifuge Technology for Pavement Design on Expansive Clays	10/22/2013	42
5-6271-03	Using Small Sample Sizes in Full Depth Reclamation (FDR) Laboratory Mix Designs	7/11/2014	43
5-6271-05	Implementing Full Depth Reclamation (FDR) to Repair Roads Damaged in the Energy Sector	9/1/2014	44
5-6614-01	Implementation of RAS Best Practices and Piloting Rejuvenators in Key Districts	9/1/2014	45
5-6616-01	Statewide Implementation of the Surface Performance-Graded (SPG) Specification for Seal Coat Binders in Service	10/8/2013	46
5-6618-01	Mitigation of High Sulfate Soils in Texas	9/5/2014	47
5-6622-01	Field Implementation for the TxME in Four Districts	4/23/2015	48
5-6740-01	Implementation of Intelligent Compaction Technology for Improving Compaction Quality of Soil and Base in Texas	7/2/2014	49
5-9046-03	Pre-construction and Next Generation Concrete Surface (NGCS) Noise Monitoring on US 290 in Harris County	8/15/2014	50

0-6656-01—Further Validation of ASR Testing and Approach for Formulating ASR Resistant Mix

Start Date: 3/10/2015 End Date: 2/28/2018

Abstract

The main objective of this project is to further validate the aggregate-solution method and the accelerated concrete cylinder testing (ACCT), and validate the approach (developed in Research Project 0-6656) of developing alkali-silica reaction (ASR)–resistant concrete mix. Developing an ASR-resistant mix will take a combined approach of aggregate–solution testing measuring activation energy and threshold alkalinity and concrete testing. The specific activities are as follows:

Project Manager

Darrin Jensen, RTI

Project Supervisor

Anol Mukhopadhyay, TTI

- Validate the usefulness of threshold alkalinity in determining alkali loading for different aggregate sources that could potentially be used to modify mix design Option 7. In Option 7 of TxDOT Item 421, it is recommended that the total alkali contribution from cement in the concrete should not exceed 3.5 pounds per cubic yard of concrete when using hydraulic cement alone. With the eventual loss of Class F fly ash sources, the department needs to investigate other methods to determine potential reactivity of aggregates in terms of alkali threshold (current test methods are not appropriate for this analysis) in order to be prepared in the event Class F fly ash is no longer readily available.
- Further validate the ACCT method (testing period, expansion limits, level of alkali loadings, appropriate level of soak solution chemistry, suitable specimen dimension, etc.). Use the TxDOT field exposure block data to calibrate the ACCT method.
- Evaluate the suitability of ACCT to test the job mix.
- Validate the combined approach using both aggregate-solution and concrete testing for formulating an ASR-resistant mix.

Total Project Budget	*Research University*	*FY 2015 Budget*
$772,000	Texas A&M Transportation Institute	$405,000

0-6658—Collection of Materials and Performance Data for Texas Flexible Pavements and Overlays

Start Date: 11/9/2010 End Date: 8/31/2015

Abstract

The primary objective of this project is to collect materials and pavement performance data on a minimum of 100 highway test sections around Texas. As well as being used to calibrate and validate mechanistic-empirical (M-E) design models, the data will also serve as an ongoing reference data source and/or diagnostic tool for TxDOT engineers and other transportation professionals. Some of the M-E models to be calibrated under this research project include the Flexible Pavement Design System design procedure, the Texas M-E, the Texas Overlay design system, and the Mechanistic-Empirical Pavement Design Guide. The scope of work to accomplish these objectives will include the following activities:

- Selection of field test sections across the state.
- Extensive laboratory and field testing.
- Literature review of M-E models and evaluation of existing databases.
- Calibration and validation of M-E model.
- Demonstration workshop of the data collected.

A plan for data collection and material testing (lab and field), a plan for data analysis, and a plan for model calibration will be developed during the first months of this research project and, after TxDOT approval, will be implemented by the research team. A minimum of 100 sections (representing different pavement types, material types, climatic regions, traffic levels, and ages [new and old]) will be targeted.

Project Manager

Kevin Pete, RTI

Project Supervisor

Lubinda Walubita, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$1,831,711	Texas A&M Transportation Institute	$229,734
	The University of Texas at El Paso	$108,000

0-6665—TxDOT Native Plant Integration Program for South, Central, and West Texas

Start Date: 9/1/2010 *End Date: 8/31/2018*

Abstract

The purpose of this project is to collect, evaluate, and release native seed sources for use by TxDOT in Central, West, and South Texas. Project seed collectors will obtain seeds from target native plant species throughout these regions. Evaluation plantings will be made using these seeds at numerous locations throughout the project area, and plant performance of the various species and collections will be assessed. Following evaluation and testing, the most suitable species and collections will be increased in field-scale production fields, and seeds harvested from these fields will be distributed to commercial growers to make well-tested, adapted native plants and seeds readily available for use by TxDOT for right-of-way vegetation management and restoration.

Project Manager

Wade Odell, RTI

Project Supervisor

Forrest S. Smith, TAMUK

Total Project Budget	*Research University*	*FY 2015 Budget*
$3,250,000	Texas A&M University–Kingsville	$500,000

0-6674-01—Improving Fracture Resistance Measurements in Asphalt Binder Specifications with Verification on Asphalt Mixtures Cracking Performance

Start Date: 12/5/2014 End Date: 8/31/2018

Abstract

The current performance grading (PG) specification for asphalt binders was developed during the Strategic Highway Research Program. The PG was based primarily on the study of unmodified asphalt binders. The PG system, while good for ensuring overall quality, fails in some cases to guarantee good rutting and cracking performance, particularly for today's binders modified in a variety of ways. Recent studies of mixes with highly polymer-modified binders from Minnesota found that the MnRoad mixes have substantially improved cold weather cracking properties over mixes currently used in Texas and still pass TxDOT's Hamburg rutting requirements.

Under Research Project 0-6674, researchers investigated these softer but highly modified binders in the laboratory and built 11 field test sections in northern districts of Texas for validation. These projects were monitored for a maximum of 12 months, which is too short a time to draw definite conclusions. A statewide binder selection catalog was also developed. Further work is needed to validate these recommendations. The major objectives of this project are to:

- Continue monitoring the 11 field test sections, accumulating a total of five years of performance data.
- Validate the statewide binder selection catalog, building field test sections in West, South, and East Texas districts.
- Perform 40-year life-cycle cost analyses with true cost and performance data on field test sections to evaluate the benefit of softer but highly modified binders.
- Update the statewide binder selection catalog.
- Evaluate the 10 most often used asphalt binders recently engineered with a variety of modification techniques.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Fujie Zhou, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$494,485	Texas A&M Transportation Institute	$188,674

0-6738—Performance Studies and Future Directions for Mixes Containing RAP and RAS

Start Date: 9/1/2012 *End Date: 8/31/2015*

Abstract

Hot-mix asphalt (HMA) produced with recycled asphalt pavement (RAP) and recycled asphalt shingles (RAS) can significantly reduce the cost of asphalt mixtures, conserve energy, and protect our environment. However, there is substantial speculation that the recent introduction of higher RAP and RAS contents to Specification Item 341 mixes has had a negative impact on the life of HMA overlays. However, no hard data are available to substantiate this. The other aspect of RAP/RAS is compactability during construction. These stiffer mixes will be more difficult to construct and therefore could be expected to have poorer overlay density and worse longitudinal joints than regular virgin HMA. The use of warm-mix asphalt (WMA) technologies will help compaction issues, but these mixes will not be homogeneously blended due to the low mixing temperatures. This project aims to determine what is working and what is not, and to study how variations in mix design options, plant production, and construction processes have impacted the performance life. Specifically, the major objectives of this project are to:

- Evaluate the impact of RAP/RAS used in HMA and WMA on durability/performance problems of the mixes through field surveys.
- Evaluate the impacts of RAP/RAS mix performance and identify approaches to improving the durability problems in terms of mix design (increasing target densities, using softer binders, reducing recycled binder content, etc.).
- Develop the best practices for industry in terms of material handling, plant production, and construction processes.
- Investigate the cost benefit of pretreatments of the RAP/RAS stockpile with rejuvenators in terms of binder blending and overall mix quality.
- Verify maximum allowable recycled binder content in the specification in terms of binder blending and rheology of the total combined binder including WMA technologies.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Fujie Zhou, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$462,432	Texas A&M Transportation Institute	$159,640

0-6746-01—Validation of TxDOT Flexible Pavement Skid Prediction Model

Start Date: 11/9/2012 End Date: 6/15/2015

Abstract

Pavement skid resistance is primarily a function of the surface texture, which includes both microtexture and macrotexture. In Research Project 0-5627, the researchers developed a method to predict asphalt pavement skid resistance based on inputs that describe aggregate texture before and after polishing, gradation of asphalt mixture, and traffic.

Building upon the developments conducted in Research Project 0-5627, in this project researchers will investigate and examine a large number of asphalt mixtures and surface treatment test sections. The test sections will be periodically tested to measure their texture and skid resistance. Aggregate texture values before or after polishing will be measured or collected from existing databases. Using the test results and incorporating appropriate traffic data, researchers will validate and modify the skid prediction model and expand the model to include skid prediction for surface treatment. Training materials on the application of the new model will be prepared at the conclusion of this project.

This skid prediction capability will allow TxDOT to redesign its current method of achieving pavement friction. In the future, TxDOT will specify the level of pavement skid needed to meet the traffic demand of individual pavement sections instead of a surrogate surface aggregate classification. Aggregate texture can be incorporated into the Aggregate Quality Monitoring Program and published in the Bituminous Rated Source Quality Catalog. The contractor can then use the skid prediction model to select combinations of aggregate sources and mixture gradations suitable to achieve the required skid number for that particular project. This procedure will work for both hot-mix asphalt concrete and surface treatments.

Project Manager

Kevin Pete, RTI

Project Supervisor

Arif Chowdhury, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$24,983	Texas A&M Transportation Institute	$24,982

0-6793—Snow and Ice Chemicals for Texas Roads

Start Date: 1/31/2012 End Date: 8/31/2015

Abstract

Currently, TxDOT districts that use snow and ice chemicals primarily use NaCl or $MgCl_2$ (with or without additives), but often this choice is not based on a quantitative assessment. In addition, the use of natural brines as an inexpensive local source of salts has been proposed by TxDOT. This project will quantify and qualify the relative merits of common snow and ice chemicals used by TxDOT in its maintenance operations as well as natural brines (e.g., Kent County Brine). This project will consider all aspects of these chemicals including effectiveness, availability, environmental concerns, environmental regulations, and impact on infrastructure durability (corrosion). Finally, taking all of these considerations into account, researchers will evaluate the cost effectiveness of each chemical as a function of intended use and location. The project will consist of a series of literature and best practice reviews, supported by required lab testing where data gaps exist, and further evaluation in a limited field trial. Anticipated outcomes include characterization of the effectiveness and cost of snow and ice control chemicals, including natural brines, for various treatment strategies for Texas roads and weather conditions. Researchers will also explore the durability impacts to infrastructure caused by snow and ice control chemicals and recommendations on how to conduct maintenance operations to minimize corrosion and scaling. Researchers will investigate current environmental regulatory guidance for snow and ice control chemicals and recommendations on a compliance strategy. Finally, researchers will develop recommendations on usage, transport, storage, and application rates for snow and ice control chemicals, including natural brines, for various treatment strategies for Texas roads and weather conditions.

Project Manager

Kevin Pete, RTI

Project Supervisor

Andrew Jackson, TechMRT

Total Project Budget	*Research University*	*FY 2015 Budget*
$556,885	The Center for Multidisciplinary Research in Transportation	$226,164

0-6808—Quantification of the Impact of a Road's Condition on Emissions

Start Date: 7/29/2014 End Date: 6/30/2016

Abstract

The scope of this project involves quantifying the impact of roadway conditions on vehicular emissions and developing detailed guidance to assist TxDOT in improving maintenance strategies to reduce these emissions. The researchers will quantify the vehicular emissions associated with different conditions of flexible pavement, continuously reinforced concrete pavement, and jointed concrete pavement, and will evaluate the effectiveness of different maintenance strategies in reducing emissions on these roadways. The researchers will use this information to develop a model to identify roadway sections that will qualify for Congestion Mitigation and Air Quality Improvement Program funds on maintenance projects.

Project Manager

Wade Odell, RTI

Project Supervisor

Carlos M. Chang, UTEP

Total Project Budget	*Research University*	*FY 2015 Budget*
$288,879	The University of Texas at El Paso	$88,702
	Texas Southern University	$50,758

0-6812—Updated Testing Procedures for Long Life Heavy Duty Stabilized Bases

Start Date: 4/25/2014 End Date: 8/31/2016

Abstract

TxDOT is in the process of evaluating new approaches and laboratory test methods for characterization of the fatigue performance of cement-treated base layers. The new approach is required to be all inclusive for statewide application and incorporation into the new Texas Mechanistic-Empirical Design System (TexME) guide. A three-point bending beam fatigue test is currently used for the determination of the modulus of rupture of the cement-treated mixes. This test proved to be impractical for lightly stabilized systems because the specimen tends to disintegrate during transportation to the test setup. Additionally, discrepancies associated with specimen preparation and non-uniform density distribution in large samples were found to be an added concern that greatly jeopardizes the accuracy of the performance prediction models. Therefore, there is an urgent need for a simple and practical fatigue test that provides inputs to the TexME structural design program. This research project provides an alternative laboratory testing protocol for mechanistic characterization of the cement-treated base layers to meet the need.

Project Manager

Kevin Pete, RTI

Project Supervisor

Reza Ashtiani, UTEP

Total Project Budget	*Research University*	*FY 2015 Budget*
$297,000	The University of Texas at El Paso	$150,000

0-6813—Evaluation of ASTM C 494 Procedures for Polycarboxylate Admixtures Used in Precast Concrete Elements

Start Date: 8/15/2014 End Date: 12/31/2016

Abstract

This project will provide TxDOT with revised tests, specifications, and recommended practices to use to inspect precast concrete (conventional and self-consolidating concrete) containing polycarboxylate (PC) admixtures. An overarching objective of this project is to increase the understanding of the effect of PC high-range water reducers on the performance of concrete mixtures, with a special focus on concrete mixtures that will be used in precast concrete beam applications. The project will leverage the results of Interagency Contract No. 46-3MTIA034: Evaluation of Long-Term Durability of Concrete, which addresses potential mechanisms for cracking in girders cast at Texas precast plants, typically appearing 18–24 months after casting.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Raissa Ferron, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$266,442	Center for Transportation Research	$120,333

0-6814—Performance Evaluation, Specifications, and Implementation of Non-tracking Tack Coat

Start Date: 5/8/2014 *End Date: 11/30/2015*

Abstract

Non-tracking tacks, recently introduced to the paving industry, bond asphalt layers together while avoiding the tracking problems associated with traditional tacks. Initially, there was only one supplier in Texas, but now multiple producers are bringing new products to the market.

Performance to date has been good, but there have been no objective evaluations on short- and long-term performance. Furthermore, there are no established methods in TxDOT to test tackiness and tracking resistance of current and new products or to test the strength of bonded layers. Key to this project is developing new test procedures and specifications to measure and specify the properties of tracking and tack. *Non-tracking* refers to the amount of time required before it is possible to drive on the material. *Tack* refers to the bond strength provided by the material.

The objectives of this study are to:

- Understand the impact of different types and quantities of non-tracking tack on engineering properties of pavements, including bonding and cracking resistance.
- Identify limits on the non-tracking tack stiffness and application rate that negatively impact engineering properties.
- Validate laboratory findings with field data from test sections.
- Incorporate this work into a set of specifications that includes new test procedures and criteria.
- Formulate plans to practically demonstrate and implement the new procedures within the industry.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Bryan Wilson, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$283,870	Texas A&M Transportation Institute	$206,502

0-6815—Improved Overlay Tester for Fatigue Cracking Resistance of Asphalt Mixtures

Start Date: 6/30/2014 End Date: 6/30/2016

Abstract

This project will focus on evaluating the previous work attempting to modify the current overlay tester (OT) to measure and characterize the fatigue properties of hot-mix asphalt (HMA) laid down by the districts. This project will select a modified test method and create corresponding specifications for the OT that rank the fatigue cracking potential of HMA mixes and provide their fatigue properties in a timely manner and with few technical complications.

Project Manager

Kevin Pete, RTI

Project Supervisor

Soheil Nazarian, UTEP

Fatigue cracking of HMA continues to be a recurring problem in Texas. Pavements with fatigue cracking deteriorate rapidly under the combination of traffic, moisture, and aging of the asphalt layer. TxDOT has implemented the OT to evaluate the cracking susceptibility and resistance to reflective cracking of HMA. The OT is a relatively simple empirical laboratory method. Despite several previous attempts to improve the OT so that parameters related to quantify resistance to fatigue cracking can be measured, additional work in that area is required. Recent studies have raised some concerns about the utility of the OT in dense-graded HMA mixes such as Types C and D, which make up about 75 percent of all HMA used in Texas. The use of the OT to measure resistance to fatigue cracking of HMA reliably in a robust manner is greatly needed for all mixture types and HMA specifications.

Through a systematic approach, full consideration of the previous work on the subject, and consultation with the manufacturers, the research team will evaluate and improve the hardware and software, laboratory test procedures, and specifications of the OT to allow direct measurement of the fatigue properties of asphalt mixtures with much less variation.

Total Project Budget	*Research University*	*FY 2015 Budget*
$325,500	The University of Texas at El Paso	$165,500

0-6817—Review and Evaluation of Current Gross Vehicle Weights and Axle Load Limits

Start Date: 7/29/2014 End Date: 2/29/2016

Abstract

In this project, the researchers will review and extend the work done under Research Project 0-6736: Rider 36 OS/OW Vehicle Fees Study and other similar efforts currently under way in Texas and other states, as well as at the federal and international level. The project will evaluate the effects of single, tandem, tridem, and quad-axle configurations on bridges and pavements, and will develop guidelines for more infrastructure-friendly vehicle configurations. In addition, the researchers will develop a cost-recovery structure that adequately funds repairs to roads used by overweight trucks. For consistency, this methodology will be compatible with that proposed for the determination of fees with oversize/overweight vehicles.

Project Manager

Sonya Badgley, RTI

Project Supervisor

C. Michael Walton, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$538,237	Center for Transportation Research	$272,533
	The University of Texas at San Antonio	$85,699

0-6819—Designing Quieter Pavement Surfaces

Start Date: 2/10/2014 End Date: 1/31/2016

Abstract

This project outlines a work plan for designing quieter asphalt and concrete pavements. A literature review will determine the state of the art in designing quieter pavements and contributing factors. An extensive pavement-noise database will be compiled, comprising a variety of asphalt and concrete surfaces with corresponding noise measurements over time. This database will be analyzed using statistical techniques and will focus on identifying all relevant design parameters influencing noise. Laboratory design procedures to evaluate noise will be developed and correlated against mixture design parameters for a range of different asphalt mixtures. Close proximity and far-field noise tests in the field on both asphalt and concrete pavements will be correlated against laboratory measures toward establishing laboratory test procedures. Following these tasks, a set of preliminary guidelines will be developed to provide the districts with recommendations on and assistance in selecting appropriate candidate projects for low-noise surfaces and for designing surfaces to provide long-term noise reductions. A case study will be completed to recommend strategies for addressing noise complaints in an urban setting. In addition, a number of new and existing pavements across Texas will be monitored. Results from the case study and field tests will be used to validate and refine the district guidelines.

Project Manager

Kevin Pete, RTI

Project Supervisor

Jorge A. Prozzi, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$341,958	Center for Transportation Research	$162,048

0-6823—Testing and Evaluation of RAP and RAS on Experimental Pavement Sections

Start Date: 7/25/2014 End Date: 8/31/2015

Abstract

This project is a continuation of the research conducted under Research Project 0-6682: Validation of the Maximum Allowable Amounts of Recycled Binder, RAP, and RAS Using Accelerated Pavement Testing. In February 2013, 12 flexible pavement test sections were constructed for accelerated pavement testing (APT) through this project using Texas mixes in typical TxDOT pavement structures. Two sections were tested to failure in the period from March 15 to May 1, 2014. APT testing will be conducted on the remaining 10 test sections in order to validate the cracking and rutting potential of both control and recycled asphalt pavement (RAP) and recycled asphalt shingle (RAS)–modified mixes.

Project Manager

Wade Odell, RTI

Project Supervisor

Stefan Romanoschi, UTA

These key issues will be evaluated in this project:

- Validate that poor results on lab-prepared RAP and RAS samples translate to poor field performance under axle loads. Industry groups claim the lab studies do not simulate plant-produced mixes.
- Validate overlay design tools that have recently been developed by the Texas A&M Transportation Institute to predict mix cracking and rutting of new overlays. These models will be validated and calibrated for RAP and RAS mixes. Having a validated design system will then permit TxDOT designers to predict the performance of mixes containing different RAP and RAS levels for a range of existing pavement types with different pavement structures and different pre-existing cracking levels.
- Determine if the proposed balanced mix design procedures, which incorporate both a cracking and rutting evaluation in the lab design phase, can be used to design RAP and RAS mixes with performance comparable to virgin mixes.

Total Project Budget	*Research University*	*FY 2015 Budget*
$493,931	The University of Texas at Arlington	$197,054
	Texas A&M Transportation Institute	$85,000

0-6826—Research on Joint Seal Materials to Improve Installation and Performance

Start Date: 7/11/2014 End Date: 1/31/2016

Abstract

Joints in Portland cement concrete (PCC) pavement are sealed with proper sealant materials to prevent intrusion of water and incompressible materials. Intrusion of water could result in corrosion of dowels or tie bars in jointed plain concrete pavement, and tie bars or longitudinal steel in continuously reinforced concrete pavement. Intrusion and collection of incompressible materials could cause surface spalling. Another important failure mechanism in PCC pavement in Texas is erosion of base materials caused by water infiltration along longitudinal joints between the outside concrete lane and asphalt shoulder. To improve the performance of PCC pavement, it is important to keep the joint seals in good condition so that water and incompressible materials cannot get into joints. There are three elements associated with joint seal performance: proper joint design, quality of joint seal materials, and proper installation. Currently, joint design is dictated in the joint design standards, JS-94. Joint seal material quality is controlled by DMS-6310. Joint sealant installation is governed by Item 438. There are discrepancies between TxDOT requirements and actual practice, potentially compromising the effectiveness of joint performance. The discrepancies need to be identified and design standards or specifications revised or field practices modified.

Project Manager

Kevin Pete, RTI

Project Supervisor

Moon Won, TechMRT

Total Project Budget	*Research University*	*FY 2015 Budget*
$203,285	Center for Multidisciplinary Research in Transportation	$147,370

0-6832—Improved Crack Sealant Application Methods

Start Date: 9/30/2014 End Date: 8/31/2017

Abstract

In this study, researchers will determine the routing standard for Texas pavements by performing a comprehensive review of all the known literature for routing as it pertains to crack sealing, as well as those factors impacting sealant performance. Surveys will yield data for Texas' methods, as well as other states' practices and preferences. The installation and monitoring of five test sites will provide data from installation through normal use over two years. The data gathered by the research team will be assessed against current knowledge on the performance of sealed cracks under various traffic, climate, and existing pavement conditions; the performance of sealants under various crack routing configurations; and the effects of these methods on pavement roughness, user perception, and estimated future maintenance and rehabilitation costs. The research team will provide a simple comparison chart of sealant types and methods highlighting short- and long-term costs and benefits of routing prior to crack sealing.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Soon-Jae Lee, TSUSM

Total Project Budget	*Research University*	*FY 2015 Budget*
$229,640	Texas State University–San Marcos	$102,690

0-6833—Use of Geocells in Pavement Design

Start Date: 10/8/2014 End Date: 8/31/2016

Abstract

In recent years, a new construction technology known as *geocells* that increases the bearing capacity of supporting layers with no to minimal increase in cost of construction has been developed. However, the benefits (performance and cost) from using geocells in pavement design, particularly in locations where good-quality base material is not readily available, are not well understood or documented. In this project, researchers will determine and document the benefits that derive from the use of the newer generation of geocells in pavement design/construction, especially in terms of reducing base layer thicknesses even though low-quality base material is being used. Researchers will focus on evaluating the feasibility of using lower/marginal-quality base and/or sub-base material in the pavements constructed with geocell systems, which has become essential due to the unavailability of good-quality base material in many regions of Texas. In this project, the research team will characterize the mechanisms for improved support, quantify the type of comparatively low-quality material that can be used as infill of geocells, and quantify the comparatively smaller thickness that could be used in bases or subbases when incorporating the use of geocells in pavement design.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Vivek Tandon, UTEP

Total Project Budget	*Research University*	*FY 2015 Budget*
$251,671	The University of Texas at El Paso	$110,968

0-6834—Optimization of the Design of Flexible Pavements with Unbounded Bases Reinforced with Geogrids Using APT

Start Date: 9/1/2015 *End Date: 8/31/2016*

Abstract

Base reinforcement results from the addition of a geogrid at the bottom of or within an unbound base course to increase the structural or load-carrying capacity of a pavement system. This project's objective is to determine the actual contribution of geogrids to the performance of flexible pavements and incorporate this understanding into tools that allow a rational design of geogrid-reinforced pavements (GRPs). Achieving the objective requires overcoming key hurdles:

- Understanding the behavior of GRPs.
- Capitalizing on this understanding to identify the material properties that govern GRP performance.
- Incorporating this understanding and properties into a robust design framework.

Accordingly, the project's innovative work plan includes evaluating both the long-term pavement performance of field sections and a comprehensive accelerated pavement testing program on GRP sections.

The significant volume of field and experimental data collected in this project will yield key project deliverables: comprehensive reports, geogrid selection criteria, documentation of geogrid testing protocols with threshold values for accepting properties, and Flexible Pavement Design System 19 program modifications to account for the presence of geogrid reinforcement in unbound bases. In addition, a set of special specifications will update TxDOT's DMS-6240, easing the selection of geogrids for the reinforcement of unbound bases. Finally, to facilitate implementation, a pilot short course will be offered to TxDOT personnel to discuss the best practices for using geogrids in pavement design, as well as the associated costs and benefits.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Jorge G. Zomberg, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$380,112	Center for Transportation Research	$43,060

0-6835—Test Procedure for Validation of Automated Distress Data

Start Date: 1/9/2015 *End Date: 5/31/2016*

Abstract

TxDOT currently has several contractors to manual collect distress data over the state highway network at a cost of over $2 million annually. This survey is conducted by driving along the shoulder, in the lane, or in the grass adjacent to the roadway. The survey is labor intensive, takes about four months to complete, and exposes the crew as well as the driving public to accident risks. Clearly, the need exists to examine the use of automated systems to collect pavement condition for the department's Pavement Management Information System (PMIS), as well as other roadway geometric information for managing other elements of the state highway infrastructure. This project will develop a performance-based specification for automated distress data collections systems, and will assist TxDOT in preparing a detailed scope of work or specifications to procure equipment and services.

To this end, a three-phase project will be conducted to:

- Develop a pilot performance-based specification on automated distress systems.
- Assist TxDOT in preparing a detailed scope of work or specifications to procure equipment and services.
- Validate the pilot specification and revise as necessary to deliver the final performance-based specification from this project.

AASHTO PP 67 discusses zone cracking, which separates the cracking into five areas, rather than classifying the cracks by type of cracking (alligator, block, etc.). Without significant research and changes to the TxDOT PMIS methodology, which is not part of this contract, using this portion of the provisional protocol would not result in usable results; therefore, the researchers will not use this portion of AASHTO PP 67.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Andrew Wimsatt, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$338,917	Texas A&M Transportation Institute	$238,917

0-6839—Designing Pavements to Support the Heavy Loads in the Energy Development Areas

Start Date: 1/1/2015 *End Date: 11/30/2017*

Abstract

Designing economical long-life pavements to handle the intense traffic loads in energy development areas presents many challenges to pavement designers, not least of which is that existing pavements are relatively thin and made with substandard materials. The intense loading and the need to keep the roadway operational at all times are issues that require new materials and design approaches. Recent failures in South Texas indicate that current design approaches do not work. Failures have recently been encountered with hot-mix asphalt overlays, and both cement and emulsion stabilization has run into problems with the need for early trafficking of the recently rehabilitated pavements.

The major objectives of this project are as follows:

- Determine traffic conditions (in terms of actual axle load level) for pavement designs in the energy development areas.
- Assist local TxDOT districts in surveying pavement conditions of impacted areas using the state-of-the-art nondestructive test equipment.
- Develop material options for handling the early trafficking requirement, which is critical in most recent projects.
- Recommend improved pavement designs that are structurally adequate for overloaded vehicles.
- Work with TxDOT districts that are currently being severely impacted, including Laredo, San Antonio, Corpus, Odessa, San Angelo, Bryan, and Yoakum, to design, construct, and monitor test sections with new materials and design approaches.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Fujie Zhou, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$527,647	Texas A&M Transportation Institute	$116,864

0-6843—Evaluating Use of Sub-grade Drains with PFC for Stormwater Drainage

Start Date: 2/17/2015 End Date: 1/31/2017

Abstract

Water standing on pavements is a major safety concern. Water accumulation on roadways leads to splash and spray and even hydroplaning, which contribute significantly to auto accidents. This project will develop a design method for the underdrains of porous friction courses (PFCs) to eliminate standing water on roadway surfaces, especially difficult drain segments. The project includes both large-scale testing and numerical modeling of storm water drainage. The large-scale testing involves testing a few pavement sections and measuring water surface within and on PFCs. The numerical model will couple the run-off on PFC surfaces with the seepage within PFCs to avoid the limitations of existing numerical models. After calibrated by the test data, the numerical model will be used to simulate the dynamic process of infiltration, run-off, and seepage for various pavement conditions under different rainfall events. With the results from the numerical modeling, the effect of underdrains on removing standing water on PFCs will be quantified. A number of design charts, equations, or similar tools will be developed to assist in determining the size, spacing, and configuration of the underdrains. Researchers will provide these design charts to TxDOT to be used for regular segments and difficult drainage segments.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Jie Huang, UTSA

Total Project Budget	*Research University*	*FY 2015 Budget*
$276,293	The University of Texas at San Antonio	$38,039
	Center for Multidisciplinary Research in Transportation	$85,010

0-6853—Improvements to Ride Specifications

Start Date: 1/23/2015 End Date: 7/31/2016

Abstract

The purpose of this research project is to develop an objective, rational, and economically and financially justifiable ride pay adjustment system that incorporates new versus existing ride quality, and a methodology to tailor the existing techniques to measure ride quality using Surface Test Type B or inertial profilers on short projects. This project will develop a comprehensive database that links TxDOT's SiteManager, Design and Construction Information System, and Pavement Management Information System databases.

To better understand the practical issues associated with ride measurement on short projects, researchers will develop a survey questionnaire with specific and direct questions that will be sent to relevant TxDOT personnel and non-TxDOT subject matter experts. The survey will identify the main issues that are associated with ride measurements on short projects. As needed, in-person or over-the-phone interviews will also be executed. Subsequently, researchers will investigate different ways to measure ride quality on short project segments and recommend procedures to calculate ride using inertial profilers or Surface Test Type B. A field experiment will be conducted to verify the recommended procedures and to identify any practical issues while implementing the proposed methods. The deliverables of this research will improve the existing pay adjustment factors and the evaluation of roughness measurements on short projects used by TxDOT.

Project Manager

Joe Adams, RTI

Project Supervisor

Jorge A. Prozzi, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$149,961	Center for Transportation Research	$65,120

0-6854—Engineering the Properties of Asphalt Mixtures Using Carbon Nanotubes

Start Date: 2/2/2015 *End Date: 2/28/2017*

Abstract

Traditional polymer-modified binders are typically used to achieve a target performance grade and to enhance resistance of the binder to distresses, such as rutting, fatigue cracking, and low-temperature cracking. Conventional modifiers used with asphalt binders are often expensive and are not very effective to improve low-temperature properties.

Recent advances in nanotechnology have allowed for the development of novel materials that can be tailored to deliver improvements in both high- and low-temperature properties of the modified composite. Carbon nanotubes (CNTs) are one of the most promising classes of materials to show reduced rutting at high temperatures. However, simultaneous improvements in low-temperature properties can only be achieved if the CNTs are surface modified to effectively disperse in the binder and break the viscosity-building molecular associations at low temperatures. In this project, the research team will evaluate an innovative and novel method to deliver CNTs into the binder via water, used in the production of foamed warm-mix asphalt.

Project Manager

Wade Odell, RTI

Project Supervisor

Navid Saleh, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$265,438	Center for Transportation Research	$71,979
	The University of Texas–Pan American	$19,888

0-6855—Validation of RAP and/or RAS in Hydraulic Cement Concrete

Start Date: 1/28/2015 End Date: 1/31/2017

Abstract

Reclaimed or recycled asphalt pavement (RAP) and recycled asphalt shingles (RAS) have been widely used in hot-mix asphalt in Texas. However, a high volume of RAP is still available in stockpiles along TxDOT's highways or at hot-mix asphalt concrete producers' plants, in spite of its use by the asphalt industry. Ground RAS from manufacturers and post-consumer uses are also available. The possible use of RAP and RAS in Portland cement concrete would not only help dispose of excess RAP and RAS but also provide a cost reduction for aggregates in hydraulic cement concrete with the additional benefit of improvement in concrete performance.

Previous research has indicated that the use of RAP as an aggregate replacement in concrete paving mix appears to not only be feasible but also offer the possibility of improving the performance of concrete pavement. Thus, the purpose of this project is to validate the earlier findings that the addition of RAP and RAS actually enhance the performance of concrete belonging to different classes while allowing recyclable products to be used.

Project Manager

Wade Odell, RTI

Project Supervisor

Anol Mukhopadhyay, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$317,614	Texas A&M Transportation Institute	$110,021

0-6856—Sustainable Perpetual Asphalt Pavements and Comparative Analysis of Lifecycle Cost to Traditional 20-Year Pavement Design

Start Date: 1/27/2015 End Date: 11/30/2017

Abstract

Since 2001, Texas has been designing and constructing perpetual pavements on heavily trafficked highways where the estimated 18-kip equivalent single axle loads (ESALs) exceed 30 million after a 20-year design period. Perpetual pavements, also commonly known as full-depth asphalt pavements, are pavement structures designed to not need major structural rehabilitation or reconstruction work but require only minor periodic surface renewals for at least 50 years. To date, there are 10 perpetual pavement sections in service within Texas. With the oldest section having a service life of over 12 years, there is an opportunity to review the existing perpetual pavement design and construction practices with a view of modifying the design procedures and recommending the best construction practices to meet current traffic demands. The concern regarding these perpetual pavements is cost; it has been suggested that they are excessively thick and that their multiple lifts of different mixes make perpetual pavements difficult and expensive to construct. A critical review of field performance with recommendations on how to make these pavements cost competitive with both conventional 20-year flexible pavements and rigid concrete pavements is warranted.

Project Manager

Wade Odell, RTI

Project Supervisor

Lubinda Walubita, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$572,426	Texas A&M Transportation Institute	$138,912

0-6857—Cost Effective Alternatives to Seal Coats

Start Date: 1/29/2015 End Date: 8/31/2017

Abstract

The primary focus of this project is the development of a mix design procedure and construction guidelines for an ultra-thin hot-mix asphalt alternative to seal coats. This project will develop performance tests and implementation guidelines for ultra-thin (approximately 0.5 inch thick or less) asphalt layers intended as an alternative to seal coats (with similar or lower lifecycle cost). The project will also address the mix design and testing of ultra-thin layer mixes both in the field and in the laboratory for the selection of appropriate performance tests to evaluate the life expectancy, aggregate loss, ride quality, and estimated lifecycle cost. Products of this project will be the designing and monitoring of demonstration projects for ultra-thin asphalt layers, a curriculum for a training program that introduces TxDOT personnel to ultra-thin asphalt overlays, a technical memorandum and research report that document the materials and construction specification for ultra-thin overlays, and a project summary report.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Yetkin Yildirim, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$448,765	Center for Transportation Research	$91,943
	The University of Texas at El Paso	$27,751

0-6858—Evaluating Limestone Cements Containing >15 Percent Limestone

Start Date: 1/16/2015 End Date: 12/31/2017

Abstract

The goal of this project is to advance the state of the art and state of the practice regarding the use of Portland-limestone cements (PLCs) containing greater than 15 percent limestone. The research team will synthesize information available in published (and unpublished) literature and perform a gap analysis to determine research needs. Researchers will also develop and execute a laboratory and field research program to address the identified research needs and obstacles to implementation in TxDOT applications. Researchers will evaluate these key technical issues and will provide valuable data on fresh and hardened concrete properties, along with any durability issues involved with PLCs.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Kevin J. Folliard, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$516,950	Center for Transportation Research	$130,000

0-6860—Develop Metrics for Tire Debris on Texas Highways

Start Date: 1/29/2015 End Date: 6/30/2016

Abstract

Tire debris is one of the most common and prominent types of waste that can be observed on roadways. However, the extent and implications of this type of debris remain largely unknown, particularly in Texas, where there is a perception among the public that tire debris may represent safety, congestion, and maintenance concerns.

Currently, traffic activity generates tire debris on Texas highways at an unknown rate. This debris must be removed as part of programs run by state and local agencies, such as maintenance or roadside emergency response. The costs associated with these operations are undetermined to a large extent. The true extent of the process of debris generation and the safety, operational, and economic ramifications are also unknown.

In this study, researchers will survey, collect field data, and review crash records in order to produce essential information on the following points:

- The volume of tire debris that is generated on Texas highways each year.
- The cost to state and local stakeholders of collecting and disposing of this type of debris.
- The safety and economic impacts to Texas road users associated with tire debris.

In summary, the objective of this project is to develop statewide metrics of the volume, rate of generation, economic implications, and safety impacts of tire debris on Texas highways.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Raul Avelar, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$192,475	Texas A&M Transportation Institute	$86,180

0-6868—Novel Material Systems for the Next Generation Flexible Pavement Structures

Start Date: 3/15/2015 End Date: 8/31/2016

Abstract

The Infrastructure Report Card published by the American Society of Civil Engineers indicates that U.S. highway infrastructure is in need of a significant upgrade. The numerous challenges to fund such a mammoth undertaking are compounded by demands placed on the highway system from extreme climate patterns and the desire to develop highway systems that are more sustainable. On the other hand, this challenge provides an opportunity to develop a novel approach to design pavement systems and to integrate viable advanced technologies in the process. In this project, researchers will investigate and demonstrate novel material systems for flexible highway pavements that will be significantly more sustainable than what is used today and that will provide longer performance life cycles that will help the bottom line. This is a multidisciplinary research effort executed by a diverse team of experts in chemical processing, molecular material simulation, construction process/cost engineering, sustainable life-cycle assessment, thermal systems, geotechnical engineering, and pavement engineering. Researchers will evaluate factory precast asphalt concrete slabs containing embedded systems for feasibility in Phase I of the research and hope to implement them in a large-scale laboratory setting in Phase II and in a field-scale setting in Phase III.

Project Manager

Chris Glancey, RTI

Project Supervisor

Sanjay Senadheera, TechMRT

Total Project Budget	*Research University*	*FY 2015 Budget*
$1,532,332	Center for Multidisciplinary Research in Transportation	$596,436

0-6873—True Road Surface Deflection Measuring Device

Start Date: 4/8/2015 *End Date: 8/31/2016*

Abstract

The high-speed measurement of accurate pavement surface deflections under a moving wheel on the Texas roadway network (network level) remains a challenge in pavement engineering. This goal cannot be accomplished with stationary deflection-measuring devices, such as the falling weight deflectometer; with slow-moving (<2 mph) and discontinuous profiling, such as the LaCroix deflectograph; or with slow-moving (<3 mph) but continuous profiling devices, such as the rolling dynamic deflectometer or total pavement acceptance device. Today, network-level studies of pavement structure are being performed with three moving devices: the Curviameter, which travels at about 11 mph and employs stationary geophones to continuously measure pavement deflections, and the rolling wheel deflectometer (RWD) and traffic speed deflectometer (TSD), which travel at 40 mph to 60 mph and use laser-based sensors to continuously measure pavement deflections. The major limitation with the RWD and TSD is the lack of accurate measurements due to pavement texture and roughness, which leads to determination of average deflections over 50 feet or more. That is, no true deflection is measured at any point—only an indicative measurement. The measurement accuracy of the Curviameter is high, but the complexity of the continuous chain mechanism to locate the geophones inhibits improvements in testing speed and continuity of measurements.

In Phase I of this study, researchers will develop a device for measuring true surface deflections at the network level. The development of this device is based on the research team's extensive experience with nondestructive testing technologies and on recent advances over the past several decades in sensor technologies that can be applied to continuous deflection measurements. These advances include the development of low-frequency accelerometers and wireless Bluetooth® technology. Pavement deflections under a fully loaded full-scale axle will be measured by sensors that are wireless and stationary on the pavement. This will eliminate the negative effects of pavement texture and roughness and will permit accurate measurements.

Project Manager

Wade Odell, RTI

Project Supervisor

Jorge A. Prozzi, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$948,124	Center for Transportation Research	$489,501

0-6874—Develop Nondestructive Rapid Quality Assurance/ Quality Control Evaluation Test Methods and Supporting Technology

Start Date: 4/15/2015 End Date: 8/31/2016

Abstract

Construction variability and isolated defects can be the limiting factors in a pavement's life. The process of ensuring quality construction of pavements currently uses small sample sizes, often missing defect areas. Innovations are needed to ensure attainment of specification requirements over the entire newly constructed pavement area while minimizing disruption to traffic. In this project, researchers will determine innovative methods for characterizing pavement materials to ensure specification compliance using nondestructive technologies. Such technologies allow for minimal traffic disruption, an increased level of testing coverage, and the potential for increased pavement life.

The research team will investigate technologies to address elements of both flexible and rigid pavement construction. Researchers will verify the compacted material density and mechanical properties of a flexible base course using nondestructive testing and mechanical-based models. This project will include rapid quality measurements during asphalt mixture compaction. This project will include roller-based and post-compaction nondestructive tests to quantify the roller compaction effort applied and to evaluate final in-place density.

For rigid pavements, this project will explore nondestructive techniques for evaluating effective curing of the concrete mixture. The focus elements included in this project, if demonstrated to be feasible and implementable, will make assuring quality pavement construction more timely and reliable with minimal disruption to traffic.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Stephen Sebesta, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$1,166,206	Texas A&M Transportation Institute	$404,955

0-6878—International Center for Partnered Pavement Preservation (ICP3)

Start Date: 3/27/2015 End Date: 8/31/2019

Abstract

This project will provide TxDOT with innovative highway pavement preservation materials, technologies, and procedures to provide a new platform for accelerating innovation in highway pavement preservation. The research results will lead directly to implementation. In each fiscal year of the project, pavement preservation needs will be identified and prioritized for investigation. The research team will select identified needs that will be evaluated and addressed with a separate work plan, and the results will be presented in an individual mid-fiscal-year technical memorandum and end-of-fiscal-year research report on an annual fiscal-year basis. The technical memorandums and research reports will include findings and recommendations that can support the implementation of the new guidelines or policies, as appropriate.

Project Manager

Wade Odell, RTI

Project Supervisor

Jorge A. Prozzi, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$1,350,000	Center for Transportation Research	$150,000

5-5598-05—Continued Implementation of High Performance Thin Overlays in Texas Districts

Start Date: 2/19/2014 End Date: 8/31/2016

Abstract

Under Research Project 0-5598, guidelines and specifications were developed on how a district could design and construct long-life overlays using the concept of the balance mix design. These new roadway surfaces must be designed to have a good combination of both rutting and cracking resistance. The process involves identifying district local sources of quality aggregates and developing both mixture type and performance test requirements to meet each district's needs. Assistance is also required for specification and plan note development and for helping during construction to ensure a quality-controlled new surface is being placed.

Training materials describing the best ways to select, design, and construct these high-performance overlays were also developed in Research Project 0-5598. The recommendations of Research Project 0-5598 have been well received by a number of districts. In the most recently completed study, overlay sections were designed and constructed in the Lufkin, Bryan, Brownwood, and San Antonio Districts.

Project Manager

Joe Adams, RTI

Project Supervisor

Tom Scullion, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$260,000	Texas A&M Transportation Institute	$120,000

5-6048-03—Implementation of Centrifuge Technology for Pavement Design on Expansive Clays

Start Date: 10/22/2013 End Date: 8/31/2016

Abstract

The overall objective of this implementation project is to capitalize on the successful centrifuge characterization of expansive clays by implementing these data into a pavement design approach. This approach will address problems involving the expansive nature of soils at the edge of pavement, which caused so much damage in the 2011 drought.

At the heart of this implementation is the use of the new centrifuge testing device developed as part of Research Project 0-6048, which provides direct measurement of the vertical swelling of clays using a centrifuge device. In this test, soil samples are subjected to water infiltration during a comparatively small testing period (24 hours). Then, the entire relationship between vertical strains and vertical stresses is obtained. The centrifuge approach is well suited for pavement design because it provides more than one data point for a single normal stress. This is a significant advantage over conventional swelling tests, which are not only prohibitively long but also provide the vertical strain for only one vertical stress. Consequently, this approach is particularly appropriate for use with the potential vertical raise (PVR) approach. The specific objectives of this project include:

- Implementing the use of undisturbed expansive clay samples into the centrifuge testing environment to allow field testing of clay specimens.
- Extending the generation of swell data to the locations of multiple additional projects in the Austin District.
- Implementing a field monitoring program involving the long-term quantification of vertical raise and associated changes in soil moisture.
- Incorporating the centrifuge swell test results into the current PVR design methodology, and demonstrating it using field monitoring data.
- Developing a training program for the Austin District and all TxDOT engineers.

Project Manager

Joe Adams, RTI

Project Supervisor

Jorge G. Zomberg, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$426,446	Center for Transportation Research	$136,009

5-6271-03—Using Small Sample Sizes in Full Depth Reclamation (FDR) Laboratory Mix Designs

Start Date: 7/11/2014 End Date: 10/31/2015

Abstract

Currently, single laboratory full-depth reclamation (FDR) design takes between 300 and 400 pounds of existing highway material for sampling. The current process is problematic because it leaves patches requiring future maintenance and limits the ability to perform dual stabilizer treatments and multiple location testing. In addition, the current test methods for a single design take a significant period of time to complete (one month in some situations).

This implementation project will use the small sample test procedures developed in Research Project 0-6271 to field-test upcoming FDR projects and demonstrate how these procedures can be used to select stabilizer contents that meet the strength criteria required in the specifications. Implementing these procedures will save a substantial amount of time and money and result in better designs and longer-lasting pavements. Additionally, the new procedure uses equipment readily available in each TxDOT district lab, eliminating the need for major equipment expenditures.

Project Manager

Joe Adams, RTI

Project Supervisor

Tom Scullion, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$130,000	Texas A&M Transportation Institute	$91,000

5-6271-05—Implementing Full Depth Reclamation (FDR) to Repair Roads Damaged in the Energy Sector

Start Date: 9/1/2014 *End Date: 8/31/2017*

Abstract

In Research Project 0-6271, the full-depth reclamation (FDR) process was extensively studied. In the process, the existing roadway is chemically stabilized (with cement, lime, fly ash, asphalt, etc.) to create either a solid base or a roadway foundation. FDR is cost effective because it makes use of in-place material, eliminating long-haul distances for new materials. When performed correctly, the FDR process creates cost-effective roadways that can readily handle heavy truck traffic. The lessons learned in the research project were incorporated into a training program that was taught in both the Bryan and Dallas Districts. Several case studies were constructed, and numerous projects were monitored around Texas.

TxDOT now faces major pavement rehabilitation and funding programs with the roadways severely damaged by energy development activities. These are often low-volume roadways that were never designed to carry large numbers of very heavy trucks. The FDR process offers great potential to stabilize roadways in place, making use of existing materials and determining the optimal stabilizing agent to make these roadways structurally adequate.

The purpose of this implementation project is to implement the findings of Research Project 0-6271. This project will provide districts with clear guidelines on how to take existing roadways through the FDR process to make long-lasting, structurally adequate roadways able to carry overloaded vehicles. A minimum of five test sections will be built in different districts around Texas. Workshops will be developed and taught in a minimum of four districts. The results will also be available for presentation at the TxDOT annual Construction and Maintenance Conferences.

Project Manager

Joe Adams, RTI

Project Supervisor

Tom Scullion, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$922,000	Texas A&M Transportation Institute	$332,000

5-6614-01—Implementation of RAS Best Practices and Piloting Rejuvenators in Key Districts

Start Date: 9/1/2014 *End Date: 8/31/2017*

Abstract

Under Research Project 0-6614, researchers developed a best practice guide for processing, mix design, production, and construction of mixes using recycled asphalt shingles. Additionally, researchers identified three rejuvenators that improve cracking resistance and performance, cost less, and preserve the environment. The purpose of this implementation project is to demonstrate the benefits of the three rejuvenators in key TxDOT districts and to develop and present training workshop materials in four TxDOT regions.

Project Manager

Joe Adams, RTI

Project Supervisor

Fujie Zhou, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$220,000	Texas A&M Transportation Institute	$70,000

5-6616-01—Statewide Implementation of the Surface Performance-Graded (SPG) Specification for Seal Coat Binders in Service

Start Date: 10/8/2013 End Date: 8/31/2017

Abstract

A surface performance-graded (SPG) specification for seal coat binders in service was developed and validated in TxDOT Research Projects 0-1710 and 0-6616 using binder properties measured in the laboratory and visual performance of 75 highway sections. The objective of this project is to implement the SPG specification statewide. Implementation will improve performance and extend the life of seal coats by providing an improved method for seal coat binder selection that accounts for differences in climate and directly relates to performance in terms of aggregate loss and bleeding over the critical first-year period. Seal coats make up approximately 40 percent of road surfaces statewide. This performance-related specification would replace the current TxDOT Seal Coat Material Selection Table (with the tier system) and conventional seal coat binder specifications for materials in service provided in TxDOT Item 300. TxDOT spends over $300 million on the contracted district-wide seal coat preventive maintenance program annually to treat approximately 8 percent of the state highway system. Implementation of this specification is expected to result in annual savings of $9 million by extending the life of 20 percent of the total seal coats by one year.

Project Manager

Joe Adams, RTI

Project Supervisor

Amy Epps Martin, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$652,500	Texas A&M Transportation Institute	$195,530

5-6618-01—Mitigation of High Sulfate Soils in Texas

Start Date: 9/5/2014 *End Date: 10/31/2016*

Abstract

In TxDOT Research Project 0-6618, two new treatment methods to mitigate high-sulfate-induced soil heave were tested on US 82 in the Paris District. Three test sections consisting of one control and two test sections were constructed on US 82 near Bells in Grayson County. The control section consisted of lime-treated soil in normal practice. The other two sections were lime/fly-ash-treated and lime-treated sections. Both sections were constructed with an extended mellowing period of seven days.

Continuous monitoring and verifying of the two test sections currently built as a part of the field monitoring task of Research Project 0-6618 will provide tangible and practical solutions for stabilizing high-sulfate soils. Two of the treatment methods considered in these sections will focus on different mellowing practices and use of a combined lime treatment with fly ash. If proven effective in the field validation studies, the stabilization solutions could prolong the life of pavements built on high-sulfate soils with minimal distress by 30 to 40 percent. This potentially means significant maintenance dollars saved for each district because there will be no need for complete rehabilitation of the pavements. Also, safety will be enhanced because roughness coming from heave bumps will be drastically reduced. This will provide smooth riding conditions with minimal pavement roller-coaster-type bumps and valleys. All these enhancements will lead to significant improvements to pavement infrastructure assets currently serviced by TxDOT.

Project Manager

Joe Adams, RTI

Project Supervisor

Anand J. Puppala, UTA

Total Project Budget	*Research University*	*FY 2015 Budget*
$150,208	The University of Texas at Arlington	$75,097

5-6622-01—Field Implementation for the TxME in Four Districts

Start Date: 4/23/2015 End Date: 8/31/2018

Abstract

The purpose of this project is to expedite the implementation of the Texas Mechanistic-Empirical (TxME) pavement design program recently developed in Research Project 0-6622: Implementation of a Texas Mechanistic-Empirical Thickness Design System (TexME) completed in August 2013. This new system provides more realistic and longer-lasting pavement designs. This project will familiarize the districts with the complete mechanistic-empirical design process that entails enhanced material inputs, as well as enhanced traffic, climate, and reliability inputs. Additionally, it will demonstrate the advantages of using enhanced design inputs to show variations in performance life when premium materials, load spectrum, and local climate data are used. Researchers will use these experiences to develop training workshop materials and present a pilot training workshop to the project team and the six selected districts incorporating the enhanced training materials.

Project Manager

Joe Adams, RTI

Project Supervisor

Sheng Hu, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$392,350	Texas A&M Transportation Institute	$68,506

5-6740-01—Implementation of Intelligent Compaction Technology for Improving Compaction Quality of Soil and Base in Texas

Start Date: 7/2/2014 *End Date: 6/30/2017*

Abstract

The main objective of this project is to capitalize on the new intelligent compaction (IC) specification for implementation of the IC technology developed through Research Project 0-6740. The specific objectives of this project include:

- Developing and deploying a training program for TxDOT engineers and inspectors.
- Supporting the districts in implementing the IC technology in their districts.
- Implementing a field monitoring program to quantify the long-term benefits of the IC technology.
- Assisting TxDOT in evaluating and incorporating the new IC specification for inclusion in the new specification book.

Project Manager

Joe Adams, RTI

Project Supervisor

Soheil Nazarian, UTEP

Total Project Budget	*Research University*	*FY 2015 Budget*
$450,000	The University of Texas at El Paso	$144,000

5-9046-03—Pre-construction and Next Generation Concrete Surface (NGCS) Noise Monitoring on US 290 in Harris County

Start Date: 8/15/2014 End Date: 8/31/2015

Abstract

The purpose of this project is to implement diamond grinding procedures to improve tire noise characteristics of existing Portland cement concrete pavements (PCCPs). This implementation project encompasses the evaluation of the before-and-after pavement noise performance of sections of PCCP that will undergo a diamond grinding treatment in the TxDOT Houston District at a date to be determined by the construction schedule, as well as the documented procedures and results of the project. The diamond grinding treatments will encompass existing transversally tined PCCP sections of the US 290 expansion in the Houston District. The resulting treated sections will follow grinding procedures that will qualify them as next-generation concrete surfaces.

Project Manager

Joe Adams, RTI

Project Supervisor

Joe Weissmann, UTSA

Total Project Budget	*Research University*	*FY 2015 Budget*
$79,992	The University of Texas at San Antonio	$58,852

Innovation

Project	Title	Start Date	Page
0-6803-01	Technology Task Force	9/1/2014	52
0-6838	Bringing Smart Transport to Texans: Ensuring the Benefit of a Connected and Autonomous Transport System in Texas	1/16/2015	53
0-6869	Advancing Innovative High-Speed Remote-Sensing Highway Infrastructure Assessment Using Emerging Technologies	3/10/2015	54
0-6871	Development of Highway Sensing and Energy Conversion (HISEC) Modules for Generating Power	3/17/2015	55
0-6875	Autonomous and Connected Vehicle Test Bed to Improve Transit, Bicycle, and Pedestrian Safety	4/21/2015	56

0-6803-01—Technology Task Force

Start Date: 9/1/2014 *End Date: 8/31/2015*

Abstract

Texas' 83rd Legislature passed the General Appropriations Bill, SB. No. 1, Item 44, VII-3, and charged TxDOT with examining and evaluating innovative transportation technologies for purposes of saving money, reducing traffic congestion, enhancing safety, and increasing economic productivity. As a result, the Texas Transportation Task Force was formally created and began with an internal core group that sought experts in various transportation technologies to share knowledge and provide directions. The task force discussed four groups of emerging transportation technologies: connected vehicles, autonomous vehicles, electric systems, and cloud computing/crowdsourcing technologies. Work in Phase 1 resulted in the development and implementation of an evaluation framework for categorizing and selecting groups of emerging technologies for development and promotion. Work in Phase II resulted in initial background work for the establishment of the Strategic Technology Business Plan. Finally, work in Phase III will reconvene the task force to review and revise past work, and to expand the list of other high-potential technologies or integrated systems and establish a transition plan that details steps for the implementation and completion of the Strategic Technology Business Plan. The Strategic Technology Business Plan is an overall plan that presents goals and objectives for technology adoption and promotion, contains a systematic review and evaluation of key emerging technologies, and outlines strategies for reaching the vision of new technology adoption and promotion aligned with the strategic goals of TxDOT.

Project Manager

Darrin Jensen, RTI

Project Supervisor

C. Michael Walton, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$280,241	Center for Transportation Research	$280,241

0-6838—Bringing Smart Transport to Texans: Ensuring the Benefit of a Connected and Autonomous Transport System in Texas

Start Date: 1/16/2015 End Date: 6/30/2016

Abstract

This project will develop and demonstrate a variety of smart-transport technologies and practices for Texas highways and freeways using automated vehicles, connected vehicles, smartphones, and related technologies, as well as TxDOT's Lonestar statewide software. The products will enable more efficient intersection, ramp, and weaving section operations for connected and autonomous vehicle operations, alongside a suite of behavioral and traffic-flow forecasts for Texas regions and networks under a variety of vehicle mixes. The project will develop and facilitate rigorous benefit-cost assessments of multiple strategies that TxDOT may pursue to bring smarter, safer, more connected, and more sustainable ground transportation systems to Texas in concert with auto manufacturers, technologists, and the traveling public. The effort will also support proactive policy making on vehicle/occupant licensing, liability, and privacy standards as technologies become available and travel behaviors change.

The project's Phase 1 demonstrations will showcase Texas' 12-mile dedicated short-range communication–instrumented highway in San Antonio for application of driver alerts, road-surface conditions, and traffic-flow monitoring, as well as vehicle guidance. The research team's innovative pod approach allows equipment to be moved between vehicles. Phase 1 will include regional and statewide behavioral forecasts (for vehicle choices, vehicle miles traveled, and traveler benefits, by location) and simulations/optimizations of smart ramp merge and smart intersection operations, under thousands of case settings, with calculated delay reductions, fuel savings, safety impacts, and emissions benefits.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Kara M. Kockelman, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$1,494,655	Center for Transportation Research	$698,423

0-6869—Advancing Innovative High-Speed Remote-Sensing Highway Infrastructure Assessment Using Emerging Technologies

Start Date: 3/10/2015 End Date: 8/31/2016

Abstract

Asset management is a strategic approach to the optimal allocation of resources for the management, operation, maintenance, and preservation of transportation infrastructure. Asset management combines engineering and economic principles with sound business practices to support decision making at the strategic, network, and project levels.

One of the key aspects of the development of asset management is data collection. Advances in technology have enhanced the data collection and integration procedures necessary to support the comprehensive analyses and evaluation processes needed for asset management. However, data collection is costly. In determining what data to collect, agencies must weigh these costs against the potential benefits of better data.

While many of the technology innovations and improved data collection processes have been in the bridges and pavements area, there are emerging technologies in the safety and operations infrastructure areas that have yet to be applied to the transportation space. These technologies are driving the costs and efficiencies to the point that makes good sense in terms of the tradeoffs between fiscal responsibilities and advantages of having the data. Therefore, while this research covers all highway infrastructure areas, it includes an emphasis on technologies to assess safety and operations infrastructure. Ultimately, through the three-phased approach, the research will bundle the best technologies that maximize sensors and computing power in an effort to achieve the vision of one day having an all-in-one data collection system for infrastructure assessment. Initially, the focus will be on highways, but it could be expanded to include other modes of transportation such as rail, air, and even maritime.

Project Manager

Chris Glancey, RTI

Project Supervisor

Paul Carlson, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$1,735,671	Texas A&M Transportation Institute	$967,266

0-6871—Development of Highway Sensing and Energy Conversion (HISEC) Modules for Generating Power

Start Date: 3/17/2015 End Date: 8/31/2016

Abstract

The transportation infrastructure serves a critical societal need to rapidly move goods and people across the nation. Using this infrastructure as a source of renewable energy by harvesting it from the roadway is a relatively novel idea that has not been fully explored yet. This project is aimed at exploring energy harvesting from the roadway infrastructure and harnessing it to generate electrical power. Millions of lane miles subjected to solar heat and vibrations, combined with repeated strains under normal working conditions, make the roadway infrastructure a very good candidate for energy harvesting. This energy can be transformed using efficient systems into usable electrical power.

Piezoelectric systems have shown promise for use in energy harvesting. Researchers will develop piezoelectric systems to harvest usable energy from roadways. These systems also provide continuous monitoring of the roadways' conditions because they are embedded in flexible pavement layers. This monitoring will provide engineering data to assist in identifying the need for maintenance. The monitoring can also enable a "smart" road by potentially gathering real-time information on vehicle weight, speed, and traffic volume.

Project Manager

Chris Glancey, RTI

Project Supervisor

Samer Dessouky, UTSA

Total Project Budget	*Research University*	*FY 2015 Budget*
$1,320,583	The University of Texas at San Antonio	$570,012
	Texas A&M Transportation Institute	$140,416

0-6875—Autonomous and Connected Vehicle Test Bed to Improve Transit, Bicycle, and Pedestrian Safety

Start Date: 4/21/2015 End Date: 4/30/2016

Abstract

Pedestrians and bicyclists represent a considerable portion of traffic injuries and deaths in the United States. In 2012, 4,743 pedestrians died in traffic crashes—a 6 percent increase from the number reported in 2011. In 2012, 726 cyclists were killed, and an additional 49,000 were injured in motor vehicle traffic crashes. In Texas, one of the most frequent crash types at Dallas Area Rapid Transit crossings involves bicyclists and pedestrians. Currently available automated technologies in passenger vehicles can be integrated into transit vehicles to help reduce these crashes by automating human tasks. In this project, the research team will design and develop a concept-of-operations document to operate near-term applications at a transit, bicycle, and pedestrian test bed. The purpose of the test bed is to demonstrate and evaluate automated and connected vehicle and infrastructure hardware and applications in a controlled environment to improve transit, bicycle, and pedestrian safety.

Project Manager

Wade Odell, RTI

Project Supervisor

Katherine Turnbull, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$504,500	Texas A&M Transportation Institute	$296,700

Planning and Environmental

Project	Title	Start Date	Page
0-6636	Photocatalytic NOx/HRVOC/O3 Removal in Transportation Applications	9/1/2010	59
0-6762-01	Continuation—Maximizing Mitigation Benefits	4/30/2015	60
0-6804	Life Cycle Cost and Performance of Lightweight Noise Barrier Materials along Bridge Structures	1/29/2013	61
0-6809	The 2055 Freight Transportation System and the Impact of Near Term Rail Movements on TxDOT Planning	7/1/2014	62
0-6818	Dynamic Ride Sharing, Car Sharing, Bike Sharing, and State-Level Mobility	6/30/2014	63
0-6820	A Process for Designating and Managing Overweight Truck Routes in Coastal Port Regions	7/25/2014	64
0-6836	Commercial Truck Platooning	4/8/2015	65
0-6837	Innovative and Automated Freight Systems Assessment	1/30/2015	66
0-6844	Putting a Price Tag on International Trade Use of State Infrastructure	1/23/2015	67
0-6846	Identify Involved Agencies Addressing Safety When Freight Centers Are Planned and Developed	1/30/2015	68
0-6848	Transportation Planning Implications of Automated Vehicles on Texas Highways	2/6/2015	69
0-6850	Texas Transportation Planning for Future Renewable Energy Projects	1/15/2015	70
0-6851	Strategies for Managing Freight Traffic through Urban Areas	1/19/2015	71
0-6852	Framework for Implementing Performance Based Planning for Rural Planning Organizations	2/2/2015	72
0-6864	Investigate the Air Quality Benefits of Nighttime Construction in Nonattainment and Early Action Compact Areas	2/12/2015	73
0-6865	Cost Effective Mitigation Strategy for State Listed Freshwater Mussels	2/2/2015	74

Project	Title	Start Date	Page
0-6866	NEPA Reporting Synthesis of State Practices	1/23/2015	75
0-6870	Integrating Underground Freight Transportation into Existing Intermodal Systems	4/10/2015	76
0-6876	Understanding the Consequences and Cost of Climate Change to the Texas Transportation System	4/8/2015	77
5-6662-03	Public Involvement Training Implementation	9/9/2014	78

0-6636—Photocatalytic NOx/HRVOC/O3 Removal in Transportation Applications

Start Date: 9/1/2010 *End Date: 12/31/2016*

Abstract

The focus of this research is intensive and thorough testing of two commercial photocatalytic coatings applied to Portland cement concrete to provide accurate data that are representative of highway applications. While published laboratory data suggest that TiO2-based materials can remove nitrogen oxides and volatile organic compounds from air samples, the tests have not been designed to be representative of outdoor air conditions. Laboratory tests have been designed for this project to emulate roadway conditions. The results of these data will be used to model the effects of using photocatalytic materials in the Houston-Galveston and Dallas-Fort Worth areas, predict the impact on air pollutant concentrations, and provide a cost per ton of pollutant removal among other metrics. Long-term outdoor exposure tests have been designed to examine the performance of the materials in real near-roadway locations in three different locations with varying pollutant concentrations and environmental conditions. Another critical component of the testing will be material evaluation, examining the effects of the concrete substrate on photocatalysis, the effect of the photocatalytic process on material degradation, and the longevity of the material.

Project Manager

Wade Odell, RTI

Project Supervisor

Maria Juenger, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$1,394,190	Center for Transportation Research	$187,419

0-6762-01—Continuation—Maximizing Mitigation Benefits

Start Date: 4/30/2015 End Date: 5/31/2015

Abstract

Research Project 0-6762 identified the need to accurately estimate and track project costs resulting from environmental mitigation. Although the research identified mitigation costs found in the Right of Way Information System, the amount only reflected compensatory mitigation costs associated with Section 404 of the Clean Water Act for wetland mitigation—or an in lieu fee, a program within the regulations (33 CFR Parts 325 and 332) that allows payment (fee) instead of (in lieu of) actually mitigating a wetland. Section 404 of the Clean Water Act regulates discharges into waters of the United States including wetlands. The U.S. Army Corps of Engineers regulates Section 404 for wetland mitigation/discharges (40 CFR Part 230). The term *Section 404* is commonly used by practitioners as wetland mitigation regulation. There are many other project-related mitigation costs, and there is no single TxDOT source or management system at TxDOT for capturing and/or estimating mitigation costs statewide.

During this continuation project, the researchers will:

- Assess environmental mitigation cost tracking and estimating at TxDOT.
- Conduct a synthesis of mitigation cost tracking and estimating at selected state departments of transportation.
- Assess and identify potential benefits from improved mitigation cost tracking and cost estimating.

The research product will be the framework for a guide to track and estimate mitigation costs. The project will complement and build upon other project cost-tracking efforts at TxDOT including cost-tracking forms developed in Research Project 0-6633 for utility cost practices, as well as Project Management Office processes to develop a *Total Project Cost Estimating Guide*.

Project Manager

Darrin Jensen, RTI

Project Supervisor

John Overman, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$87,000	Texas A&M Transportation Institute	$43,800

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

Start Date: 1/29/2013 End Date: 8/31/2017

Abstract

The site of this study is elevated eastbound sections of IH 30, west of downtown Dallas. These sections are located north of the Kessler Park Neighborhood where the CTR team conducted a major sound project in 2010 and 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 feet, possessing a concrete sound wall approximately 8 feet in height. The second area 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 feet long. The research team will evaluate the performance of a lightweight traffic noise wall, which will extend the height of the existing wall. The new wall will both attenuate sound propagation and block the current line of sight from the adjacent neighborhood to the highway.

The CTR team will 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 the research components to integrate the research activities with the sound wall bidding, construction, and maintenance activities, which will be managed separately by the Dallas District. This work plan will allow the subsequent study to capture sound measurements and life-cycle impacts at key locations before and after the construction of the lightweight sound walls before fall 2013. The measurement of sound absorption or reflection (depending on the type selected by the Dallas team) will be undertaken during regular cycles of weather, including wind and temperature changes, starting in winter 2013.

Project Manager

Wade Odell, RTI

Project Supervisor

Robert Harrison, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$416,615	Center for Transportation Research	$95,875

0-6809—The 2055 Freight Transportation System and the Impact of Near Term Rail Movements on TxDOT Planning

Start Date: 7/1/2014 *End Date: 8/31/2015*

Abstract

Efficient, reliable, and safe freight transportation is critical to the economic prosperity of any region. An efficient multimodal and intermodal transportation system reduces transportation and supply chain transaction costs and increases connectivity, mobility, reliability, and accessibility to local and global markets. An efficient freight transportation system, therefore, supports economic development, expansion of international trade, increased employment, growth in personal income, and growth of the gross domestic product of a region, ultimately improving the quality of life of its citizens. This research project develops parameters for a successful Texas Freight Transportation System four decades into the future and emphasizes the role of TxDOT in identifying and planning for changes in Texas' rail imports and exports and traffic volumes over the short term.

At the conclusion of this project, the research team will produce a framework for Texas' freight transportation system in 2055 and a set of recommended planning steps that will be beneficial to TxDOT's International Relations Office, Transportation Planning and Programming Division, Rail Division, and border and coastal districts in addressing the growing impacts of imports and exports by rail in the state.

Project Manager

Kevin Pete, RTI

Project Supervisor

Jolanda Prozzi, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$490,343	Texas A&M Transportation Institute	$261,433
	Center for Transportation Research	$72,243

0-6818—Dynamic Ride Sharing, Car Sharing, Bike Sharing, and State-Level Mobility

Start Date: 6/30/2014 End Date: 12/31/2015

Abstract

Texas is one of the fastest growing states in the nation, and its growth is expected to continue, supported by diversity in its economy, geography, and population. The challenge of prioritizing limited resources in this environment requires a proactive approach to travel demand management.

This project provides guidance for TxDOT in its planning and mobility efforts and in understanding the viability of various alternative mobility programs.

There is not a one-size-fits-all approach to identifying the most appropriate mobility programs for a region. Identifying and understanding the role of key factors such as the agencies involved, the regulations in force, regional travel behavior characteristics, and the vendor criteria for program implementation are critical components of this research. This research will evaluate best practices and lessons learned from introducing mobility programs across a variety of settings. It will use executive interviews, focus groups, and surveys to obtain details and document perspectives of the varying stakeholder groups. The research will result in the development of a guidebook that will aid TxDOT in determining how to best identify and implement alternative mobility programs in a given region as part of its planning and mobility efforts.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Stacey Bricka, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$269,000	Texas A&M Transportation Institute	$63,800

0-6820—A Process for Designating and Managing Overweight Truck Routes in Coastal Port Regions

Start Date: 7/25/2014 End Date: 8/31/2016

Abstract

The purpose of this study is to develop a process to evaluate, designate, and manage routine permitted overweight truck corridors serving coastal ports in Texas. These corridors can potentially enhance the competitive edge of companies importing or exporting freight through Texas ports while creating a self-sustaining system through permit fees. The research team recognizes that successful development of this analysis methodology will require close coordination with TxDOT, port authorities, metropolitan planning organizations, regional mobility authorities, manufacturers, and the trucking industry.

The methodology will account for current and projected freight flows and opportunities that use the full cargo capacities of trucks operating along each corridor. The methodology will provide an economic analysis of candidate corridors that accounts for pavement and bridge infrastructure strengthening and adjustments in geometric features; long-term maintenance costs; right-of-way, utility, and environmental clearance timeframes and impacts; sustainability based on projected permit revenue; and safety, security, and law enforcement requirements. The methodology will also account for current legal restrictions for certain routes types that can carry permitted indivisible loads but are restricted from carrying permitted divisible loads.

The methodology will be flexible and provide a means for examining each factor and factor weight and its contributions to the final economic assessment of each corridor.

Project Manager

Sonya Badgley, RTI

Project Supervisor

C. Mike Walton, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$475,205	Center for Transportation Research	$137,426
	The University of Texas at San Antonio	$48,749

0-6836—Commercial Truck Platooning

Start Date: 4/8/2015 *End Date: 3/31/2016*

Abstract

This project will perform the most practical commercial vehicle platooning effort in the United States. Existing studies indicate platooning offers major safety and fuel saving benefits that are two critical issues for fleet operators. Truck platooning is defined as electronically coupling two or more trucks (or vehicles) where the following truck's longitudinal and lateral functions are automated to mimic the leading truck while maintaining a tight distance. Texas is one of the key trucking hubs in the national supply chain, making it a perfect test bed for developing and implementing this technology. The research team offers significant expertise and experience in truck automation.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Beverly T. Kuhn, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$1,181,094	Texas A&M Transportation Institute	$826,295

0-6837—Innovative and Automated Freight Systems Assessment

Start Date: 1/30/2015 End Date: 12/31/2015

Abstract

Many innovative and automated freight delivery strategies and technologies have been proposed to address the future freight needs of Texas' growing population. TxDOT and local transportation planners need to evaluate operational changes or technology applications to ensure continued, timely flow of commercial freight through the Texas transportation system. Emerging freight delivery technologies, such as automated freight vehicles or airborne small package delivery, and innovative operational freight strategies, such as nighttime off-peak hour deliveries or conversion of managed lanes to truck-only use during high port traffic periods, are potential ways to better use existing infrastructure. Changes in buying habits of consumer goods toward direct home package delivery could also dramatically shift distribution patterns and increase the number of intercity and local delivery trucks on TxDOT roadways.

The primary objective of this project is to establish a process to evaluate freight operational changes or technology applications in order to ensure continued timely flow of commercial freight through the Texas transportation system. This project will develop and adapt the necessary evaluation metrics for future use. This project will also assess several currently proposed freight strategies and technologies to determine which of these should be further evaluated for implementation on the Texas transportation system in future project phases.

Project Manager

Wade Odell, RTI

Project Supervisor

Curtis Morgan, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$517,892	Texas A&M Transportation Institute	$388,292

0-6844—Putting a Price Tag on International Trade Use of State Infrastructure

Start Date: 1/23/2015 End Date: 12/31/2016

Abstract

A price tag is defined as a label attached to a product indicating its price; in transportation infrastructure terms, a price tag is an indication of the infrastructure construction and maintenance costs. In this project, researchers will develop a utility-based methodological framework for assigning price tags to freight corridors. This project will allow TxDOT to maintain freight corridors with high condition standards and prepare for the potential trade growth. Researchers will also provide TxDOT with capabilities to communicate its decisions to policy makers so that the necessary funds can be obtained to retain Texas' economic competitiveness.

Project Manager

Joe Adams, RTI

Project Supervisor

Zhanmin Zhang, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$324,976	Center for Transportation Research	$112,809

0-6846—Identify Involved Agencies Addressing Safety When Freight Centers Are Planned and Developed

Start Date: 1/30/2015 End Date: 7/31/2016

Abstract

This project stems from an observed need to improve coordination and cooperation among various entities in the process of planning for developing safer and more efficient connections between intermodal facilities and the highway network. Coordination and cooperation are extremely important given the number of public agencies (local, regional, and state) and private companies (railroads, transportation, manufacturing, etc.) that become involved in the planning process. When a limited number of entities, public or private, are involved in the planning process, some vital stakeholder concerns may not be adequately considered. Guidance is needed to provide a consistent approach to involve all of the entities that should be part of the process. Excluding some entities, even unintentionally, could result in important facts, issues, and other considerations being left out of the process. Exclusions could result in project delays, increased costs, omitted project steps, or duplicated efforts.

The project objectives are:

- Investigate previous and current freight planning efforts and identify lessons learned and best practices to be applied in Texas.
- Develop guidance that stakeholders in Texas can use in planning and coordinating intermodal freight facilities to improve freight movement, enhance safety, and minimize congestion.
- Identify short-term accessibility improvement opportunities that could be considered to address current roadway operational issues such as curb radius at intersections in the vicinity of multimodal facilities.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Bill Frawley, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$270,397	Texas A&M Transportation Institute	$107,810

0-6848—Transportation Planning Implications of Automated Vehicles on Texas Highways

Start Date: 2/6/2015 *End Date: 8/31/2016*

Abstract

This research project explores the transportation planning implications of automated and connected vehicles (AV/CV) on Texas highways and includes an in-depth study of how travel modeling can assist in planning for AV/CV. The research team will assess how these potentially transformative technologies can be included in transportation planning to assist in the decision-making process. Researchers will also define AV/CV implementation along various scales of vehicle technology advancement, public acceptance and adoption, and infrastructure implementation.

Project Manager

Wade Odell, RTI

Project Supervisor

Thomas A. Williams, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$276,242	Texas A&M Transportation Institute	$98,997

0-6850—Texas Transportation Planning for Future Renewable Energy Projects

Start Date: 1/15/2015 End Date: 8/31/2016

Abstract

There will be a significant increase in the number of renewable energy production facilities in Texas. The construction of wind farms requires the transport of wind turbine components that create increased loads on rural roads and bridges. These rural roads and bridges are typically not designed for such loads. This will result in a greater burden on the transportation infrastructure in Texas.

Given the upward trend in wind energy production in particular, TxDOT is looking to plan for the impacts of future renewable energy projects on roads while facilitating the development of new renewable projects in and around Texas. Thus, in this project, the research team will create an operational planning tool that can be used to propose route plans for wind turbine components passing along Texas routes, and will develop recommendations for planning construction of new wind farms and maintenance strategies for the roads.

Project Manager

Wade Odell, RTI

Project Supervisor

Chandra Bhat, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$224,500	Center for Transportation Research	$86,800

0-6851—Strategies for Managing Freight Traffic through Urban Areas

Start Date: 1/19/2015 End Date: 5/31/2016

Abstract

Economic activity in most cities relies on the movement of goods via freight vehicles. The freight transportation system has a direct impact on the livelihood of successful urban areas; however, the presence of trucks on the freeway system complicates congestion patterns as the trucks interact with passenger cars. Trucks take up a large portion of roadway space, and the places that rely on freight the most are typically where there is a concentration of people and activities. As a result, traffic congestion increases while the safety of the roadway diminishes. Trucks also have different speed and acceleration/deceleration patterns, which further complicate congestion mitigation. Mitigation strategies most often applied include both traffic and demand management techniques and strategic technology deployment, such as various intelligent transportation system approaches.

The purpose of this project is to provide guidance in the selection and deployment of freight management strategies and possible changes to TxDOT policy as it relates to freight movement. Researchers will use a state-of-the-art modeling methodology to assess various strategies in multiple freight-significant locations in Texas. Researchers will also develop a set of modeling guidelines to assess the most applicable tools and techniques needed when managing urban freight movement.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Jeff Shelton, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$205,913	Texas A&M Transportation Institute	$117,466

0-6852—Framework for Implementing Performance Based Planning for Rural Planning Organizations

Start Date: 2/2/2015 *End Date: 7/31/2016*

Abstract

Moving Ahead for Progress in the 21st Century (MAP-21) places increased emphasis on performance-based management of the multimodal transportation system and requires the use of performance-based methods in state, metropolitan, and non-metropolitan transportation planning and programming. MAP-21 emphasizes safety, infrastructure condition, congestion reduction, system reliability, freight movement, and economic vitality. Establishing a common set of performance measures allows for the evaluation and comparison of different projects and transportation corridors for both current and future conditions, and translates data and statistics into a form that the public and decision makers can easily understand. For this project, the research team will provide TxDOT with a framework, performance measures, tools, and guidance to conduct performance-based transportation planning and programming in non-metropolitan areas of the state and support rural transportation planning organizations.

Project Manager

Sonya Badgley, RTI

Project Supervisor

John Overman, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$228,200	Texas A&M Transportation Institute	$105,500

0-6864—Investigate the Air Quality Benefits of Nighttime Construction in Nonattainment and Early Action Compact Areas

Start Date: 2/12/2015 End Date: 2/28/2017

Abstract

The practice of performing some work zone activities at night has existed in the United States since at least the 1960s. As is the case today, early attempts at night work were initiated because officials considered it impractical to close traffic lanes on certain high-volume roadways during normal daylight hours. Currently, there is no comprehensive evaluation of the changes in emissions associated with moving construction activities to nighttime. It is commonly expected that when construction activities are shifted to nighttime, reduced congestion levels could result in less vehicle emissions. The extent and scale of this impact have not been studied in detail. There is a need for a logical approach to combine the many aspects and impacts of nighttime construction in a systematic manner to provide the necessary information for decision making on pursuing nighttime construction for a specific project.

In this project, researchers will provide TxDOT with a nighttime construction decision support framework and a quantified characterization of the expected changes in the emissions from construction activity and affected traffic. This decision support framework will help the stakeholders evaluate factors such as cost, safety, mobility, location, air quality impacts, and local considerations on a systematic basis. A series of case studies and the development of a decision support tool will provide TxDOT with practical, usable research results that can be applied to make appropriate decisions. The case studies will include estimating emissions of construction site activities and the affected traffic. The emission estimates will also be used in a high-level emission dispersion analysis. This analysis will help to evaluate the impact of key meteorological factors on the concentrations of pollutant emissions and the resultant air quality at and around construction zones.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Reza Farzaneh, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$425,900	Texas A&M Transportation Institute	$116,610

0-6865—Cost Effective Mitigation Strategy for State Listed Freshwater Mussels

Start Date: 2/2/2015 *End Date: 7/31/2016*

Abstract

Transportation agencies continue to promote economic growth through infrastructure development; however, with this development comes the responsibility of preserving important natural resources. When road and bridge construction is proposed, an environmental impact assessment is conducted to determine the potential threat that a given project has on sensitive species or ecological areas. For freshwater mussels, surveys are often performed to determine whether mussels are present and their distribution within the project area. If mussels of concern are found, a relocation plan is often implemented wherein mussels are moved to minimize impacts from construction activities. In Texas, there are no current standard protocols for establishing presence or absence of state-threatened, federally listed, or candidate species within a bridge construction project area or guidelines for when and how to conduct mussel relocations. The overall goal of this project is to provide TxDOT with guidelines for conducting freshwater mussel surveys and relocations.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Charles Randklev, TAES

Total Project Budget	*Research University*	*FY 2015 Budget*
$60,000	Texas A&M AgriLife Extension Service	$30,861

0-6866—NEPA Reporting Synthesis of State Practices

Start Date: 1/23/2015 End Date: 12/31/2015

Abstract

Under the Surface Transportation Project Delivery Program created by SAFETEA-LU (23 United States Code 32701) and continued under MAP-21, federal transportation law has authorized delegating the National Environmental Policy Act (NEPA) review and approval processes to state departments of transportation. This research will assist TxDOT with its goals of shortening project review periods, developing a robust review process, and cutting costs where possible. Collectively, these accomplishments help TxDOT achieve one of its strategic plan goals: "Become a best-in-class state agency." The objectives of this research study are to:

- Review the effectiveness of practices for NEPA assignment in other states and provide recommendations on best practices.
- Assess challenges in conducting effective NEPA reports and approvals, including benefits and costs that have been quantified.
- Review the legal and case law landscape to identify any potential litigation trends, and any legal impediments that may impact NEPA assignment.
- Recommend process revisions and procedures for developing a robust NEPA assignment program within TxDOT.

Project Manager

Joe Adams, RTI

Project Supervisor

Lisa Laftus-Otway, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$124,384	Center for Transportation Research	$57,378
	University of North Texas	$25,704

0-6870—Integrating Underground Freight Transportation into Existing Intermodal Systems

Start Date: 4/10/2015 End Date: 5/30/2016

Abstract

This research project will investigate the feasibility of addressing the potential for employing a variety of technological advances in underground freight technology that allows for the optimized use of the available highway capacity through managing freight use. One of the concepts calls for the construction of freight tubes (also called pneumatic capsule pipeline), a technology that can be used to transport most cargoes normally transported by trucks, including construction materials (i.e., sand, gravel, and cement); goods on pallets and in crates, boxes, etc.; and even full-size (i.e., 40-foot-length) shipping containers. Tube freight transportation is a class of unmanned transportation systems in which close-fitting capsules or trains of capsules carry freight through tubes between terminals. Enabling the State of Texas—through public-private partnerships—to use a part of its underground space in the existing right of way of highways, especially of interstate highways, will greatly facilitate the construction of such tubes and reduce their construction costs. However, many questions must be answered through a rigorous study before freight tubes can be used along highways and before they can become an integral part of the nation's future freight transportation system. This project also examines the use of underground freight tubes in congested urban environments, such as where application of the Freight Shuttle System may not be practical and doable.

Project Manager

Chris Glancey, RTI

Project Supervisor

Mohammad Najafi, UTA

Total Project Budget	*Research University*	*FY 2015 Budget*
$247,049	The University of Texas at Arlington	$99,620

0-6876—Understanding the Consequences and Cost of Climate Change to the Texas Transportation System

Start Date: 4/8/2015 *End Date: 5/31/2016*

Abstract

The consequences of climate change have the ability to create significant damage to the state's existing transportation infrastructure on a scale that will grow over time. The potential consequences include damage to highway pavements due to increased temperatures and more severe and frequent droughts; the inundation of roadways, bridges, and ferry infrastructure in low-lying coastal areas due to sea level rise; and stronger storm surges along the Texas coast and the subsequent damage to bridges and roadways. TxDOT risks the possibility of spending hundreds of millions or even billions of dollars of state funds to maintain or replace damaged infrastructure due to climate change. TxDOT needs to determine the scale of the potential problem, its potential costs, and the disruptions that may result from future climate change. In this project, researchers will develop a framework to assist with avoiding any significant, unanticipated costs that would be imposed upon Texas taxpayers and industries due to damage or loss of the state's transportation infrastructure as a result of climate change.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Vivek Tandon, UTEP

Total Project Budget	*Research University*	*FY 2015 Budget*
$249,903	The University of Texas at El Paso	$29,711

5-6662-03—Public Involvement Training Implementation

Start Date: 9/9/2014 *End Date: 8/31/2015*

Abstract

TxDOT's Office of Public Involvement recently implemented a public involvement policy and wishes to provide training to TxDOT staff, including district public information officers, to improve its liaisons with the public. At the public involvement training workshops, TxDOT staff will learn the agency's public involvement policy statement, the importance of good public involvement, how to identify stakeholders, and effective communication techniques when engaging the public. Previous work completed in Research Project 0-6662 and Research Project 5-6662-01 created a public involvement policy and performed initial planning for public involvement training. This project completes curriculum development and provides course training workshops to TxDOT staff.

Project Manager

Joe Adams, RTI

Project Supervisor

Carol Abel Lewis, TSU

Total Project Budget	*Research University*	*FY 2015 Budget*
$40,000	Texas Southern University	$40,000

Safety and Operations

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0-6824—New Rainfall Coefficients

Start Date: 8/22/2014 End Date: 8/31/2015

Abstract

The objective of this project is to update the depth duration frequency (DDF) and intensity duration frequency (IDF) of annual maximum rainfall throughout Texas from previous research and implementation projects sponsored by TxDOT. Previous research and implementation projects include:

- 0-4193, Regional Characteristics of Unit Hydrographs.
- 0-4194, Regional Characteristics of Storm Hyetographs.
- 0-5521, Develop Statewide Regression Equations for Improved Flood Peak Estimation.
- 5-1301, Updated Precipitation Atlases for Texas.

The Texas Tech University and U.S. Geological Survey research teams will work concurrently to develop new rainfall coefficients, provide readily usable equations to generate design storm hyetographs, and rapidly deploy the results of the research to TxDOT design engineers via a revised EBDLKUP-NEWXLS tool.

The research team will produce updated DDF/IDF values for a 10-minute-duration to a 24-hour-duration precipitation by county in Texas. These DDF/IDF values will be used to fit a form of power-law equations having coefficients named E, B, and D so that the DDF/IDF for arbitrary durations between 10 minutes and 24 hours can be specified. The county-specific equations will be incorporated into a revised EBDLKUP-NEWXLS spreadsheet, and the E, B, and D values will be tabulated in both the spreadsheet and the final report.

Project Manager

Wade Odell, RTI

Project Supervisor

Theodore Cleveland, TechMRT

Total Project Budget	*Research University*	*FY 2015 Budget*
$194,086	Center for Multidisciplinary Research in Transportation	$82,841
	U.S. Geological Survey	$92,000

0-6828—Develop Guidelines for New Vehicle Detectors at High-Speed Signalized Intersections

Start Date: 8/14/2014 End Date: 8/31/2015

Abstract

Early indications from the use of the newest vehicle detectors for high-speed signalized intersections suggest that they perform well as replacements for TxDOT's legacy systems, but this early conclusion needs corroboration based on rigorous field testing in a variety of traffic and environmental conditions. Without such testing, it is difficult to know whether the detectors are as good as they appear. This research will investigate the performance characteristics of detectors designed for the stop line area and dilemma zone detection. In some cases, new detectors will involve the two technologies to cover both upstream and stop line areas. There is also increasing use of infrared (IR) cameras with video imaging systems in an attempt to overcome some of the limitations of traditional cameras.

While these IR cameras may improve video detection for some lighting and temperature conditions, there is compelling evidence that they do not improve detection performance under all conditions.

The objectives of this research are to:

- Determine current TxDOT-specific needs for new vehicle detectors.
- Identify the most promising detectors for both stop line and dilemma zone detection.
- Develop guidelines on each new technology and establish recommended controller and detector settings to guide TxDOT on installation and use of each detector and combination.

Project Manager

Kevin Pete, RTI

Project Supervisor

Dan Middleton, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$175,204	Texas A&M Transportation Institute	$162,345

0-6840—Analysis of the Shoulder Widening Need on the State Highway System

Start Date: 1/7/2015 *End Date: 11/30/2015*

Abstract

In many rural Texas areas, pedestrians and cyclists have limited trip options, and therefore travelers often use rural low-speed highways for their trips. If these corridors do not have adequate roadway shoulders available, pedestrians and cyclists cannot travel on the shoulder and instead must occupy an active travel lane. Consequently, the objective of this project is to define the criteria for roadway shoulder suitability for pedestrians and bicycles, apply these criteria to Texas highways to determine candidate locations that merit shoulder improvements, identify high-use or high-demand locations, and develop a list of target locations, coupled with the suitability criteria to be incorporated into a strategic corridor development plan.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Karen Dixon, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$163,853	Texas A&M Transportation Institute	$108,575

0-6845—Connected Vehicle Problems, Challenges, and Major Technologies

Start Date: 1/16/2015 End Date: 12/31/2016

Abstract

The objective of the project is to compare and evaluate existing and emerging vehicular ad-hoc network (VANET) technologies in connected vehicle environments, including but not limited to the architecture, routing protocols, and hardware of vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications. During this project, researchers will:

- Provide an up-to-date overview and comparison of existing and emerging VANET technologies and their applications.
- Identify technical challenges and potential solutions associated with the system architecture, hardware, and software in VANET deployments.
- Demonstrate secure V2V and V2I messaging via round-trip timing and security-enhanced location sensors in a realistic attack scenario. This experiment will be undertaken in a laboratory setting.
- Provide guidelines for V2V and V2I applications in Texas roadway settings and identify opportunities for data collection through connected vehicle systems.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Chandra Bhat, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$335,000	Center for Transportation Research	$126,500

0-6847—An Assessment of Autonomous Vehicles: Traffic Impacts and Infrastructure Needs

Start Date: 1/15/2015 End Date: 12/31/2016

Abstract

This research project will survey Texans on vehicle and technology preferences, and then anticipate the adoption rates of various levels of vehicle automation and connectivity under different pricing, demographic, regional, and other scenarios. This approach will allow the research team and TxDOT to anticipate the benefits of such technologies for Texas households and businesses, at various levels of autonomous vehicle and connected vehicle adoption. Researchers will also investigate the economic impacts on different industry sectors (including vehicle repair and medical care industries) and the cost effectiveness of various TxDOT interventions and protocols in the design, management, and improvement of its transportation system. The project will deliver an assessment of connected and autonomous vehicle benefits, costs, and impacts for surface transportation systems; a detailed description of the adoption rates under multiple scenarios simulated; and recommended modifications for Texas transportation design, planning, and project evaluation practices to reflect automated vehicle impacts.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Kara M. Kockelman, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$341,388	Center for Transportation Research	$126,625

0-6849—Implications of Automated Vehicles on Safety, Design, and Operation of the Texas Highway

Start Date: 1/15/2015 End Date: 8/31/2016

Abstract

This project seeks to quantify crash-related gains of various vehicle automation and connectivity features by first documenting all demonstrated and emerging technologies, and then anticipating Texans' adoption rates of such technologies (for both personal and commercial uses). The project will simulate crash contexts under various technology, network design, and traffic management techniques. Researchers will document the state of research and development in automated and connected vehicle technologies, and evolve the Texas fleet and its daily use under market (price, technology, demographics, and land use) scenarios. Researchers will be able to anticipate the near-term and long-term impacts (e.g., those emerging in less than 15 years and those emerging over 25 years or more, respectively) on Texas crash counts and severities, and identify the spectrum of economic, institutional, and other outcomes that may come from a near-crashless roadway system. The team will identify the best practices for TxDOT and other agencies to most cost effectively facilitate Texas' adoption and use of top technologies. Researchers will apply comprehensive benefit-cost analyses and provide TxDOT staff with training on the topics and project results, and will offer recommendations to facilitate project implementation.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Kara M. Kockelman, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$320,144	Center for Transportation Research	$128,733

0-6859—Operational Analysis of Active Traffic Management Strategies

Start Date: 1/22/2015 End Date: 12/31/2016

Abstract

This project will develop tools for analyzing the effectiveness of active traffic management (ATM) strategies, along with supporting methodologies. The ATM strategies studied in this project are ramp metering, variable speed limits, mainline gap metering, coordinated freeway-arterial operations, dynamic lane use control, dynamic shoulder lane (hard shoulder running), dynamic route guidance, junction control, travel time signs, overhead gantries, and queue warning. The supporting methodologies will predict the effectiveness of these strategies based on traffic and other network data. These tools and methodologies address three related needs:

- Using traffic data to perform bottleneck analyses.
- Identifying locations where ATM implementation would relieve congestion.
- Identifying ATM decision rules to be applied in real time, including activation/deactivation thresholds and control rules.

The research team will develop four methodologies, including supporting tools; combining microsimulation for traffic realism and dynamic traffic assignment for vehicle rerouting and bottleneck analysis; and three frameworks, which require only one, or neither, of these models. For the latter frameworks, the research team will replace unavailable models with much simpler methodologies (resembling the procedures in the *Highway Capacity Manual*) obtained from comprehensive simulation runs performed during the project. These latter methodologies will be presented in spreadsheet form. All tools, spreadsheets, and supporting documentation will be delivered to TxDOT, and a training workshop will be scheduled.

Project Manager

Wade Odell, RTI

Project Supervisor

Stephen Boyles, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$288,863	Center for Transportation Research	$104,089

0-6861—Improving Safety and Efficiency of Signalized Intersections during Inclement Weather

Start Date: 2/12/2015 End Date: 12/31/2018

Abstract

Inclement weather, such as rain, snow, fog, and ice, create special operational challenges for traffic management agencies. This project will provide TxDOT with technical guidance for improving the safety and efficiency of signalized intersections during inclement weather. Researchers will examine available technologies for detecting adverse weather at signalized intersections and provide technical guidance on strategies for modifying traffic signal operations during various types of weather events. The results of this project will provide a realistic and practical architectural framework for collecting and disseminating weather information to improve signalized intersection operations. As part of this research effort, researchers will assess existing TxDOT mechanisms for providing weather-responsive traffic signal operations for different types of inclement weather events. Following this assessment, researchers will provide TxDOT with practical and implementable guidelines for developing traffic signal timing plans and using specific traffic signal controller features to make significant improvements in safety and congestion at signalized intersections during weather events such as fog, rain, ice, snow, and high winds. Researchers will provide guidance for operating traffic signals and developing traffic signal timing plans for large-scale evacuations, such as hurricane evacuations in coastal regions, in the form of revisions to the TxDOT *Traffic Signal Operations Handbook*. A one-day training module for implementing weather-responsive traffic operations will be developed by researchers and tested as part of this project.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Kevin Balke, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$343,735	Texas A&M Transportation Institute	$109,730

0-6867—Wrong-Way Driving Connected Vehicle Demonstration

Start Date: 2/12/2015 End Date: 12/31/2015

Abstract

This project will focus on developing a concept of operations and functional requirements for a connected vehicle test bed for wrong-way driving applications that will notify TxDOT and emergency response vehicles and personnel, including but not limited to law enforcement vehicles, about wrong-way driving events. More specifically, this project is a foundational systems engineering and planning effort focusing on:

- Identifying and selecting test bed locations.
- Conducting needs assessments.
- Developing a comprehensive concept of operations.
- Engaging market suppliers to develop wrong-way driving connected vehicle cost information.
- Creating financial requirements for test bed operations.
- Designing and testing potential warning messaging for fixed signing and in-vehicle applications.
- Outlining the system design for the selected wrong-way applications.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Melisa Finley, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$591,554	Texas A&M Transportation Institute	$459,012

0-6877—Communications and Radar-Supported Transportation Operations and Planning (CAR-STOP)

Start Date: 3/27/2015 End Date: 6/30/2016

Abstract

This project's research activities will focus on the advancement of the body of knowledge on the use of wireless technology (both communications and radar) to address the transportation safety challenges facing the state. The emphasis will be on both conducting basic research and porting that basic research to applied research in the form of pilot implementation tests.

Researchers will:

- Develop conceptual and functional frameworks for integrated wireless safety systems that incorporate information derived from both communication and radar platforms.
- Advance and develop a new combined communication-radar paradigm for automotive applications using next-generation millimeter wave communication.
- Conduct preliminary tests with real data and develop a concept of operations and requirements for full deployment.
- Design a complete research plan for time and cost extensions of the project with the objective of developing, testing, and refining an integrated communication-radar unit at mmWave.

The project will be directed toward improving the use of wireless technologies to obtain data from multiple and heterogeneous sources, advancing machine learning (that is, automated non-human learning as opposed to human-driven learning) and data-driven information extraction capabilities that are localized and timely, and bringing information together with driver characteristics and behavior to develop safety systems that are effective and customized.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Chandra Bhat, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$881,377	Center for Transportation Research	$262,447

0-6879—Cross-Border ITS Systems with Traffic Management Center

Start Date: 4/30/2015 End Date: 5/31/2016

Abstract

The traffic management centers (TMCs) in Texas play a vital role in managing traffic operations in many of our major metropolitan areas. TMCs have deployed extensive detection, monitoring, and communication infrastructure to allow TxDOT operators to manage incidents and reduce collisions, provide traveler information through roadside assets, provide traffic status to broadcast media, and support work zone monitoring and construction information. Currently, there is no cross-border TMC or traveler data exchange along the Texas/Mexico border to inform the traveling public of the traffic conditions on the other side of the border; therefore, travelers do not have information regarding traveling conditions between border sister cities.

In this project, researchers will evaluate the current state of the practice and future plans in Mexico to advance intelligent transportation systems. Researchers will also develop a framework and an action plan for TxDOT to lead the deployment of cross-border TMCs and to share data to improve the traffic conditions along the Texas/Mexico border and adjacent border cities.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Roberto Macias, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$130,102	Texas A&M Transportation Institute	$50,061

5-6408-01—Inspector Training for Nighttime Sign Inspections Using the Calibrated Sign Method

Start Date: 12/17/2014 End Date: 8/31/2015

Abstract

Under Research Project 0-6408, researchers evaluated TxDOT's current sign retroreflectivity maintenance practices, assessed their effectiveness, and recommended statewide sign retroreflectivity maintenance practices that could be easily and effectively implemented to ensure TxDOT compliance with the language related to minimum sign retroreflectivity in the 2009 edition of the *Texas Manual on Uniform Traffic Control Devices*.

Project Manager

Wade Odell, RTI

Project Supervisor

Paul Carlson, TTI

The purpose of this project is to provide training to TxDOT sign inspectors so that TxDOT will be in compliance with the language related to minimum sign retroreflectivity in the new *Texas Manual on Uniform Traffic Control Devices*. Researchers will develop training materials and conduct training workshops throughout the state as the primary objective of this project.

Total Project Budget	*Research University*	*FY 2015 Budget*
$56,500	Texas A&M Transportation Institute	$56,500

9-1001-14—Traffic Control Device Evaluation Program

Start Date: 9/1/2013 *End Date: 8/31/2016*

Abstract

This project will provide TxDOT with a mechanism to quickly and effectively conduct high-priority, limited-scope evaluations of traffic control devices (TCDs) including 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, TCD material performance, or changes in TxDOT practices regarding a TCD. Examples of various evaluations include safety effects, visibility assessments, and cost-benefit analyses. The activities conducted through this project will support the development of TCD-related policy, standards, guidelines, handbooks, and training.

The research activities of this project are specifically oriented to provide results that will lead directly to implementation. In each year of the project, TCD issues will be identified and prioritized for investigation. The selected issues will be evaluated and addressed with a separate work plan, and the results will be presented in an individual technical memorandum. The technical memorandums will include findings and recommendations that can support the implementation of the new guidelines or policy, as appropriate.

Project Manager

Wade Odell, RTI

Project Supervisor

Paul Carlson, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$994,929	Texas A&M Transportation Institute	$354,929

9-1002-15—Roadside Safety Device Crash Testing Program

Start Date: 9/4/2014 *End Date: 8/31/2017*

Abstract

This project provides TxDOT with a mechanism to quickly and effectively evaluate high-priority issues related to roadside safety devices. Roadside safety devices shield motorists from roadside hazards such as non-traversable terrain and fixed objects. To maintain the safety of the motoring public, these safety devices must be designed to accommodate a variety of site conditions and placement locations, as well as a changing vehicle fleet. As changes are made or in-service problems are encountered, there is a need to assess the compliance of existing safety devices with current vehicle testing criteria and to develop new devices with enhanced performance.

This project is set up to provide quick response to identified roadside safety needs and produce research results that will be immediately implemented. Implementation efforts will occur each year throughout the life of the project. The selected safety issues will be evaluated through engineering analyses, computer simulation, dynamic impact testing, and full-scale vehicular crash testing, as appropriate. Each report will include findings, drawings, and recommendations that support the implementation of new or revised design guidelines or standard detail sheets, as appropriate. The project will result in new or improved safety features that will be implemented through new or revised standard detail sheets. It will support the roadside safety needs of the Bridge, Design, Maintenance, and Traffic Operations Divisions.

Project Manager

Wade Odell, RTI

Project Supervisor

Roger Bligh, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$1,800,000	Texas A&M Transportation Institute	$600,000

Structures and Hydraulics

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0-6715—Interaction between Drilled Shafts and Mechanically Stabilized Earth (MSE) Walls

Start Date: 9/1/2011 *End Date: 8/31/2015*

Abstract

Due to space constraints, drilled shafts supporting superstructures are often constructed within mechanically stabilized earth (MSE) walls. The interaction between the drilled shafts and the MSE wall is not well known and not typically incorporated in the design.

The objective of this project is to investigate this interaction and propose design guidelines. To do so, a field study of three sites and a series of numerical simulations will be performed. The field study will consist of instrumenting two TxDOT sites where the movements and pressures will be monitored. The third site will be the National Geotechnical Experimentation Site at Texas A&M University where two drilled shafts and an MSE wall will be built, instrumented, and brought to failure.

The numerical model will be calibrated against the large-scale experiment. Then, simulations will extend the investigation to situations not covered by the field study. The parametric studies include cases where the drilled shafts affect the wall and vice versa. The load on the drilled shaft and the earth pressures to be resisted by the MSE wall will be quantified for each case.

Based on the results of the field study and the numerical simulations, design guidelines will be prepared.

Project Manager

Kevin Pete, RTI

Project Supervisor

Jean-Louis Briaud, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$409,374	Texas A&M Transportation Institute	$27,055
	The University of Texas at San Antonio	–

0-6719—Strengthening Continuous Steel Girders with Post-Installed Shear Connectors

Start Date: 9/1/2011 *End Date: 8/31/2015*

Abstract

A number of older bridges in Texas are constructed with floor systems consisting of a non-composite concrete slab over steel girders. A potentially economical means of strengthening these floor systems is to connect the existing concrete slab and steel girders to permit the development of composite action. Research Project 0-4124, completed in 2007, developed methods to strengthen existing non-composite steel girder bridges in positive moment regions by post-installing shear connectors, permitting substantial increases in load ratings. This project will extend the concepts developed in Research Project 0-4124 to permit the use of post-installed shear connectors to strengthen continuous multi-span non-composite bridges with inadequate capacity in negative moment regions. The project will investigate two strengthening approaches. The first approach will be to install shear connectors in negative moment regions to increase negative moment capacity through composite action. The second approach will be to install shear connectors in positive moment regions and allow redistribution of moments from negative to the strengthened positive moment regions. These approaches will be investigated through a comprehensive series of experimental, analytical, and computational studies, with the ultimate goal of providing practical guidelines for economical strengthening of older continuous steel girder bridges.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Michael Englehardt, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$854,454	Center for Transportation Research	$212,848

0-6731—Repair Systems for Deteriorated Bridge Piles

Start Date: 9/1/2011 *End Date: 8/31/2015*

Abstract

The objective of this project is to develop a durable repair system for deteriorated steel bridge piles that can be implemented without the need for dewatering. A rigorous survey of the relevant practice nationwide will be conducted to inform and direct the remaining research efforts. The current state of the practice will be critically reviewed, and the most promising alternatives will be identified for detailed investigation. The structural performance, constructability, and economy of the existing systems will be considered. A simplified but reliable framework for assessing the condition of deteriorated piles will be developed. The framework will be used to direct the full-scale testing of artificially deteriorated and repaired piles. Accelerated environmental exposure tests will also be conducted to evaluate the durability of the different repair systems. The results of the full-scale tests and the environmental durability tests will be used to direct a life-cycle cost analysis to identify the most economical repair systems based on initial costs, life-cycle costs, agency costs, and user costs. To evaluate the performance of the repair systems in real applications, field testing and long-term monitoring will be conducted at two bridge sites. Based on the research findings, guidelines for the design, construction, and maintenance of the systems will be developed to facilitate transfer of the technology to TxDOT bridge maintenance operations. The successful completion of the research project is expected to lead to the development of a new method and guidelines for repair of steel bridge piles, which will significantly enhance the safety and economy of existing bridge infrastructure throughout the state.

Project Manager

Wade Odell, RTI

Project Supervisor

M. Dawood, UH

Total Project Budget	*Research University*	*FY 2015 Budget*
$631,309	University of Houston	$110,695
	Center for Multidisciplinary Research in Transportation	$74,306

0-6783—Bi-directional Application of Carbon Fiber Reinforced Polymer (CFRP) with CFRP Anchors for Shear-Strengthening and Design Recommendations/Quality Control Procedures for CFRP Anchors

Start Date: 9/1/2012 *End Date: 12/31/2015*

Abstract

The objective of this study is to demonstrate the feasibility of using bi-directional carbon fiber reinforced polymer (CFRP) for shear strengthening of large bridge I-beams and U-beams. This project is an outgrowth of Research Project 0-6306 in which it was demonstrated that uni-directional CFRP strips and CFRP anchors could be used to improve the shear strength of reinforced concrete elements. The prime objective of that study was to evaluate the role of CFRP anchors. The tests showed that without anchors, the CFRP strips debonded, and there was no significant improvement in the shear capacity. With CFRP anchors, it was possible to achieve a 40–50 percent increase in shear capacity. Tests of four 54-inch-deep I-beams with both uni-directional and bi-directional CFRP strips indicated that the use of bi-directional strips led to significantly greater increases in shear capacity. It would not have been possible to strengthen the I-beams without the use of anchors to prevent debonding of the CFRP at reentrant corners of the cross section. Because the data on the bi-directional layout of CFRP was limited, additional work is needed to understand the behavior of the CFRP in strengthening thin webs subjected to large shear forces.

Since the anchor installation is a key element of the strengthening technique, this project will develop design guidelines for shear strengthening using bi-directional application of CFRP strips with CFRP anchors, design guidelines for CFRP anchors, construction procedures that detail installation of CFRP anchors, and an in-situ anchor testing methodology for quality control of installation.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Marcelo Sanchez, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$349,640	Texas A&M Transportation Institute	$56,187

0-6784—Creep Behavior of Soil Nail Walls in High Plasticity Index (PI) Soils

Start Date: 9/12/2012 End Date: 8/31/2015

Abstract

The objective of this project is to investigate the creep behavior of soil walls in high-plasticity clays. Creep behavior depends mainly on load level. Field investigation, laboratory tests, and numerical modeling will be used to study the effect of the load level on creep behavior tests, and numerical modeling will be used to study the effect of the load level on creep behavior of soil nails. Field studies will include conducting loading tests at the National Geotechnical Experimental Site (NGES) and monitoring an actual soil nail wall. The tests at the NGES will focus on the creep behavior of soil nails in a natural clay deposit. It will comprise four soil nails to be installed and around 10 existing tendons (installed in 1991). An actual soil nail wall (ideally in an embankment fill) will be tested and monitored long term. Laboratory test will complement the information gathered from the field. Numerical models (based on limit state analysis and the finite element method) will be calibrated with the information gathered from the experimental sites. Those models will be used to study in more detail the behavior of soil nails in high-plasticity clays. This will be done by simulating different field and operation conditions. Design guidelines for soil nail walls in high-plasticity clays will be prepared.

Project Manager

Wade Odell, RTI

Project Supervisor

Marcelo Sanchez, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$349,640	Texas A&M Transportation Institute	$56,187

0-6785—Extending Use of Elastomeric Bearings to Higher Demand Applications

Start Date: 9/1/2012 *End Date: 8/31/2015*

Abstract

Steel girders are often used in Texas for moderate- to long-span bridge applications. The long spans coupled with potential support skew and curved geometry result in significant demands on the bearings at the supports to accommodate rotations and complex bridge movements. Expensive pot bearings are commonly used in steel bridge applications. However, past studies (Research Project 0-5040) have shown that these expensive bearings do not perform well in accommodating bridge translations. The elastomeric bearing pads that are routinely used in concrete bridge systems generally provide a much more reliable means of accommodating translations, and the pads are significantly cheaper than pot bearings. Previous studies sponsored by TxDOT and the National Cooperative Highway Research Program have resulted in a well-defined design procedure for elastomeric bearings. However, the studies have focused primarily on bearing pads for use in short- to moderate-span systems. The typical steel I-girder or tub girder systems used in Texas bridges have larger vertical reactions and more significant translational and rotational demands than intended by the previous research studies. Although in recent years TxDOT has successfully used elastomeric pads in steel bridge applications, no full-size tests on the large bearings have been conducted to demonstrate the ability of the bearings to satisfy long-term performance requirements. In the absence of these tests, it is not clear if manufacturers have the ability to consistently produce bearings for high-demand applications. This project includes laboratory testing, field monitoring, and parametric computational modeling that will provide the supporting data so that elastomeric bearings can be confidently used in the wide range of bridge applications throughout Texas. The use of elastomeric bearings in steel bridge applications will result in systems that are easier to fabricate, erect, and maintain while also improving long-term bridge behavior.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Todd Helwig, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$604,416	Center for Transportation Research	$192,473

0-6816—Partial Depth Precast Concrete Deck Panels on Curved Bridges

Start Date: 7/11/2014 End Date: 12/31/2017

Abstract

The primary objective of this research is to extend the use of precast concrete panels (PCPs) to curved girder systems. The focus of the study includes steel I-girder systems, steel tub girder systems, and spliced prestressed concrete U-beams, which are currently being considered for use in some Texas bridges.

The research methods that are to be employed in this study consist of full-scale laboratory testing and parametric finite element modeling of the PCPs and the corresponding curved girder systems.

Project Manager

Wade Odell, RTI

Project Supervisor

Todd Helwig, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$1,414,137	Center for Transportation Research	$433,415

0-6829—Fatigue Resistance and Reliability of High Mast Illumination Poles (HMIPs) with Pre-existing Cracks (CTR)

Start Date: 8/22/2014 End Date: 3/31/2018

Abstract

High-mast illumination poles (HMIPs) are used throughout Texas and the United States to provide lighting along highways and at interchanges. Texas currently has about 5,000 HMIPs, varying in height from 100 to 175 feet. In recent years, a number of HMIP collapses have been reported in other states. These collapses have been attributed to fatigue failures at the HMIP shaft-to-base plate connection.

This project will generate data and information to support a probabilistic-based assessment of the remaining life of pre-cracked HMIPs. Laboratory fatigue tests will be conducted on pre-cracked galvanized HMIPs. In addition, field data will be collected, and additional analyses will be conducted to characterize the wind response of Texas HMIPs. Field and laboratory studies will be supplemented by finite element studies simulating the global and local response of pre-cracked HMIPs. The results of the laboratory data, field studies, and analytical studies will be combined in a reliability-based framework to provide a probabilistic assessment of the fatigue life of in-service pre-cracked HMIPs. Finally, additional information on options for mitigating risk associated with cracked HMIPs, such as increased inspection and monitoring, repair techniques, and methods to reduce vortex shedding, will be developed in this project.

Project Manager

Wade Odell, RTI

Project Supervisor

Michael Englehardt, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$1,437,727	Center for Transportation Research	$479,833

0-6830—Fatigue Resistance and Reliability of High Mast Illumination Poles (HMIPs) with Pre-existing Cracks (UH)

Start Date: 9/3/2014 *End Date: 8/31/2016*

Abstract

This research project will evaluate the safe and serviceable lives and probability-based life-cycle costs of TxDOT high-mast illumination poles. The research includes a unique high-cycle resonant bending fatigue testing plan that will enable testing of high-mast pole base connections up to 100 million cycles within six weeks. The research team will also conduct a detailed wind analysis based on a field monitoring campaign. The field measurements will be used to develop new and detailed wind-loading models to minimize the uncertainty associated with wind loading of these structures. The dynamic response of the poles and the corresponding stress ranges will be modeled through a finite element analysis approach. A probabilistic life-cycle analysis will be used to evaluate the probability of failure of the poles and the benefit-cost ratio of various intervention techniques. The findings of the research project will serve as a state-of-the-art reference for TxDOT engineers and decision makers to allocate resources, minimize risk, and maximize benefit-cost ratios associated with maintenance of high-mast poles.

Project Manager

Wade Odell, RTI

Project Supervisor

Mina Dawood, TechMRT

Total Project Budget	*Research University*	*FY 2015 Budget*
$587,917	University of Houston	$178,332
	Center for Multidisciplinary Research in Transportation	$133,126

0-6831—End Region Behavior of Pretensioned Concrete Beams with 0.7-Inch Prestressing Strands

Start Date: 7/31/2014 End Date: 8/31/2017

Abstract

While future implementation of 0.7-inch prestressing strands may reduce fabrication costs and extend the working range of pretensioned concrete beams, the limits of the technology have yet to be defined. An innovative combination of analytical and experimental methods will be used in this project to resolve the primary technical challenges to the fabrication of state serviceable TX girders with 0.7-inch strands.

Effective doubling of the stress imposed by each strand within a standard (2-inch by 2-inch) grid is expected to have a dramatic effect on the performance of current end region details. Practical modifications to the prestressing and end region reinforcement schemes will be experimentally evaluated and refined to obtain serviceable behavior.

The unique end region stresses imposed by 0.7-inch strands may influence the failure mode and ultimate strength of shear-dominated TX girders. Full-scale shear tests will be completed to identify the controlling shear failure mechanisms and assess the conservation of the corresponding shear capacities estimated through application of the American Association of State and Highway Transportation Officials Load and Resistance Factor Design shear design provisions.

Implementation of 0.7-inch strands through application of the research findings will be greatly facilitated by continuum TxDOT and industry stakeholder involvement throughout the course of the project.

Project Manager

Wade Odell, RTI

Project Supervisor

Oguzhan Bayrak, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$835,000	Center for Transportation Research	$258,542

0-6841—Modeling a Change in Flowrate through Detention or Additional Pavement on the Receiving Stream

Start Date: 1/15/2015 End Date: 12/31/2015

Abstract

The addition or removal of flow from a stream affects the water surface downstream and possibly upstream. The extent of such effects is only known by modeling the receiving stream. A vital component of such modeling is knowing where to locate boundaries in the model. Rapid model development to assess incremental changes in flowrate from incremental changes in pavement coverage or detention benefits TxDOT by reducing the time required to assess the hydraulic impact. In this project, researchers will develop guidance that concisely describes how far upstream or downstream a hydraulic model needs to extend to fully describe those effects, and will support rapid model construction to assess changes in anticipated discharge.

Project Manager

Wade Odell, RTI

Project Supervisor

Ted Cleveland, TechMRT

Total Project Budget	*Research University*	*FY 2015 Budget*
$59,945	Center for Multidisciplinary Research in Transportation	$37,798

0-6842—Analysis of Curb Inlets in the New TxDOT Standard Inlet and Manhole Program

Start Date: 1/15/2015 End Date: 2/28/2017

Abstract

This project will provide design guidance for the flow performance of the new TxDOT standard on-grade Type PCO precast curb inlet. The new curb inlet uses flush slab supports for inlets longer than 5 feet, which is required in Texas due to small road slopes and intense rainfall rates. The flush slab supports are thought to cause a substantial decrease in the curb inlet capacity, but there are no examples of inlet experiments in the literature that can be used to quantify the effect of the slab supports. Without new guidance on inlet capacity with slab supports, roadway designers must resort to making rough estimates of probable drainage effects, which could result in significant over- or under-capacity designs.

The research team will conduct full-scale experiments using the existing UT Roadway Physical Model and will analyze the experimental results to provide a set of flow equations for inlet behavior that can be used in standard design software (for example, GeoPak Drainage). The research team will test the new inlet design both with and without slab supports with the standard opening sizes (5, 9.5, and 14 feet) over a variety of roadway longitudinal and cross slopes at different flow rates and roadway roughness.

The research team will determine how the new precast curb inlet will behave, which is critical to making best use of the new standards.

Project Manager

Wade Odell, RTI

Project Supervisor

Ben R. Hodges, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$307,551	Center for Transportation Research	$126,123

0-6862—Improved Tub Girder Details

Start Date: 1/23/2015 End Date: 12/31/2018

Abstract

Steel trapezoidal box girders, generally referred to as tub girders, have been widely used on a number of bridges throughout Texas. The smooth profile of the girder systems provides an aesthetically appealing bridge that also possesses several structural advantages compared to other girder types. Due to the high torsional stiffness of the closed box section, the girders are a popular choice in horizontally curved systems where the bridge geometry leads to large torsional moments. The girders have also been used on a number of straight girder systems throughout the state, leading to improved bridge aesthetics. While tub girders have primarily been used on bridges with longer spans where concrete girders are not viable, an application of relatively shallow steel tub girders was recently used in the TxDOT Waco District on a bridge with span lengths normally reserved for concrete girder systems. The resulting bridge provided an aesthetically appealing structure that satisfied a demanding vertical clearance requirement and was cost comparable with precast concrete girders. This shallow tub girder application demonstrates that steel trapezoidal box girders offer a viable alternative that should be considered for a wider variety of bridge applications. However, to augment the viability of tub girders, improved details need to be considered to further enhance their economic and structural advantages. Modifications in the girder geometry can provide more efficient systems. This research consists of large-scale laboratory testing and parametric finite element analyses. The project will result in improved details for tub girders as well as design methodologies for the girders and bracing components.

Project Manager

Wade Odell, RTI

Project Supervisor

Todd Helwig, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$988,485	Center for Transportation Research	$131,076

0-6863—Develop Strong and Serviceable Details for Precast, Prestressed Concrete Bent Cap Standards That Can Be Implemented on Everyday Bridge Construction Projects

Start Date: 1/27/2015 End Date: 11/30/2017

Abstract

This project will enable TxDOT to use pretensioned, precast bent caps through a comprehensive investigation that will include a literature search, review of design considerations, numerical modeling, and experimental verification. The specific objectives are to:

- Develop strong and serviceable details for precast, pretensioned concrete bent cap standards that can be implemented in the TxDOT Bridge Standard.
- Develop serviceable details for the overhang portion of the bent cap where the longitudinal prestressing force is less likely to be fully effective.
- Evaluate the use of interior voids to reduce precast unit weight and enhance constructability.

Project Manager

Darrin Jensen, RTI

Project Supervisor

Anna Birely, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$686,356	Texas A&M Transportation Institute	$126,989

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

Start Date: 3/27/2015 End Date: 8/31/2015

Abstract

Deicing using geothermal energy can provide TxDOT with a better alternative than the existing method of deicing with sands and/or salts. This research project will address this topic with a primary focus on a comprehensive synthesis study. As a part of this synthesis, the available literature on geothermal energy, along with successful 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, 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 deicing 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 deicing system for field application. Recommendations will be made on candidate geothermal structures and bridge deck/pavement heating systems for field demonstration studies as a part of follow-up validation studies.

Project Manager

Sonya Badgley, RTI

Project Supervisor

Xinbao Yu, UTA

Total Project Budget	*Research University*	*FY 2015 Budget*
$193,063	The University of Texas at Arlington	$50,727

5-4829-03—Implementation of Geosynthetic-Reinforced Unbound Base Courses

Start Date: 9/1/2014 *End Date: 8/31/2017*

Abstract

This project will establish material specifications for geosynthetics used to reinforce unbound base courses, particularly for those placed on subgrades comprised of expansive clays. This project includes the following:

- Producing material property data using the small pullout equipment developed in Research Project 0-4829 to establish specifications.
- Collecting field performance data to establish limits of acceptable material property values.
- Developing guidance documents for proper selection and inspection.
- Providing support and training to TxDOT personnel for the use of geosynthetic-reinforced pavements.

Project Manager

Joe Adams, RTI

Project Supervisor

Jorge G. Zomberg, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$496,976	Center for Transportation Research	$158,884

5-6022-03—Implementation Using Geofoam for Bridge Approach Slabs and Roadway Embankments

Start Date: 4/29/2015 End Date: 8/31/2017

Abstract

TxDOT's Fort Worth District installed a novel lightweight fill material, expanded polystyrene (EPS) geofoam, as part of a rehabilitation of the US 67 bridge over SH 174 in Johnson County. The bridge embankment, constructed in 1995, is approximately 40 feet high. Readily available moderate plasticity clay soil was adopted as the fill material. Over the past 16 years, the approach slabs at each end of this bridge experienced more than 17 inches of settlement. The district funded a rehabilitation project to remove the modular block walls underneath, construct 3:1 slopes, repair bridge beams, and remove and replace 150 feet of approach slab and pavement on each end. EPS geofoam was selected due to its lightweight and high-compressibility attribute. This rehabilitation work started in January 2012 and was completed in the following month (February 2012).

This area was instrumented with four horizontal inclinometers and four pressure cells to monitor the settlement behavior and pressure response of the embankment in relation to the dead load of the overlying pavement structure, live traffic loading, embankment settlement, and pressure against the abutment and wing walls. After the completion of installation in February 2012, the research team conducted field performance monitoring at regular intervals. It can be observed from the horizontal inclinometer data that during the three years after opening to traffic, less than 1.5 inches of post-construction vertical displacement (settlement) occurred. Due to the continual soil movement and water draining from under the approach slab, the influencing factors contributing to settlement of geofoam installation are not yet identified. Additional data collection is desired in order to evaluate the longer-term performance of the EPS geofoam in this embankment. Hence, continued site visits for data collection need to be conducted for at least five to six years. Long-term performance data will also help in the formulation of design charts for future use of EPS geofoam in other projects.

Project Manager

Joe Adams, RTI

Project Supervisor

Anand Puppala, UTA

Total Project Budget	*Research University*	*FY 2015 Budget*
$336,370	The University of Texas at Arlington	$152,702

TxDOT Administration Research

Project	Title	Start Date	Page
0-6806-CTR	TxDOT Administration Research (CTR)	9/1/2013	116
0-6806-TTI	TxDOT Administration Research (TTI)	9/1/2013	117

0-6806-CTR—TxDOT Administration Research (CTR)

Start Date: 9/1/2013 *End Date: 8/31/2015*

Abstract

This research project will evaluate numerous transportation issues and develop findings and/or recommendations based on results. This project has been structured to address some of the unique considerations related to transportation. Two of the most significant of these are that:

- Transportation research needs are sometimes identified in a manner that necessitates a quick response that does not fit into the normal research program planning cycle.
- Individual transportation research needs are not always large enough to justify funding as a stand-alone research project, despite the fact that the issue may be an important one.

Project Manager

Kevin Pete, RTI

Project Supervisor

Khali Persad, CTR

Total Project Budget	*Research University*	*FY 2015 Budget*
$250,000	Center for Transportation Research	$125,000

0-6806-TTI—TxDOT Administration Research (TTI)

Start Date: 9/1/2013 *End Date: 8/31/2015*

Abstract

This research project will evaluate numerous transportation issues and develop findings and/or recommendations based on results. This project has been structured to address some of the unique considerations related to transportation. Two of the most significant of these are that:

- Transportation research needs are sometimes identified in a manner that necessitates a quick response that does not fit into the normal research program planning cycle.
- Individual transportation research needs are not always large enough to justify funding as a stand-alone research project, despite the fact that the issue may be an important one.

Project Manager

Kevin Pete, RTI

Project Supervisor

Bill Stockton, TTI

Total Project Budget	*Research University*	*FY 2015 Budget*
$250,000	Texas A&M Transportation Institute	$125,000