Research Program

FY 2012

Research and Technology Implementation Office

The Texas Department of Transportation

Table of Contents

Institutions Active in TxDOT's 2012 Research Program .....pg. 2

Fiscal Year 2012 Research Program .....pg. 3

RMC 1 - List of Projects.....pg. 5
RMC 1 - Active Projects.....pg. 7

RMC 2 - List of Projects.....pg. 43
RMC 2 - Active Projects.....pg. 45

RMC 4 - List of Projects.....pg. 68
RMC 4 - Active Projects.....pg. 70

RMC 5 - List of Projects.....pg. 94
RMC 5 - Active Projects.....pg. 96

RMC P - List of Projects.....pg. 129
RMC P - Active Projects.....pg. 130

Index .....pg. 138

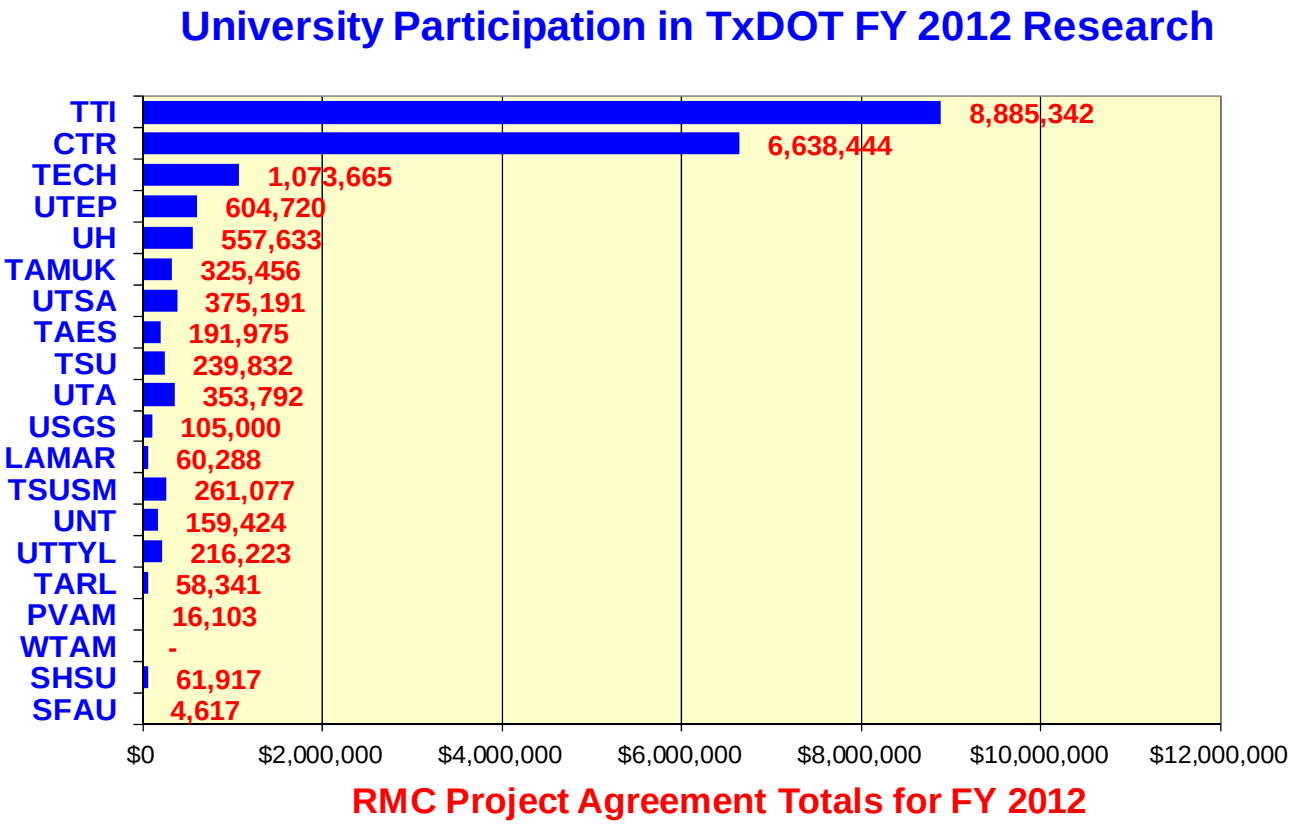
Institutions Active in TxDOT's 2012 Research Program

Acronym	University / Research Institution
CTR	Center for Transportation Research, University of Texas at Austin
LAMAR	Lamar University
PVAM	Prairie View A&M University
SFAU	Stephen F. Austin State University
SHSU	Sam Houston State University
TAES	Texas AgriLife Research
TAMUK	Texas A&M University – Kingsville
TARL	Tarleton State University
TECHMRT	Center for Multidisciplinary Research in Transportation, Texas Tech University
TSU	Texas Southern University
TSUSM	Texas State University – San Marcos
TTI	Texas Transportation Institute
UH	University of Houston
UNT	University of North Texas
USGS	United States Geological Survey
UTA	University of Texas at Arlington
UTEP	University of Texas at El Paso
UTSA	University of Texas at San Antonio
UTTYL	University of Texas at Tyler
WTAM	West Texas A&M University

FISCAL YEAR 2012 RESEARCH PROGRAM

University Participation

TxDOT's fiscal year 2012 research program consists of 129 projects, with budgets totaling $19.6 million. This work is contracted to nineteen Texas state-supported universities and the United States Geological Survey (USGS). The figure below shows project agreement totals by university / research institution.

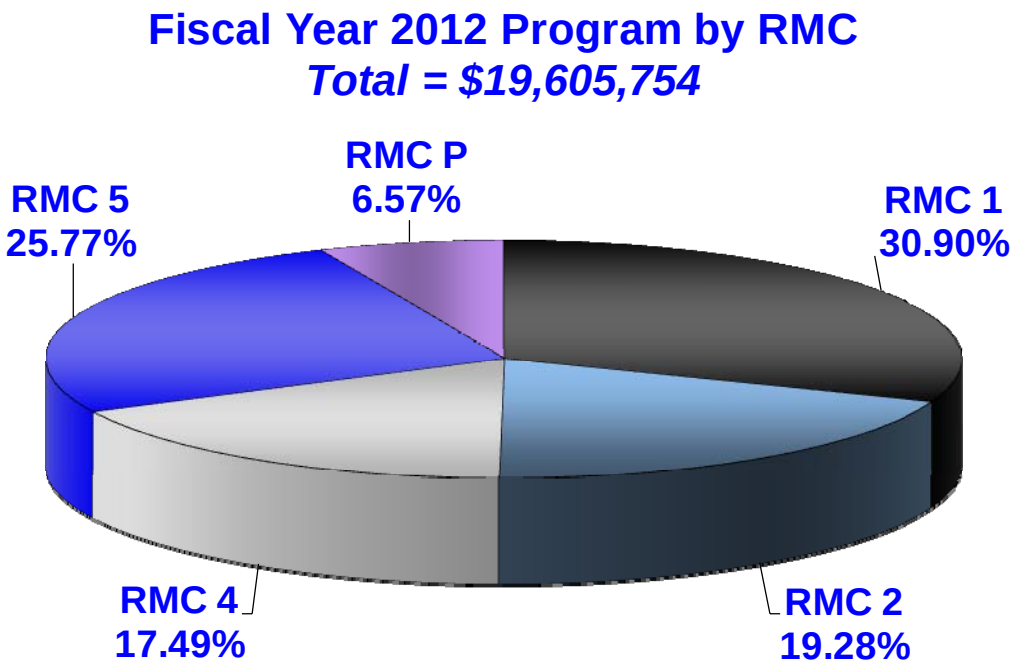


Research Management Committee (RMC) Funding

The table below shows a summary by RMC of the number of continuing and new projects, and total funding, for fiscal year 2012.

RMC	Focus Areas of RMC	Number of Continuing Projects	Number of New Projects	Total Project Funding
1	Construction and Maintenance	26	11	$ 6,057,563
2	Planning and Environment	14	11	$ 3,780,027
4	Safety and Operations	11	13	$ 3,428,742
5	Structures and Hydraulics	22	11	$ 5,052,038
P	Administration	7	3	$ 1,287,384
Total		80	49	$ 19,605,754

The figure below shows each RMC's proportion of the total fiscal year 2012 program.



RMC 1 – Active Projects

Project	Title	Start Date	Page
0-5836	Performance of Permeable Friction Course (PFC) Pavements Over Time	9/1/2008	7
0-6005	Developing a Testing Device for Total Pavements Acceptance	9/1/2008	8
0-6009	Evaluation of Binder Aging and its Influence in Aging of Hot Mix Asphalt Concrete	10/2/2007	9
0-6092	Performance Evaluation and Mix Design for High RAP Mixtures	9/1/2008	10
0-6132	Development and Field Evaluation of the Next Generation of HMA Mix Design Procedures	9/1/2008	11
0-6255	Use of Manufactured Sands for Concrete Paving	9/1/2008	12
0-6274	Project Level Performance Database for Rigid Pavement in Texas, Phase II	11/14/2008	13
0-6444	Treatments for Clays in Aggregates Used to Produce Cement Concrete, Bituminous Materials and Chip Seals	9/1/2009	14
0-6591	Developing a Fundamental Understanding of the Chemistry of Warm Mix Additives	9/1/2009	15
0-6607	Search for a Test for Fracture Potential of Asphalt Mixes	9/1/2010	16
0-6610	Impact of Changes in Profile Measurement Technology on QA Testing of Pavement Smoothness	9/1/2010	17
0-6611	Improvements of Partial and Full-Depth Repair Practices for CRCP Distresses	9/1/2010	18
0-6613	Evaluate Binder and Mixture Aging for Warm Mix Asphalts	9/1/2010	19
0-6614	Use of Recycled Asphalt Shingles in HMA	9/1/2010	20
0-6615	Use of Fine Graded Asphalt Mixes	9/1/2010	21
0-6616	Validate Surface Performance-Graded (SPG) Specification for Surface Treatment Binders	9/1/2010	22
0-6617	Revamping Aggregate Property Requirements for Portland Cement Concrete	9/1/2010	23
0-6618	Mitigation of High Sulfate Soils in Texas	9/1/2010	24
0-6619	Evaluation of Skid Measurements Used by TXDOT	9/1/2010	25
0-6620	Dwarf Turf-type and Early Maturing Annual Ryegrass to Establish Perennial Vegetation	9/1/2010	26
0-6621	Developing a Mixture Based Specification for Flexible Base	9/20/2010	27

RMC 1 – Active Projects

Project	Title	Start Date	Page
0-6622	Implementation of a Texas Mechanistic-Empirical Thickness Design System (TexME)	11/5/2010	28
0-6623	Optimizing Resource Allocations for Routine Highway Maintenance	9/1/2010	29
0-6658	Collection of Materials and Performance Data for Texas Flexible Pavements and Overlays	11/9/2010	30
0-6663	Evaluation of Pavement Rutting and Distress Measurements	10/4/2010	31
0-6665	TxDOT Native Plant Integration Program for South, Central and West Texas	9/1/2010	32
0-6673	Evaluate the Improvement in Pavement Ride, Distress and Condition Based on Different Treatment Types	9/1/2011	33
0-6674	Improving Fracture Resistance Measurement in Asphalt Binder Specification with Verification on Asphalt Mixtures Cracking	9/1/2011	34
0-6675	Evaluation of Bonus/Penalty Pay Adjustment Systems for HMA and Ride Specifications of Concrete and Asphalt Pavements	9/1/2011	35
0-6676	Rapid Field Detection of Moisture Content for Base and Subgrade	9/1/2011	36
0-6677	Costs Associated with Conversion of Surfaced Roads to Unsurfaced Roads	9/1/2011	37
0-6679	Performance Life of Various HMA Mixes in Texas	9/1/2011	38
0-6681	Optimizing Concrete Pavement Type Selection Based on Aggregate Availability	9/14/2011	39
0-6683	Develop a Pavement Project Evaluation Index to Support the 4-Year Pavement Management Plan	9/1/2011	40
0-6686	Improving DMS 9210 Requirements for Limestone Rock Asphalt (LRA)	9/1/2011	41
0-6687	Minimize Premature Distresses in Continuously Reinforced Concrete Pavement	9/1/2011	42

0-5836 - Performance of Permeable Friction Course (PFC) Pavements Over Time

Start Date - 09/01/2008 ***End Date*** - 08/31/2012

Abstract

Objective: This project will address the need to track the performance of permeable friction course (PFC) pavements by developing a database of PFC performance in terms of functionality (noise, permeability), durability (resistance to raveling and possibly rutting and cracking), and safety (skid resistance and accident history).

Recent TxDOT projects 0-5262, 0-5185, and 0-4834 addressed important design, construction, and maintenance issues associated with permeable friction courses (PFC) that have been increasingly utilized by TxDOT over the past several years based on safety and environmental benefits. To complete the evaluation of this relatively new hot mix asphalt concrete (HMAC) mixture type as a possible solution for pavement maintenance and rehabilitation, performance must be tracked over time to assess benefits, costs, and changes in benefits. The project will address this need by developing a database of PFC performance in terms of functionality (noise, permeability), durability (resistance to raveling and possibly rutting and cracking), and safety (skid resistance and accident history). Field performance of sections from both previous TxDOT projects and new construction will be monitored non-destructively at regular intervals using ground penetrating radar (GPR), noise measurement equipment, the portable seismic pavement analyzer (PSPA), the Tex-246-F Field Water Flow Test, TxDOT skid trailers, circular texture meters (CTMeter), and i-Buttons. As performance problems are identified, cores will be taken and further laboratory evaluation will be completed. Results from analyses of multi-year performance data and previous research will be used to produce guidelines for design, construction, and maintenance of PFC.

Project Director

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Project Advisors

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Research Supervisor

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Total Project Budget	*Research Universities*	*FY 2012 Budget*
$663,214	Center for Transportation Research	$61,879
	Texas Transportation Institute	$110,532

0-6005 - Developing a Testing Device for Total Pavements Acceptance

Start Date - 09/01/2008 ***End Date*** - 08/31/2012

Abstract

Objective: This research project will produce a state-of-the-art Total Pavement Acceptance Device (TPAD) that will provide TxDOT with enhanced testing capabilities for accepting new pavements and evaluating existing pavements.

The Rolling Dynamic Deflectometer (RDD) was developed through TxDOT's research program and has provided TxDOT with valuable pavement structural condition information for over fifteen years. The pavement structural condition data collected with the RDD has been used to evaluate both highway and airport pavement conditions on numerous projects. Applications include rehabilitation treatment selection, pavement forensic investigations, evaluation of alternative, new, in-service treatment strategies on the same route, and other applications. The success of continuous deflection measurement technology is evidenced by the back-log of pavement projects waiting for RDD testing. Advancements have occurred over the past 15 years in continuous deflection measurement equipment technology and data signal processing technology. In addition, new non-destructive testing (NDT) technologies have been developed and implemented by TxDOT. Field experience has shown that RDD data is enhanced when combined with other NDT data such as pavement layer thickness and subsurface condition information from Ground Penetrating Radar (GPR); visual distress data from the V-Crack system; Right-of-Way images from a high-definition video camera; transverse profile data from rut measure devices; and accurate location measurements. Field experience has also shown that it is sometimes difficult to collect and later compare RDD and other NDT equipment data due to variations in distance measurement accuracy on the different pieces of equipment, time lags between data collection efforts, and human error. These factors can result in excessive time delays in post processing RDD and other NDT data.

Based on the extensive past history with the RDD and these other NDT technologies, TxDOT proposed to develop a single piece of equipment that combines the capabilities of the RDD, GPR, V-Crack, rut measurement, video, and accurate distance measurements. This device will have the capability to collect all of these data types in a single pass. In addition, TxDOT proposed that a data analysis software package be developed that can post process and display all of these data types in a customized display. The software would allow users to view various data types in a single display, which will greatly enhance analysis and interpretation capabilities. This research will take advantage of extensive research knowledge and abilities, technological advancements, and extensive field experience to produce a state-of-the-art Total Pavement Acceptance Device (TPAD). The TPAD will provide TxDOT with enhanced testing capabilities for accepting new pavements and evaluating existing pavements that do not currently exist anywhere in the world.

Project Director

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Project Advisors

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Research Supervisor

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Total Project Budget	*Research Universities*	*FY 2012 Budget*
$1,571,570	Center for Transportation Research	$110,000
	Texas Transportation Institute	$50,000

0-6009 - Evaluation of Binder Aging and its Influence in Aging of Hot Mix Asphalt Concrete

Start Date - 10/02/2007 ***End Date*** - 08/31/2012

Abstract

Objective: This project will address issues associated with binder aging, maintenance treatments, and fatigue in different mixtures of hot mix asphalt pavements.

While it is becoming recognized that binders oxidize in pavements over time to a significant depth in hot mix asphalt (HMA) pavements and thus reduce pavement durability, a number of important issues require a better understanding for implementation. Maintenance treatment effectiveness is not well documented, nor is the varying impact of binder oxidation on fatigue in different mixtures understood. Finally, the level of binder aging at different milestones in pavement service (placement and during pavement service) as related to laboratory aging is not well known. This project will address these issues with laboratory and field studies of mixtures and pavements 1) to develop a pavement oxidation model and calibrate it with pavement binder aging data; 2) to provide information on the effectiveness of maintenance treatments; and 3) to assess the importance of different mixture parameters to the decline of fatigue resistance with aging. The expected results of the project will be 1) a new test procedure and process for characterizing binder aging, and for predicting service life for different applications, 2) an HMA fatigue mix design component that incorporates aging, 3) guidelines for optimizing HMA mixture resistance to aging, and 4) guidelines for the best maintenance treatments.

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Total Project Budget	*Research Universities*	*FY 2012 Budget*
$1,278,498	Texas Transportation Institute	$282,000

0-6092 - Performance Evaluation and Mix Design for High RAP Mixtures

Start Date - 09/01/2008 ***End Date*** - 08/31/2012

Abstract

Objective: This research project will address and develop good practices for designing and constructing mixes containing higher than normal RAP contents.

Economical benefits of using RAP are well known, but TxDOT should only consider using it if; a) its long-term performance is judged to be the same or better than the conventional mix, b) the quality/uniformity of the RAP layer can be certified on a day to day basis, and c) for the surface layers containing RAP adequate skid resistance must be maintained as compared to conventional mix using Class A aggregates

This project will address all three of these critical factors. Past experiences have found that high RAP contents can potentially lead to very stiff HMA mixes and in some instances virgin binders have been found to be incompatible with the existing aged binder.

As far as how TxDOT can address these issues, it is envisioned that if this research shows high RAP content mixes to be cost effective, then a potential scenario could include;

- for final mix approval the contractors will submit two sets of samples for testing; one set made using conventional materials and the other modified with RAP. These samples will be tested for rutting and cracking using the Hamburg/Overlay Tester combination. If no detrimental performance is observed then recommendations will be made for field evaluation.
- the consistency and day to day variability is a big concern especially as several of the stockpiles are owned by contractors. It is envisioned that the best day to day control will be in terms of setting tolerances on the compaction curve generated with the Superpave compactor.
- skid resistance continues to be a concern for surface mixes. TTI will evaluate this characteristic property using the polishing wheel and the circular skid tester to measure the polishing potential of RAP mixes in the laboratory. Mixes which pass the tests and place in the field will then be monitored with traditional skid test equipment.

Project Director

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Project Advisors

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Research Supervisor

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Total Project Budget	*Research Universities*	*FY 2012 Budget*
$535,975	Texas Transportation Institute	$110,000

0-6132 - Development and Field Evaluation of the Next Generation of HMA Mix Design Procedures

Start Date - 09/01/2008 ***End Date*** - 08/31/2012

Abstract

Objective: The goal of this project is to critically review new ideas and recommendations from recent findings concerning HMA mix designs to extract what is practical and cost effective, and to build and field test the next generation of mix design procedures.

Recent changes to the Texas HMA mix design procedures have ensured that the mixes routinely used on Texas highways are not prone to rutting. The adoption of the higher PG graded binders and the Hamburg tester has virtually eliminated rutting. However concerns have been raised about mixes which are now "drier", more difficult to compact and more susceptible to both reflection and fatigue cracking. This is particularly a problem with the dense graded Type C and D mixes which are widely used throughout the state. Several studies have recently been completed either by universities or the Construction Division making recommendations on how to achieve a more balanced mix design where the mix will continue to be rut resistance but also will have adequate workability and flexibility. Several new ideas are under consideration to either modify existing design criteria (target densities, VMA requirements, etc.) or to include new test procedures such as the Overlay Tester (OT).

Now it is time to critically review these findings, to extract what is practical and cost effective and to build and field test the next generation of mix design procedures. The new procedures will be run in parallel with the existing procedures and the new designs will be evaluated in a series of test sections constructed on actual construction projects. However one major concern is that with the current research cycle the construction and monitoring of test sections under actual traffic loads will take a minimum of 6 to 8 years to obtain definitive information on new mix performance. There is an urgent need to use accelerated pavement testing to validate the possible changes to TxDOT's mix design procedures.

Project Director

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Research Supervisor

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Total Project Budget	*Research Universities*	*FY 2012 Budget*
$1,342,768	Texas Transportation Institute	$165,193
	University of Texas at San Antonio	$0

0-6255 - Use of Manufactured Sands for Concrete Paving

Start Date - 09/01/2008 ***End Date*** - 08/31/2012

Abstract

Objective: The purpose of this research is to find solutions for using manufactured fine aggregates (MFAs) for producing good quality paving concrete that has adequate surface friction.

The use of manufactured fine aggregate (MFA) is becoming much more prevalent due to the depletion of natural sand sources in parts of the state, particularly the Fort Worth and Dallas Districts. Manufactured sands are produced with amounts of minus No. 200 fractions (micro fines) ranging from 5 to 20 percent. Generally the micro fines are washed out since TxDOT limits the amount of micro fines to 6 percent, and it is not feasible to eliminate a portion of them. The elimination of the micro fines represents a wasted aggregate resource and leads to a disposal problem for producers. In addition, the elimination of the micro fines often produces a harsh mix that does not finish well, leading to the necessity of adding natural sand for workability. Research at the International Center for Aggregates Research has shown that very good concrete can be made using manufactured sand, with and without micro fines. Generally the flexural strength, abrasion resistance, and impermeability are increased; compressive strengths vary and shrinkage, while slightly higher, is still within acceptable ranges. Water reducers and mineral admixtures can be used to improve workability, since in many cases the more angular MFA results in reduced workability. Another issue using manufactured sands, particularly carbonate materials, is the low acid insoluble (AI) residue. Low values of AI are generally believed to result in polishing of the mortar matrix, which in turn leads to reduced surface friction. It is important to determine appropriate methods of using manufactured sands for paving. As natural sands are depleted in various areas of the state, MFA will result in less expensive fine aggregate if they can be used successfully. This research is directed to finding solutions for using MFA for producing good quality paving concrete that has adequate surface friction. Specifically, the research will focus on three areas:

• Development of grading guidelines. Previous research related to manufactured sands in concrete paving and paving applications will be identified using a survey of states and Texas Department of Transportation (TxDOT) districts. Information on surface friction will be sought. The survey will seek information on MFA in Districts using significant amounts of concrete paving. A laboratory test program will be conducted to characterize sands identified in the survey. Specifications will be developed that will include grading limits, aggregate tests for characterization, and optimization of aggregates.

• Development of proportioning guidelines. Preliminary proportioning guidelines will be developed and laboratory concrete mixtures will be prepared and subjected to a range of fresh and hardened concrete property tests. Field sections of concrete pavements will be installed as part of TxDOT paving operations to determine if the proposed grading and proportioning guidelines produce workable concrete that has suitable fresh and hardened properties suitable for concrete paving.

• Development of surface friction guidelines. Surface friction values from exiting concrete pavements in other states and Texas will be sought in order to correlate the friction values with AI values and methods of surface texturing. Several concrete pavements in other states and in Texas have been identified, and the survey will likely identify others. The new concrete pavements made with MFA as part of this research will have a goal of investigating the effect of MFA and surface texture on skid resistance with time. Guidelines will be prepared that will recommend methods for insuring adequate surface friction.

Project Director

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Research Supervisor

David Fowler, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$565,000	Center for Transportation Research	$135,000

0-6274 - Project Level Performance Database for Rigid Pavement in Texas, Phase II

Start Date - 11/14/2008 ***End Date*** - 08/31/2013

Abstract

Objectives: The purpose of this project is to update the existing Rigid Pavement Database to include information that will help in the development and calibration of the TxDOT M-E Design for continuously reinforced concrete pavement (CRCP) and develop an advanced and user-friendly database to track the performance of typical and special concrete pavements in Texas . This study will concentrate on the following areas:

1) Additional project level data collection in selected test sections: The detailed CRCP behavior and performance have been investigated in the current rigid pavement database project, 0-5445. The investigations included identifying the effect of (a) crack spacing on load transfer efficiency, (b) concrete setting temperature on transverse crack spacing, and (c) slab thickness on deflections. The investigations also resulted in developing a hypothesis on punchout mechanisms. Additional project level field testing will be conducted to gather more information on CRCP behavior and performance. The findings will be used to develop and calibrate to-be-developed TxDOT M-E design procedures for CRCP.
2) Expansion of the database to include more Level 2 and Level 3 sections: This will help understand the performance of jointed concrete pavement (JCP) and CRCP sections constructed with various designs and environmental conditions. Sections that encompass a wide range of conditions in Texas in design, materials, and environmental condition, will be included in Level 2 and Level 3 investigations. If distresses are observed and determined to be due to cumulative fatigue damage, the sections will be included in Level 1 investigations and more detailed testing and evaluations will be conducted.
3) Inclusion of special sections in the database: Over the years, TxDOT has built a number of special test sections to investigate the effects of various factors as well as to try new concepts. They include post-tensioned concrete pavement (PTCP) built in Waco in 1985 with additional construction in 2008, pre-cast PTCP in Georgetown, bonded and unbonded concrete overlay sections throughout the state, fast-track concrete pavement (FTCP) sections in Houston, whitetopping sections in Abilene and Odessa, and other sections.
4) Further development of an advanced and user friendly database: A web-based database architecture was developed under the current database project. This database is webbased, GIS-oriented, and application-integrated, and will allow interactions with other TxDOT pavement databases. As more project level information is collected in this project, the database will be populated with the information and user friendly analysis functions will be developed.

Project Director

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Research Supervisor

Moon Won, TECHMRT

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$917,015	Center for Multidisciplinary Research in Transportation	$128,273
	Center for Transportation Research	$90,000

0-6444 - Treatments for Clays in Aggregates Used to Produce Cement Concrete, Bituminous Materials and Chip Seals

Start Date - 09/01/2009 ***End Date*** - 08/31/2012

Abstract

Objectives: This project will determine what clay minerals (i.e. smectite, illite, kaolinite, etc.) are responsible for deterioration of pavement structures such as coarse and fine aggregates used in Portland cement concrete, bituminous mixes and chip seals. Researchers will also identify a quick test method to measure deleterious clay minerals in stockpiles.

The Texas Department of Transportation has recently expressed concern about clay contamination in pavement structures. Our testing plan is designed to identify the lowest concentration of clay mineral one can have in an aggregate and still obtain an acceptable pavement structure. We intend to start with clay mineral standards and good aggregates to determine what clays are detrimental and how they affect the engineering properties. We will then move on to natural aggregates from Texas that have traditionally had problems with clay contamination and do the same testing on these aggregates. We will fully characterize the mineralogy of each aggregate and use this information to develop a remediation plan. Knowing clay mineralogy, you can determine what kind of chemical pretreatments will benefit the aggregate. At the end of the project we should be able to quickly identify clay mineralogy in a stockpile, determine what type and concentration of clay mineral will result in poor pavement performance and suggest ways to lower the clay contamination and make the aggregate acceptable for use.

Project Director

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Project Advisors

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Ryan Barborak, CST

Research Supervisor

Anol Mukhopadhyay, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$390,755	Texas Transportation Institute	$134,389

0-6591 - Developing a Fundamental Understanding of the Chemistry of Warm Mix Additives

Start Date - 09/01/2009 ***End Date*** - 08/31/2012

Abstract

Objective: This objective of the research is to ensure that warm mix asphalt (WMA) mixtures are performing better or on par with HMA mixtures.

Several technologies have been introduced in the last half-decade in the United States to produce asphalt mixtures at temperatures that are 86° to 112°F lower than conventional mixing and compaction temperatures. These mixtures are referred to as Warm Mix Asphalt or WMA mixtures. There are several different technologies that may be used to produce WMA mixtures. These include additives such as chemicals, organic compounds, water-bearing zeolite particles, or introduction of water during mixing to cause foaming. Several field demonstration projections based on one or more of these technologies have been executed in Texas and other states over the past two to three years. The National Cooperative Highway Research Program (NCHRP) is sponsoring two projects on the development and validation of a mix design procedure for WMA mixtures. Several independent research studies have made broad comparisons between the engineering properties and performance of WMA mixtures to conventional HMA mixtures. However, there is very little evidence in the literature that indicates the mechanisms by which the WMA additives or processes affect the physio-chemical and rheological properties of the asphalt binder and consequently their long-term performance as a pavement material.

This project provides a brief background on the challenges and several important un-answered questions that are crucial to ensure that the WMA mixtures perform better or on par with HMA mixtures. For example, the detailed mechanisms and implications of WMA additives on aging, resistance to rutting, fracture and fatigue, and moisture damage are not well established. There is a need to identify strategies to improve durability or limit the use of WMA mixtures that do not meet existing specifications established for HMA mixtures. In the case of WMA mixtures that satisfy specification requirements for tests originally intended for HMA mixtures, it is important to verify that these tests and requirements capture the long-term durability related problems that may be unique to WMA mixtures.

The work plan addresses the above questions using a multi-faceted approach. The physical and chemical changes in the asphalt binders due to the presence of WMA additives or processes are investigated using a comprehensive set of fundamental material characterization tests. Examples of tests include spectroscopic analysis, changes in molecular size distribution, changes in surface characteristics, and adhesion. The impact of these changes on the rheological properties of not aged and long-term aged binders with and without WMA additives is investigated. Finally, a series of standard and specialized mechanical performance tests are conducted on sand-asphalt mixtures and full asphalt mixtures to evaluate the long-term performance characteristics of WMA mixtures.

Project Director

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Project Advisors

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Martin (Marty) Stewart, FTW

Research Supervisor

Amit Bhasin, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$364,900	Center for Transportation Research	$60,000

0-6607 - Search for a Test for Fracture Potential of Asphalt Mixes

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: This project will develop a test for fracture potential of asphalt mixes.

The incorporation of the Hamburg Wheel Tracking test in TxDOT mix-design specifications has resulted in HMA mixes that exhibit resistance to rutting, but in many cases, lack the optimum resistance to fracture and cracking. Field evidence indicates that most of Texas' HMA pavements are prone to cracking with the occurrence of other premature failures related to cracking. As a means to address this issue, TxDOT currently uses and has implemented the Overlay Tester (OT) to evaluate the cracking susceptibility and resistance to reflective cracking of HMA mixes. While, the OT has been fairly satisfactory with SMA and Crack Attenuating Mixture (CAM) mixes, performance has been relatively poor with most conventional dense-graded HMA mixes such as Type A, B, C and D (Items 340/341), which makes up about 75% of all the HMA mixes used in Texas. This is partly attributed to the severity of the OT which results in high variability of the OT on dense graded mixes. A laboratory mixture test to characterize the cracking susceptibility of HMA mixes is thus greatly needed for all the Texas HMA mix types. As a minimum, such a test protocol must have the following characteristic features:

- Applicability for routine HMA screening and not necessarily performance prediction such as fatigue life.
- Practical and easily implementable by TxDOT.
- Easy sample preparation with potential to test both lab-prepared and field cores.
- Reasonable test duration of no more than one day.
- Acceptable level of variation and test reliability.

To address this issue, a research task under project 0-6132 was initiated to develop a defensible cracking performance test. As a continuation of this effort and in order to address the objective of this project, various crack tests will be evaluated including the following: Overlay Tester, direct-tension test, indirect-tension test, semi-circular bending test, bending beam, and the C(T) ASTM 7313 (b). Expected deliverables from this study will include recommendations for a practical and reliable test for routine crack evaluation of HMA mixes with acceptable level of variability. A preliminary test protocol along with the laboratory test procedures and mix screening criteria will be submitted to TxDOT.

Project Director

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Martin Kalinowski, HOU
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Ronald Hatcher, CHS
Stephen Smith, ODA

Research Supervisor

Tom Scullion, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$275,738	Texas Transportation Institute	$136,613

0-6610 - Impact of Changes in Profile Measurement Technology on QA Testing of Pavement Smoothness

Start Date - 09/01/2010 ***End Date*** - 08/31/2013

Abstract

Objective: This research will establish the impact of recent changes in profiling technology lasers on TxDOT's implementation of the Department's Item 585 ride specification.

According to the research project statement, the project should provide recommendations on whether and how the Department can accommodate new sensor technology within the existing framework of Item 585, considering that the pay adjustment schedules in this current specification are based on inertial profiles collected with the traditional single-point lasers. Of particular importance to this research is verification of the ride statistics and defect locations determined from profile measurements with the traditional single-point and newer wide-footprint lasers. This verification would require ground truth measurements to establish benchmarks that may be used to identify where changes are required in the existing ride specification and determine what these changes should be. Additionally, this research project aims to evaluate the bump criteria in the existing ride specification to establish an improved methodology that Engineers can use to objectively determine the need for corrections based on measured surface profiles to fix defects that diminish road-user perception of ride quality.

Project Director

Magdy Mikhail, CST

Project Advisors

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Rodney Tucker, SJT
Todd Copenhaver, CST

Research Supervisor

Emmanuel Fernando, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$593,841	Texas Transportation Institute	$87,237
	University of Texas at Arlington	$82,111

0-6611 - Improvements of Partial and Full-Depth Repair Practices for CRCP Distresses

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: This project will develop and enhance the effectiveness of full-depth repair (FDR) and partial-depth repair (PDR) on CRC pavements.

Field evaluations of the performance of full-depth repair (FDR) of continuously reinforced concrete pavement (CRCP) distresses in Texas reveal that improvements are needed to the current FDR practices. For example, Item 361 of the TxDOT Standard Specifications, "Full-Depth Repair of Concrete Pavement," has requirements that are detrimental to the performance of FDR of CRCP. Also, the effectiveness of the current practice of drilling and epoxy application for tie bars is compromised by non-compliance with the specifications or selection of non-optimum epoxies.

A substantial amount of CRCP distresses in Texas are limited to the upper half of the slab thickness above longitudinal reinforcement. However, the primary method to repair these distresses in Texas has been FDR. FDR is more expensive and more destructive to CRCP than reasonable partial-depth repair (PDR). Currently, TxDOT does not have guidelines on when to perform PDR. This project will develop specifications and design standards for PDR.

Since TxDOT has more than 11,000 lane miles of CRCP and has lately placed more emphasis on repairs and maintenance than building new pavements, this project is quite timely and the implementation of the findings from this study will improve TxDOT's pavement repair effectiveness while saving valuable financial resources.

Project Director

Kit Black, AMA

Project Advisors

Bernardo Ferrel, AMA
Chris Reed, CHS
Dar Hao Chen, CST
Gerald (Jerry) Lankes, TCPA
Hua Chen, CST
Paul (Siong Z) Wong, ATL
Quincy Allen, HOU

Research Supervisor

Moon Won, TECHMRT

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$269,254	Center for Multidisciplinary Research in Transportation	$138,970

0-6613 - Evaluate Binder and Mixture Aging for Warm Mix Asphalts

Start Date - 09/01/2010 ***End Date*** - 08/31/2013

Abstract

Objectives: The purpose of this project is to evaluate binder oxidation, binder absorption by aggregates, and the impact of these issues on mixture durability for the various common warm mix technologies and to develop a new binder specification, suitable for unmodified and modified binders, that incorporates binder oxidative aging and its impact on WMA pavement durability.

Warm mix asphalt (WMA) technologies employ reduced mixing and placement temperatures thereby allowing reduced fuel consumption, enhanced compaction, increased haul distances and an extended paving season. Issues of concern in WMA are binder oxidation and absorption and their impact on pavement durability. Ongoing TxDOT project 0-6009 is quantifying oxidation rates in HMA pavements and their impact on pavement durability, but does not address warm mixes or binder absorption.

To accomplish the objectives in this project researchers will be taking measurements of laboratory and field warm mix materials: binders, aggregates, lab-compacted mixtures, and pavement cores. Studies will include measurements of fundamental absorption-related properties of binders and aggregates, absorption of warm mix and hot mix asphalts by aggregates at both warm mix and hot mix temperatures, and characterization of laboratory and field warm mixture specimens as to both mixture rheology and recovered binder oxidation and rheological hardening.

Project Director

Jerry Peterson, CST

Project Advisors

Alan Albus, LBB
Dar Hao Chen, CST
Gisel Carrasco, CST
Jacques Fontenot, TYL
Ronald Hatcher, CHS

Research Supervisor

Charles Glover, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$525,511	Texas Transportation Institute	$171,997

0-6614 - Use of Recycled Asphalt Shingles in HMA

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: This research project will conduct and in depth study of the use of recycled asphalt shingles (RAS) in hot-mix asphalt (HMA) or warm-mix asphalt (WMA) mixtures and recommend changes to Texas Department of Transportation (TxDOT) specifications to allow optimal use of these mixtures.

Use of recycled asphalt shingles (RAS) in hot-mix asphalt (HMA) or warm-mix asphalt (WMA) mixtures has the potential to significantly reduce the cost of asphalt paving mixes while conserving energy and preserving the environment. Research on this subject is relatively limited in the literature. The main objectives of this research project are defined as below:

- Define best practices relative to the use of RAS in HMA and WMA mixes,
- Develop a balanced mixture design method(s) for RAS mixes including characterizing RAS binder and developing new RAS binder blending charts,
- Construct and monitor field test sections containing RAS,
- Define the environmental benefits associated with the use of RAS, and
- Recommend changes in Texas Department of Transportation (TxDOT) specifications to allow optimal use of RAS.

To achieve these objectives, researchers will:

- Task 1 - define current best practices by visiting shingle manufacturers and shingle processors in Texas and testing RAS materials as well as conducting literature reviews.
- Task 2 - characterize RAS binder properties and develop RAS binder blending charts through extensive laboratory binder testing. Mixture design method(s) for RAS mixes will be proposed based on laboratory evaluation of engineering properties of RAS mixes in Task 3, and will be validated through field test sections in Task 4.
- Task 5 - define the environmental benefits and cost savings.
- Task 6 - recommend changes to current specifications and mix design methods based on research results from Task 1 through 5.
- Task 7 - Conduct two workshops to effectively implement findings.
- Task 8 - Document all research activities in a research report.

Project Director

Robert Lee, CST

Project Advisors

Douglass Mack, ENV
Gisel Carrasco, CST
Mary Fletcher, TYL
Mike Wittie, LBB
Stephen Smith, ODA

Research Supervisor

Fujie Zhou, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$317,026	Texas Transportation Institute	$157,989

0-6615 - Use of Fine Graded Asphalt Mixes

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: This research will explore the use of fine Graded Friction Courses (OGFCs) as a new alternative to chip seals for maintaining low-volume roads.

TxDOT has to explore new ways to maintain low volume roads besides just doing chip seals. Chip seals are a good way to keep roads sealed but when this treatment is used near populated areas it can create some problems with road noise. The state of New Mexico has significantly improved the performance of their low volume pavements in the past 10 years. Many people have noticed the good performance of a specific type of Open Graded Friction Course (OGFC) that is currently used on many low volume roads in New Mexico. The OGFC is finer and placed significantly thinner than TxDOT's PFC mixes. The typical OGFC in New Mexico is placed at a thickness between ½" and ¾". This mix is used as an alternate to seal coat or microsurfacing. The mix is much quieter and smoother than a typical seal coat or microsurfacing. A cost and performance comparison between this type of OGFC and a seal coat and/or microsurfacing would be beneficial. Such a mix could give TxDOT more or better options regarding surfacing low volume roadways. Other states are using fine grained dense mixes to execute thin overlays on aged pavements that do not require strengthening. These types of overlays last longer than chip seals and they are more appealing especially for urban environments.

Project Director

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Project Advisors

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KC Evans, ODA
Martin Kalinowski, HOU
Richard Izzo, CST
Ronald Hatcher, CHS
Tomas Saenz, ELP

Research Supervisor

Tom Scullion, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$280,884	Texas Transportation Institute	$141,639

0-6616 - Validate Surface Performance-Graded (SPG) Specification for Surface Treatment Binders

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: This project will use final laboratory and field results to produce a revised surface performance-graded (SPG) specification for surface treatment binders in service.

Currently TxDOT utilizes the Performance Grading (PG) system for grading hot mix asphalt (HMA) binders and older penetration and viscosity systems for grading surface treatment binders in service as either emulsion residues or hot-applied asphalt cements. In 2003 TxDOT project 0-1710 developed and initially validated a Surface Performance Grading (SPG) system for surface treatment binders in service to reconcile differences in required equipment and account for other differences in design and construction methods, structural functions and response behavior, distress types, and environmental exposure. At that time, lack of national field validation and the use of regional materials precluded adoption of the SPG specification by the American Society of Testing and Materials (ASTM). Now there is renewed national and state interest in completing the validation and improving the SPG specification.

Specifically, the project will address this need by standardizing the emulsion residue recovery method through evaluation of the Force Draft Oven and Texas Oven methods, exploring the exclusive use of the Dynamic Shear Rheometer (DSR) for determining performance-based properties, and further field validating the thresholds for these properties. Laboratory and field results will be used to produce a revised SPG specification for surface treatment binders in service.

Project Director

Darren Hazlett, CST

Project Advisors

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Kenneth Corse, AMA
Mike Craig, LBB
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Research Supervisor

Amy Martin, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$306,866	Texas Transportation Institute	$144,166

0-6617 - Revamping Aggregate Property Requirements for Portland Cement Concrete

Start Date - 09/01/2010 ***End Date*** - 08/31/2013

Abstract

Objective: This research will evaluate several aggregate tests and their relationship to concrete performance and determine what aggregate properties are important for concrete used in pavements.

Current TxDOT specifications for aggregates in Portland cement concrete have been in Item 421 for over 37 years. Two tests have been required to qualify aggregate for concrete. The magnesium sulfate soundness test which was developed to evaluate the effect of freezing and thawing of aggregates and is only an indirect test for durability. It has had very mixed results as a predictor of concrete performance. The Los Angeles abrasion test has been used to evaluate aggregate strength and toughness. This test has also been shown not to be a good predictor of concrete performance. This research will evaluate several tests including the micro-Deval, aggregate imaging system (AIMS), unconfined freeze-thaw, crushing strength (wet and dry), and absorption tests singly and in combination. Concrete performance will be established from subjective ratings by TxDOT personnel based on many years of service. The concrete performance will be correlated with the aggregate test results. From these correlations aggregate tests and test limits will be recommended.

Project Director

Michael Dawidczik, CST

Project Advisors

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Ryan Barborak, CST
Steven Swindell, BRY

Research Supervisor

David Fowler, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$542,000	Center for Transportation Research	$182,000

0-6618 - Mitigation of High Sulfate Soils in Texas

Start Date - 09/01/2010 ***End Date*** - 08/31/2013

Abstract

Objective: The main objective of this research is to determine ways to stabilize soils with sulfate concentration higher than 8000 ppm and if the soil mineralogy is a factor in this stabilization.

Despite increased knowledge and awareness of sulfate heave, the Texas Department of Transportation (TxDOT) continues to experience pavement failures during and immediately after construction on roads designed to last 20 years or more. Failures are particularly evident in sites where high sulfate soils of 8000 ppm or higher predominate. Many of these failures are attributed to sulfate-induced heave where an expansive mineral called ettringite is formed from calcium-based stabilizers reacting with water, clay, and sulfates.

The researchers have identified several tasks to address development of methods to quantify reactive alumina and silica in treated soils; establish stabilizer dosage and sulfate concentrations at which heaving occur; understand the rate of heaving or ettringite formation kinetics; address reactions between sulfates and other additives such as fly ash and develop mitigation strategies to address heaving in sulfate soils. Project deliverables will include: 1) development of methods to better understand the causes of heaving in chemically treated high sulfate soils, and 2) develop methods or strategies to limit the sulfate heaving in these high sulfate soils.

Project Director

Miguel (Mike) Arellano, AUS

Project Advisors

Clifton (Cliff) Coward, CST
Gary Mizer, CHS
Jimmy Si, CST
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Mary Fletcher, TYL
Michael Lee, LFK
Noel Paramanantham, PAR
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Research Supervisor

Anand Puppala, UTA

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$381,350	Sam Houston State University	$61,917
	Texas Transportation Institute	$20,000
	University of Texas at Arlington	$64,114

0-6619 - Evaluation of Skid Measurements Used by TxDOT

Start Date - 09/01/2010 ***End Date*** - 02/28/2013

Abstract

Objective: This study will evaluate the skid measurement equipment used by TxDOT to ensure accuracy of measurements using one channel systems and if necessary modify the equipment to measure load.

Accurate estimates of tire-roadway friction values (SN) are critical to the safety of the traveling public. The seven skid measurement systems currently used by TxDOT do not directly measure the vertical test wheel load (W) but calculate it using the locked wheel drag force (F) and the trailer geometry. This technique has been proven at TTI to work well on flat, tangent pavement sections. When vertical wheel loads are not measured directly, external dynamic forces such as grade, curvature and roughness could contribute to errors in the reported skid number.

The first phase of this project will quantify the magnitude of any errors by means of field experiments where the two channel, Texas Transportation Institute, ASTM E-274, skid trailer is compared to the one channel TxDOT, E-274 skid trailer. The comparisons will be made on selected roadways that exhibit mild, medium and sever geometric attributes.

If the errors are found significant, the second phase of the project will be the development of methods to either measure the vertical load directly by the use of strain gages or inertial methods using accelerometers or other transducers. If logistically practical, the chosen modification will then be applied to a TxDOT system for test.

Project Director

Magdy Mikhail, CST

Project Advisors

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Edward Morgan, CST
Elizabeth (Lisa) Lukefahr, CST
John Wirth, CST
Michael Lee, LFK
Paul Schneider, TYL
Phillip Hempel, CST
Rodney Tucker, SJT
Tom Hunter, LFK

Research Supervisor

Richard (Dick) Zimmer, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$272,069	Texas Transportation Institute	$82,833

0-6620 - Dwarf Turf-type and Early Maturing Annual Ryegrass to Establish Perennial Vegetation

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: The findings from this research will result in a procedure manual for utilizing ryegrass lines to establish permanent vegetation on roadsides.

Annual ryegrass is not currently recommended by TxDOT for roadside re-vegetation nurse crop because its late maturity and height are too competitive for establishing perennial or spring plant mixtures. Two genotypes are available which are significantly less competitive and could be seeded with fall seeded perennials and wild flowers: a short dwarf-type ryegrass developed for home lawns and an early maturity type ryegrass which produces seed heads in January or February. Both the dwarf- and early maturing-type annual ryegrasses could be less competitive for nutrients, moisture, and sunlight. We will determine if dwarf or early maturing ryegrass are less competitive nurse crops for warm season perennials and allow spring development of wildflower seed production. We will fall plant perennials and the TxDOT wild flower mix in all treatments for each of four zones to determine the ideal annual ryegrass genotype, seeding rates, fertilizer rates, and stand management. We will also determine long-term effect of treatments on establishment and persistence of warm-season perennials and wild flowers. We will then test these findings on TxDOT right-of-way construction sites in all 11 Natural Regions of Texas and write a procedure manual for utilizing ryegrass lines to establishment permanent vegetation on roadsides.

Project Director

Dennis Markwardt, MNT

Project Advisors

David Harper, LBB
Jon Geiselbrecht, AUS
Marvin Hatter, SAT
Steve Orchard, CRP
Sydney Newman, PAR

Research Supervisor

Hennen Cummings, TARL

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$200,523	Stephen F. Austin University	$4,617
	Tarleton State University	$48,341
	Texas AgriLife Research	$43,866

0-6621 - Developing a Mixture Based Specification for Flexible Base

Start Date - 09/20/2010 ***End Date*** - 08/31/2012

Abstract

Objective: This project will develop a mixture-based specification for flexible base in a quality control/quality assurance (QC/QA) format for the Texas Department of Transportation (TxDOT).

The main features of this project are the early development of a draft specification for flexible base material; the utilization of an industry working group comprised of TxDOT, producer, and contractor representatives to provide feedback during formulation of the specification; and the utilization of the research team to provide detailed information from which critical decisions can be made to form the specification. After identifying important flexible base properties for inclusion in the specification, this project will use laboratory testing in conjunction with pavement performance predictions to develop operational tolerances from the job-mix formula that will not compromise the strength requirements of Item 247. Additionally, this project will propose pay factors based upon performance predictions from "as designed" to "as constructed" properties. Finally, this project will develop a mixture design procedure for flexible base course material for incorporating the new Flexible Base QC/QA Specification into the Texas Asphalt Pavement Association's Soil and Base Certification Program.

Project Director

Caroline Herrera, CST

Project Advisors

Chris Reed, CHS
Darlene Goehl, BRY
Joe Leidy, CST
John Bilyeu, CST
Richard Williammee, FTW
Ronald Hatcher, CHS
Stevan Perez, LBB

Research Supervisor

Jon Epps, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$411,344	Texas Transportation Institute	$203,295

0-6622 - Implementation of a Texas Mechanistic-Empirical Thickness Design System (TexME)

Start Date - 11/05/2010 ***End Date*** - 08/31/2013

Abstract

Objective: Updating performance models and testing procedures to allow a mechanistic-empirical pavement design system.

Since the mid 1990's there have been many improvements in base materials and asphalt mixes. However, TxDOT performance models have not been updated to reflect those improvements, so it is impossible to determine benefits from improved base materials or superior asphalt mixes. The development of new performance models based on fundamental material properties will enable Texas pavement designers to take full advantage of new materials. The main objectives of this project are defined as below:

1. Improve on models and testing procedures developed in project 0-5798 and develop additional performance models and testing procedures that allow mechanistic-empirical prediction of pavement performance for Texas flexible pavement types and environmental conditions. Integrate performance prediction models for all flexible pavement types including surface-treated pavements, and incorporate traffic load spectra, and the enhanced integrated climatic model (EICM) into program specification documents that can be used to update and enhance the FPS 19 design system implemented in the 1990's;
2. Conduct case study in two districts to demonstrate and document the advantage of the ME-based design process for Texas conditions;
3. Establish comprehensive material testing facilities at the Cedar Park campus of the Texas Department of Transportation; and
4. Conduct workshops on the materials testing procedures and the ME design process using a prototype workstation-based application.

Project Director

Joe Leidy, CST

Project Advisors

Brett Haggerty, CST
Catherine Wolff, TPP
David Wagner, FTW
Ernest De La Garza, CRP
John Wright, PAR
Magdy Mikhail, CST
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Suling Cao, HOU

Research Supervisor

Fujie Zhou, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$728,210	Texas Transportation Institute	$260,383
	University of Texas at El Paso	$62,150

0-6623 - Optimizing Resource Allocations for Routine Highway Maintenance

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: This project will develop a methodology and provide guidelines for assisting TxDOT districts in making critical maintenance decisions when there is a budget cut to decide what activities are the most cost-effective.

TxDOT has been experiencing fluctuations of budget over the years in terms of the resources available for maintaining and preserving the highway infrastructure. This fluctuation in budget can potentially make the highway condition unstable if the maintenance budget falls short for a sustainable period of time. As a result, it is important for TxDOT to look into maintenance and rehabilitation policies that lower the risk of unstable road network conditions. However, the question of how to minimize the risk of such budget fluctuations on network-level roadway has not been addressed in the current literature. There is an immediate need to develop a methodology that can help minimize the impact of budget fluctuations on highway maintenance programs. Therefore, guidelines are needed to assist TxDOT districts in making critical maintenance decisions when there is a budget cut. Such guidelines should consider not only the direct impact of reducing certain maintenance activities, but also the cascading effect of doing so.

Project Director

German Claros, RTI

Project Advisors

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Michael Lee, LFK
Pedro (Pete) Alvarez, PHR
Ted Moore, LBB
Zheng (Jenny) Li, CST

Research Supervisor

Zhanmin Zhang, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$268,557	Center for Transportation Research	135,194

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

Start Date - 11/09/2010 ***End Date*** - 08/31/2015

Abstract

Objective: The primary objective of this project is to collect materials and pavement performance data on a minimum of a 100 highway test sections around the State of 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. The scope of work to accomplish these objectives will include the following activities:

o Selection of field test sections across the State.
o Extensive laboratory and field testing.
o Literature review of M-E models and evaluation of existing databases.
o M-E model calibration and validation.
o 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 Director

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Project Advisors

Billy Pigg, WAC
Jaime Gandara, CST
Jerry Peterson, CST
Joe Leidy, CST
Mark McDaniel, CST
Stephen Guerra, CST
Todd Copenhaver, CST

Research Supervisor

Lubinda Walubita, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$1,831,711	Texas Transportation Institute	$301,187
	University of Texas at El Paso	$142,000

0-6663 - Evaluation of Pavement Rutting and Distress Measurements

Start Date - 10/04/2010 ***End Date*** - 08/31/2012

Abstract

Objective: The Texas Department of Transportation (TxDOT) has developed a state-of-the-art 3-D system for rut measurements. The objective of this project is to evaluate this system.

The development of a system to more accurately measure and quantify roadway cracking is also currently underway. These systems will allow the assessment of road performance at both the network- and project-levels and potentially eliminate the need for manual visual assessments to rate pavement distress. Furthermore, the improved accuracy of these systems, which can measure distress while traveling at highway speeds, will eliminate any subjective elements in visual rating and can lead to more consistent and reliable data.

The improved accuracy of the systems under development will significantly impact the TxDOT Pavement Management Information System (PMIS). PMIS is used to monitor statewide pavement condition and to evaluate the effectiveness of pavement maintenance and rehabilitation treatments. PMIS is also used to report progress towards the annual statewide pavement condition goal (90 percent of lane miles in "good" or better condition). Based on preliminary reports from other State agencies, adoption of the new system may indicate an "apparent" increase in overall pavement rutting. Consequently, current algorithms and utility functions used in PMIS will require revision to reflect the improved accuracy of these new systems.

To ensure the rational adoption of the new systems, TxDOT has initiated this project to allow an independent assessment of the accuracy and repeatability of the new automated distress data measurements. The TxDOT system will be compared to other similar systems from a variety of different vendors to identify the best system for automated distress that can be implemented by TxDOT. The project will have two phases. Phase I will evaluate the rut measurements and Phase 2 will evaluate automated distress data measurements including longitudinal, transverse, and alligator cracking, failures, spalled cracks and punchouts.

In Phase 1, a factorial experiment will test different pavements including those with hot-mix, cement concrete and surface treatments representing the population of pavement textures apparent on the Texas road network. The accuracy and repeatability of rut measurements using a 6-ft straight edge will be compared the TxDOT system as well as other systems. The research will also evaluate the impact to PMIS scores and recommend any necessary changes to the utility factors due to the new rut depth measurements.

In Phase 2 a survey will be done to determine the current state of practice for automated distress measurements by different highway agencies in the US and abroad. The system developed by TxDOT will be compared to other viable systems towards recommendations for implementation of the best system to improve the accuracy and repeatability of condition data measurements. Likewise, the impact to PMIS scores will be investigated and recommendations made regarding changes to utility factors, if necessary, to reflect the condition measurements with the new system.

Project Director

Miguel (Mike) Arellano, AUS

Project Advisors

Darlene Goehl, BRY
Magdy Mikhail, CST
Robin Huang, CST
Todd Copenhaver, CST
Tracy House, AUS

Research Supervisor

Mike Murphy, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$488,016	Center for Transportation Research	$268,311

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

Start Date - 09/01/2010 ***End Date*** - 08/31/2013

Abstract

Objective: This project will collect, evaluate, and release native seed sources for use by TxDOT in Central, West, and South Texas.

This project will work 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 Director

Dennis Markwardt, MNT

Project Advisors

Research Supervisor

Forrest Smith, TAMUK

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$750,000	Texas A&M University – Kingsville	$300,000

0-6673 - Evaluate the Improvement in Pavement Ride, Distress and Condition Based on Different Treatment Types

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this project is to standardize treatment types and develop revised values for ride and distress scores.

The scope of this project involves preparing a set of guidelines to assist TxDOT districts in identifying the appropriate PMIS treatment levels to develop pavement management plans, and also to predict the improvement of pavement ride, distress, and condition due to assigned treatments. The project will also investigate the need to incorporate a network level structural index to the decision criteria, and evaluate if treatment level definitions should be expanded or sublevels added to the major categories.

An enhanced PMIS decision making process to assign treatment levels will result in better forecasting of pavement performance allowing TxDOT to have reliable information to support funding allocation decisions when developing pavement management plans.

Project Director

Zheng (Jenny) Li, CST

Project Advisors

Aldo Madrid, ELP
Ali Esmaili-Doki, PAR
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Pedro Alvarez, PHR
Terry Paholek, BRY
Wade (Daniel) Blackmon, PAR

Research Supervisor

Carlos Chang Albitres, UTEP

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$338,984	Texas Transportation Institute	$84,815
	University of Texas at El Paso	$84,876

0-6674 - Improving Fracture Resistance Measurement in Asphalt Binder Specification with Verification on Asphalt Mixtures Cracking

Start Date - 09/01/2011 ***End Date*** - 08/31/2014

Abstract

Objective: The objective of this project is to develop better laboratory tests procedures for binders that can predict rutting or cracking performance.

The current performance grading (PG) specification for asphalt binders was developed during the Strategic Highway Research Program (SHRP), it is based primarily on the study of unmodified asphalt binders. Over the years experience has proven that the PG grading system, while good for ensuring overall quality, fails in some cases to guarantee good rutting and cracking performance, particularly as it applies to modified binders. Specifically, recent studies on mixes with highly modified binders from out of state (Minnesota) found that the MnRoad mixes have substantially improved cold weather cracking properties than mixes currently used in Texas, while still passing TxDOT's Hamburg rutting requirements.

To eliminate this type of apparent discrepancy AASHTO has adopted a new PG grading system based on the Multiple Stress Creep and Recovery (MSCR) test which is claimed to encourage the adoption of binders which are softer but still retain the required rut resistant. The benefits of the new grading system have not been verified for Texas asphalt binders and mixes.
The major objectives of project 0-6674 are:
1. Determine if the new AASHTO MSCR-based binder grading system is superior to the current TxDOT binder grading system;
2. Identify/develop a simple test method or methods to characterize fracture and adhesive properties of asphalt binders and associated tentative specification limits;
3. Determine if the asphalt binders not currently used in Texas would potentially improve overlay performance, if so conduct an associated cost-benefit analysis;
4. Identify optimal asphalt binder/aggregate combinations for different environmental zones in Texas;
5. Develop and initially populate a catalogue of all these measured (binder, binder/fine aggregate mastic, and asphalt mix) properties with relevant information that can be used to track the field performance of pavements constructed using these asphalt binders.

Project Director
Jerry Peterson, CST

Project Advisors
Dar Hao Chen, CST
Gisel Carrasco, CST
Rhonda Roundy, CST
Stacey Young, LBB

Research Supervisor
Fujie Zhou, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$503,940	Texas Transportation Institute	$167,145

0-6675 - Evaluation of Bonus/Penalty Pay Adjustment Systems for HMA and Ride Specifications of Concrete and Asphalt Pavements

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this project is to evaluate if the current pay adjustment factors (PAFs) have improved the quality of HMAC in TxDOT and if revisions are necessary.

TxDOT currently uses a pay adjustment factor (PAF) system for production and placement of HMA and ride quality of HMAC and concrete pavements that has been in existence for almost a decade. Current PAFs are not based on expected pavement performance but rather on historical data reflecting contractors' capabilities. A meaningful PAF system should be based on expected pavement performance such that the bonuses/penalties can be economically justified. Current PAFs may be skewed resulting in PAFs that are mostly greater than 1.0.

The goal of this research is to address the following objectives: 1) evaluate the validity of PAFs for ride quality, 2) evaluate the validity of PAFs for HMA production, 3) evaluate the validity of PAFs for placement, and 4) modify existing PAFs based on performance considerations.

PAFs proposed under the revised framework will incorporate the economic implications associated with superior (or inferior) pavement performance as they translate to extended (or reduced) pavement service life. A rational system should reflect that the bonuses awarded to the contractors neither exceed the benefits to the highway agency, nor the penalties levied from the contractors fall short of the potential losses incurred by the agency due to a reduced service life.

Project Director

Tomas Saenz, ELP

Project Advisors

Bryan Esmaili-Doki, PAR
Feng Hong, CST
Tom Hunter, LFK

Research Supervisor

Wei Fan, UTTYL

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$319,822	Center for Transportation Research	$79,790
	University of Texas at Tyler	$80,040

0-6676 - Rapid Field Detection of Moisture Content for Base and Subgrade

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this project is to determine if there is a device that can measure moisture content of soils and granular bases in the field to implement the measurement of modulus of these materials.

Water content in pavement materials plays a critical role both in construction and performance. During the construction phase, the water content influences compaction; in performance, water content significantly influences strength, modulus, and permanent deformation characteristics. While efforts exist to link design and construction by accepting compacted materials based on modulus, these efforts historically have been hindered due to the dependence of modulus on water content. For modulus-based acceptance to be implementable, companion water content measurements are necessary at the time of acceptance testing. Although the nuclear gauge can provide water content measurements in the field, restrictions and licensing requirements make the use of that gauge somewhat burdensome to agencies; test procedures are needed using rapid, accurate, non-nuclear moisture-measurement methods.

To make the possibility of modulus-based acceptance an implementable reality by including nonnuclear moisture measurement, this project will:

• Evaluate and rank non-nuclear techniques for measuring water content in soils and bases used in pavement construction.
• Develop test procedures in TxDOT format for measuring water content with non-nuclear methods.
• Produce a training workshop and training materials.
• Produce a training DVD.

Project Director

Jimmy Si, CST

Project Advisors

Caroline Herrera, CST
Daniel Taylor, PAR
John Bilyeu, CST
Stephen Kasberg, BRY
Tony Moran, WAC

Research Supervisor

Stephen Sebesta, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$314,465	Texas Transportation Institute	$124,615

0-6677 - Costs Associated with Conversion of Surfaced Roads to Unsurfaced Roads

Start Date - 09/01/2011 ***End Date*** - 08/31/2012

Abstract

Objective: The objective of this project is to determine the number of lane miles that can be converted to un-surface roads reducing the maintenance cost.

This project will evaluate the methods, costs, and economic impact of roadway surface conversion for TxDOT. Under the right conditions, converting an existing roadway from surfaced to un-surfaced can result in fiscal benefits for a transportation agency. Criteria for conversion to an un-surfaced roadway will focus primarily on the climatic conditions, soil conditions, and traffic volumes that foster a successful utilization of this technique. Once the criteria are determined, all roadways in Texas meeting the conversion criteria will be identified. The most efficient methods for conversion from surfaced to un-surfaced and vice-versa will be extracted from a comprehensive literature review and survey and then detailed. Selected roadways will be analyzed using a life cycle cost analysis to determine construction, material and maintenance costs over the life of the roadway under surfaced and un-surfaced scenarios. The economic impact of this project will be examined from an agency perspective using cost benefit analysis to determine if this procedure warrants adoption by TxDOT.

Project Director

Paul Montgomery, LFK

Project Advisors

Jason Pike, DES
Mark Shafer, BRY
Stacey Young, LBB

Research Supervisor

Soon-Jae Lee, TSUSM

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$118,112	Texas State University - San Marcos	$118,112

0-6679 - Performance Life of Various HMA Mixes in Texas

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this project is to define the service life of various HMA mixtures so that numbers can be used by planners designers, and maintenance personnel.

A number of hot mix asphalt (HMA)1 types, such as permeable friction course (PFC), stone mastic asphalt (SMA), performance design mixes and conventional dense graded mixes are currently used to construct or overlay Texas roads. One of the important inputs into current pavement design programs used by the Texas Department of Transportation (TxDOT) is the performance lives of HMA mixes since they significantly impact the life cycle cost analyses of the pavement structures and the ultimate selection of the HMA type. Knowing performance lives is also key information when developing pavement maintenance programs. Currently, the estimated performance life of different HMA mixes (including the frequency of overlay) by the designers in Texas is highly subjective. We will address this problem not only in terms of the properties of the asphalt mix type but also in the context of the actual pavement design process (e.g., staged construction vs. perpetual pavement), quality of construction, maintenance needs, traffic volume, and environmental conditions.

Project Director

Brett Haggerty, CST

Project Advisors

Billy Pigg, WAC
Bryan Esmaili-Doki, PAR
Gisel Carrasco, CST
Miguel (Mike) Arellano, AUS

Research Supervisor

Soheil Nazarian, UTEP

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$306,000	University of Texas at El Paso	$135,000

0-6681 - Optimizing Concrete Pavement Type Selection Based on Aggregate Availability

Start Date - 09/14/2011 ***End Date*** - 08/31/2012

Abstract

Objective: The objective of this project is to develop guidelines to select rigid pavements based on the type of aggregate that will produce the best performance.

Coarse aggregate occupies about 40 percent of Portland cement concrete (PCC) volume, and thus has substantial effect on PCC properties, such as coefficient of thermal expansion (CoTE), modulus of elasticity, and drying shrinkage. On the other hand, its effect on strength is not as significant.

Effort was made to incorporate PCC properties as affected by coarse aggregate type in rigid pavement designs, most recently in NCHRP 1-37(A) in the development of mechanistic-empirical pavement design guide (MEPDG). However, the approach was limited to the effect of coarse aggregate type on required slab thickness.

According to FY 2010 TxDOT PMIS, TxDOT has 12,345 lane miles of continuously reinforced concrete pavement (CRCP) and 1,399 punchouts. All the distresses recorded as punchouts in the Amarillo, Childress, Dallas, Fort Worth, Lubbock, and Wichita Falls districts were visually investigated under TxDOT rigid pavement database project (0-6274). The findings indicated that one-third of the distresses recorded as punchouts in PMIS were actually large spalling and distresses caused by delaminations. They were not due to the structural deficiency of the pavement system. In Texas, spalling and delaminations normally develop in CRCP when certain coarse aggregate types are used. TxDOT recognized this, and sponsored several research studies since the mid-1980s to address this issue, with no solutions obtained. On the other hand, these coarse aggregate types have been used in plain jointed concrete pavement (called concrete pavement, contraction design (CPCD) in Texas) with almost no spalling issues. The fundamental design concepts and structural behaviors of CRCP and CPCD are vastly different, and these coarse aggregate types are not compatible with CRCP behavior, resulting in spalling and delaminations. On the other hand, they are quite compatible with CPCD behavior, and the performance of CPCD with those aggregates has been satisfactory. Proper selection of PCC pavement type based on coarse aggregate type will enhance overall PCC pavement performance, thus minimizing maintenance and repair costs.

Project Director

Hua Chen, CST

Project Advisors

Allan Moore, WFS
Miles Garrison, ATL
Monte Rater, PAR
Richard (Rich) Rogers, CCT

Research Supervisor

Moon Won, TECHMRT

Total Project Budget	*Research Universities*	*FY 2011 Budget*
$170,000	Center for Multidisciplinary Research in Transportation`	$70,000
	Center for Transportation Research	$60,000
	Texas State University - San Marcos	$40,000

0-6683 - Develop a Pavement Project Evaluation Index to Support the 4-Year Pavement Management Plan

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this project is to develop an objective ranking index that provides information for the selection and priority of pavements projects.

Each district of the Texas Department of Transportation (TxDOT) is required to develop a 4-year pavement management plan. These plans are reviewed by the 4-Year Pavement Management Task Force and the department's administration. Currently, varying forms of ranking indices and weights are used to develop these plans. These indices consider factors such as traffic volume, Skid Number, treatment history, and pavement surface conditions. The objective of this study is to develop a consistent and sound decision-support methodology that can be used by TxDOT to prioritize and rank pavement projects for the 4-Year Pavement Management Plan. This methodology is essential for developing a cost-effective and defensible multi-year pavement management plan for TxDOT. This objective will be accomplished through a practical work plan that consists of five tasks: 1) review and summarize current and best practices, 2) identify and evaluate key decision factors for pavement project prioritization, 3) develop project prioritization and ranking methodology, 4) validate methodology based on comparisons of actual vs. planned vs. recommended projects, and 5) close out the research project.

Project Director

Darlene Goehl, BRY

Project Advisors

Charles Gurganus, TYL
Mykol Woodruff, PAR
Shaun Barnes, WFS
Stacey Young, LBB
Tammy Sims, PAR

Research Supervisor

Nasir Gharaibeh, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$283,127	Texas Transportation Institute	$121,616
	University of Texas at San Antonio	$15,000

0-6686 - Improving DMS 9210 Requirements for Limestone Rock Asphalt (LRA)

Start Date - 09/01/2011 ***End Date*** - 08/31/2012

Abstract

Objective: The objective of this project is to evaluate the specification for LRA (item 330) to see if revisions are required to improve the quality of this material.

Limestone Rock Asphalt (LRA) mixtures have been produced and placed for several decades using specification requirements currently listed under DMS 9210. Several Districts have had placement issues and premature failures at the beginning of 2010. These issues and failures have been attributed to material properties. Requirements for DMS 9210 have not changed for several years and need to be evaluated to possibly produce a higher quality material to reduce the occurrence of premature failures and to minimize placement issues. The objectives of the study are to (1) Evaluate specification requirements of Item 330 and DMS 9210, (2) Conduct field evaluations and lab testing to determine workability and acceptability as stockpile material for use as needed in pavement maintenance, and (3) Consider improvements to the specification requirements to ensure an acceptable and workable stockpile material for up to 6 months.

Project Director

John Bohuslav, SAT

Project Advisors

Darlene Goehl, BRY
Jerry Peterson, CST
Michael Dawidczik, CST
Richard Izzo, CST

Research Supervisor

Cindy Estakhri, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$122,105	Texas Transportation Institute	$122,105

0-6687 - Minimize Premature Distresses in Continuously Reinforced Concrete Pavement

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this project is to evaluate premature distresses on CRCP and develop new specifications that can prevent these types of distresses.

Field evaluations of the performance of continuously reinforced concrete pavement (CRCP) in Texas reveal that a substantial portion of distresses is not necessarily due to structural deficiencies of CRCP. Rather, many distresses appear to be due to construction and material related issues and to a lesser extent, imperfections in design details. Since these distresses occur long before structural distresses develop, they are considered premature distresses. The repair of CRCP distresses is expensive and is not always effective in restoring the pavement condition. Prevention of premature distresses in CRCP is the best course of action.

The most effective way to prevent or minimize premature distresses is to identify the mechanisms of distresses, develop appropriate special provisions to existing specifications or special specifications, and/or modify existing design standards. In this study, focus will be placed on identifying mechanisms of selected premature distress types primarily through field testing and data analysis. Once the mechanisms are identified, modifications will be suggested to the existing design standards and specifications. The products in the form of revised design standards or special provisions/special specifications could be implemented in a pilot project. The findings from field trials could be used to further enhance the revisions to design standards and specifications.

Project Director

Elizabeth (Lisa) Lukefahr, CST

Project Advisors

Andy Naranjo, CST
Dar Hao Chen, CST
Duane Schwarz, WAC
John Cordary, FTW
Hua Chen, CST
Julie Rodgers, PAR
Paul (Siong Z) Wong, ATL
Quincy Allen, HOU

Research Supervisor

Moon Won, TECHMRT

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$272,945	Center for Multidisciplinary Research in Transportation	$108,170
	Center for Transportation Research	$30,000

RMC 2 – Active Projects

Project	Title	Start Date	Page
0-5949	Bioretention for Stormwater Quality Improvement in Texas	9/1/2007	45
0-6263	Study of the Potential Impacts of Highway Construction on Selected Birds with an Emphasis on Golden-Cheeked Warblers	9/1/2008	46
0-6404	Accommodating Oversize & Overweight Loads	9/3/2009	47
0-6487	Development of a Performance Measurement Based Methodology to Objectively Compare Operational Improvements with Capacity Additions	9/1/2009	48
0-6624	Improving the Response and Participation by Utility Owners in the Project Development Process	9/1/2010	49
0-6626	Fleet Equipment Performance Measurement Preventive Maintenance Model (PM2)	9/2/2010	50
0-6628	Economic Considerations in Transportation System Development and Operations	9/1/2010	51
0-6629	Texas-Specific Drive Cycles and Idle Emissions Rates for Using with EPA's MOVES Model	9/1/2010	52
0-6631	Best Practices for Utility Investigations in the TxDOT Project Development Process	9/1/2010	53
0-6634	Potential Value Extraction from TxDOT's Right of Way and Other Property Assets	9/1/2010	54
0-6635	Water Quality Performance of Permeable Friction Course on Curbed Sections	9/1/2010	55
0-6636	Photocatalytic NOx /HRVOC/O3 Removal in Transportation Applications	9/1/2010	56
0-6638	Preparing for EPA Effluent Limitation Guidelines	9/1/2010	57
0-6657	Investigating Regional Dynamic Traffic Assignment Modeling for Improved Bottleneck Analysis	9/1/2010	58
0-6688	Evaluation of the I-10 Katy Freeway Managed Lanes	9/1/2011	59
0-6690-CTR	Selected 2012-2014 Trade Flows and Texas Gulf Ports: Panama Canal and South American Markets	9/1/2011	60
0-6691	Managing the TDM Process: Developing MPO Institutional Capacity	9/1/2011	61
0-6692	Truck-Rail Intermodal Flows: A Corridor Toolkit	9/1/2011	62
0-6693	Equipment Replacement/Retention Decision Making	9/1/2011	63

RMC 2 – Active Projects

Project	Title	Start Date	Page
0-6694	Identifying Best Practices for Managing Operating Costs for Rural and Small Urban Public Transportation Systems	9/1/2011	64
0-6696	Incorporating Greenhouse Gas (GHG) Emissions in Long Range Transportation Planning	9/1/2011	65
0-6698	Examining the Use of Existing Public Rights-of-Way for High-Speed Rail or Other Infrastructure	9/13/2011	66
0-6701	Linking Regional Planning with Project Planning in Support of NEPA	9/1/2011	67

0-5949 - Bioretention for Stormwater Quality Improvement in Texas

Start Date - 09/01/2007 ***End Date*** - 08/31/2012

Abstract

Objective: The purpose of this project is to investigate the applicability and identify benefits and drawbacks of bioretention best management practices (BMPs) in Texas, specifically for highway related applications.

Bioretention was developed in the late 1980's in Prince George's County, Maryland. This technique utilizes soil, sand, organic matter, and vegetation-based storage and infiltration facilities for treating runoff from paved surfaces such as parking lots, streets, and highways. Currently, most bioretention results have been created by experiments conducted in different regions where climates and plants are very different fiom Texas. This project will begin with a literature review and case study and identify applicable situations for The Texas Department of Transportation, followed by pilot testing and in-situ demonstrations. The pilot testing will focus on analyzing the bioretention cell's water quality performance and hydrologic responses. The full scale, in-situ demonstrations will closely monitor performance over a 2-3 year period to address not only the water quality issues, but maintenance of the facility. The findings will be used to develop design and implementation guidelines for adoption by TxDOT. The significance of this project is that TxDOT will have an opportunity to adopt the bioretention technology and include the design guidelines in TxDOT's design manuals. This will enable TxDOT designers to familiarize and apply the latest design tool promoted by the US Environmental Protection Agency. Potential applicable situations include rights-of-way at interchanges and along roadsides.

Project Director

Jon Geiselbrecht, AUS

Project Advisors

Amy Foster, ENV
Barrie Cogburn, DES
Craig Dunning, DES
David Zwernemann, AUS
John Moravec, BRY

Research Supervisor

Ming-Han Li, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$564,364	Texas Transportation Institute	$101,397

0-6263 - Study of the Potential Impacts of Highway Construction on Selected Birds with an Emphasis on Golden-Cheeked Warblers

Start Date - 09/01/2008 ***End Date*** - 08/31/2012

Abstract

Objective: This study will determine if road construction activity alters the spatial distribution, breeding success, and behavior of Hill Country birds, with an emphasis on the Golden-Cheeked Warbler.

A major challenge for the Texas Department of Transportation (TxDOT) is to be able to conclusively state the potential impact of road construction work on both flora and fauna, with particular emphasis on those species granted special protection by law or regulation. The Texas Hill Country, comprising much of the Austin, San Angelo and San Antonio Districts, is home to a variety of species that are either threatened or endangered.

Other focal bird species that will be included in this study, depending on abundance a study site, include the Black-and-white Warbler and White-Eyed Vireo. Data will be gathered over three field seasons coinciding with the breeding period each year for the Golden-Cheeked Warbler. The information gathered will be used to meet the following objectives: (a) determine the influence of the impacts on the abundance of birds in relation to distance from the edge of right of way (ROW); (b) determine the spatial and temporal influence of the impacts on breeding success and behavior in relation to distance from the ROW; (c) determine the extent to which vocal adjustment or other behaviors is being utilized by birds in response to unnatural noise; and (d) determine the spatial and temporal extent of impacts to study species caused by the impacts; and make recommendations designed to alleviate negative impacts.

Project Director

Nancy Fisher, SJT

Project Advisors

Allison Arnold, USFW
Ann Maxwell, SJT
Brandy Huston, ENV
Cal Newnam, AUS
Doug Booher, TTA
Julia (Julie) Brown, SAT
Michael (Mike) Rhodes, WAC
Stirling Robertson, ENV

Research Supervisor

Michael Morrison, TAES

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$1,150,496	Texas AgriLife Research	$138,109

0-6404 - Accommodating Oversize & Overweight Loads

Start Date - 09/03/2009 ***End Date*** - 11/30/2011

Abstract

Objective: This project will identify the most common oversize & overweight (OS/OW) dimension and weight groups, identify criteria for assigning these groups to existing road networks, and criteria for assigning current and projected OS/OW groups to the future road network upgraded to meet future demand.

Adequate management of oversize/overweight (OS/OW) permit loads throughout the state of Texas is critical to maintaining a vibrant state economy. The growth in the number and size of permit loads in recent years is clear evidence that new tools and new techniques are needed to match this growth without causing undue delays to permit applicants. Problems such as increasing prevalence of reroutes due to maintenance and other district activities, along with potential damage to the highway infrastructure from permit loads led to this research project.

The research project will result in a statewide map recommending primary and alternate OS/OW route networks for the most common origins and destinations based on historical MCD data.

Project Director

Connie Flickinger, BRY

Project Advisors

Andrew Wanees, AUS
Brian Merrill, BRG
Darlene Goehl, BRY
Janet Manley, BMT
John Holt, BRG
Justin Obinna, MNT

Research Supervisor

Dan Middleton, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$277,672	Texas Transportation Institute	$28,784

0-6487 - Development of a Performance Measurement Based Methodology to Objectively Compare Operational Improvements with Capacity Additions

Start Date - 09/01/2009 ***End Date*** - 08/31/2012

Abstract

Objective: This project will produce a performance-based methodology and user-friendly spreadsheet-based tool for straightforward and equitable comparison of benefits (and costs) across any set of operational improvements and capacity expansion projects that district offices may be considering.

Recognizing that congestion, safety, economic opportunity, asset valuation and emissions levels are key measures of project success, the tool will emphasize multi-criteria evaluation for project scores and ranks. Performance scores, based on time savings, travel time, reliability, safety improvement, emissions reductions, land appreciation, pavement quality, and other features of the enhanced network-vis-a-vis project costs, over the project's lifetime-will highlight opportunities for optimal investment decisions, as well as project limitations that may require remedy.

Project Director

Ron Hagquist, SPM

Project Advisors

Brandy Huston, ENV
Dean Wilkerson, TSD
Keith Taylor, AUS
Mark Johnson, TRF

Research Supervisor

Kara Kockelman, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$425,000	Center for Transportation Research	$160,000
	Texas A&M University – Kingsville	$0

0-6624 - Improving the Response and Participation by Utility Owners in the Project Development Process

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: The purpose of the research is to develop strategies to improve the participation and response of utility owners in the project development process.

Detection of utility conflicts as early as possible during the project development process can help to improve the timely adjustment of utilities and/or allow time to develop alternatives to avoid utility adjustments. However, because TxDOT does not have contractual relationships with private utility companies, there are only limited legal mechanisms to induce the private utilities to comply in a timely way with relocation requests. Further, utility owners hesitate to get involved in the utility adjustment process and typically do not participate actively until the transportation project is at least 60-90 percent design complete, which can result in significant project delays or the need to re-design the project to avoid a utility relocation.

Research activities include: reviewing strategies used by TxDOT and other states to encourage early participation by utilities; developing strategies that include a combination of elements such as performance measures, "carrots and sticks," and accountability; identifying potential changes in laws and regulations related to the recommended strategies; developing recommendations for changes to business processes and relevant TxDOT manuals; and developing and testing training materials.

Project Director

Tommy Jones, ABL

Project Advisors

Charon Williams, ROW
David Roberts, HOU
Guy Sledge, LBB
Stephen Stakemiller, HOU

Research Supervisor

Cesar Quiroga, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$293,000	Texas Transportation Institute	$150,000

0-6626 - Fleet Equipment Performance Measurement Preventive Maintenance Model (PM2)

Start Date - 09/02/2010 ***End Date*** - 02/28/2013

Abstract

Objective: This research will develop an algorithm (through statistical modeling) that can be used to recommend appropriate oil change intervals based on engine data collected through on-board diagnostic systems to help refine predictions for when equipment maintenance should be performed.

The concept of preventive maintenance is very important in the effective management and deployment of vehicle fleets. The Texas Department of Transportation (TxDOT) operates a large fleet of over 17,000 pieces of on-road and off-road equipment. Consequently, fleet maintenance procedures represent a significant cost to the agency. TxDOT currently uses a fleet tracking program (FleetTrackS) to identify when specific fleet equipment require maintenance. This scheduling is dependent on simple variables such as vehicle miles or operational hours logged.

Newer engines and vehicles are equipped with on-board diagnostic systems that can provide data on engine operation including engine speed and throttle position (an indication of load value). There is the possibility of tracking these parameters (performance measures) over time and correlating to another performance measure (oil degradation). This can refine predictions for when equipment maintenance should be performed. The aim of this research is to provide a "proof of concept" for this idea by developing an algorithm (through statistical modeling) that can be used to recommend appropriate oil change intervals based on engine data collected through on-board diagnostic systems. Recommendations for an expanded implementation project will be made if the concept proves to benefit TxDOT and make good economic sense.

Project Director

Johnie Muller, GSD

Project Advisors

Lori Clark, NCTCOG
Richard (Rick) Walbrick, LBB
Ron Hagquist, SPM
Timothy Nicholes, AUS

Research Supervisor

Tara Ramani, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$295,414	Texas Transportation Institute	$168,192

0-6628 - Economic Considerations in Transportation System Development and Operations

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objectives: This research will produce a Transportation Economics Encyclopedia, and use presentations and reports to inform TxDOT and other agencies about economic considerations in transportation system development and operations.

An essential backbone of regional and national economies, transportation has a myriad of associations and impacts. An understanding of the causal mechanisms behind, and the extent of, these associations and impacts can be vital to defensible and optimal decision-making by budget-constrained transportation agencies. From travel time savings to job creation (both direct and indirect), income growth to property value changes, motor vehicle crashes to air quality and noise impacts, microeconomic choices to macroeconomic shifts, transport policies and investments carry great weight.

The notion of trade-offs is fundamental to a solid understanding of economic practice and theory. Salient comparisons include marginal benefits (to travelers and the larger community) versus marginal costs (to suppliers of transport, like TxDOT, as well as those enduring any negative externalized costs). They include maintenance and operations versus new construction, private interests versus social objectives, short-run versus long-term impacts, highways versus transit provision, speeds and flows versus access and connectivity, single-occupant vehicles versus non-motorized modes, trucks versus trains, access to seaports versus airports, local versus regional interests, national versus global interests, and so on. The Encyclopedia, presentations, and reports developed under this project will illuminate all these contexts, in the most straightforward of terms, with meaningful applications to illustrate their value and implications. The first year will be largely devoted to producing a Transportation Economics Encyclopedia (as a practitioner's desktop reference), and the second year will focus on provision of final case study applications, presentation slides by subject, workshops and a webinar series for bringing the subjects alive to TxDOT personnel, and any others TxDOT wishes to include in this educational process.

Project Director

Duncan Stewart, RTI

Project Advisors

Ann Zeeck, GPA
Brandy Huston, ENV
Chuck Steed, CHS
Martin Kalinowski, HOU
Matt MacGregor, DAL
Ron Hagquist, SPM

Research Supervisor

Kara Kockelman, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$270,000	Center for Transportation Research	$135,000

0-6629 - Texas-Specific Drive Cycles and Idle Emissions Rates for Using with EPA's MOVES Model

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: This study will provide TxDOT with local drive cycles for different regions of Texas for different vehicle classes and roadway types as well as cold start and idling emissions rates for heavy-duty diesel trucks.

The U.S. Environmental Protection Agency's (EPA) newest emissions model, Motor Vehicle Emission Simulator (MOVES), utilizes a disaggregate approach that enables the users of the model to create and use local drive schedules (drive cycles) in order to perform an accurate analysis. However, only the national average drive schedules are currently included in the default database of the model. Furthermore, the cold start and idling emissions and activity data of heavy duty diesel trucks (HDDVs) that are included in the MOVES model are based on a very limited number of data sources even though they are very important components of the total on-road mobile source emissions inventory.

Research activities will include the estimated emissions from MOVES for different vehicle classes being compared to real-world on-road emissions measurement. Furthermore, the technical and tactical issues of integrating the results of this study into MOVES for formal emissions analyses purposes will be investigated and recommendations will be made based on the findings.

Project Director

Bill Knowles, TPP

Project Advisors

Jackie Ploch, ENV
Janie Temple, TPP
Laura Norton, TPP
Madhu Venugopal, NCTCOG

Research Supervisor

Mohamadreza Farzaneh, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$379,710	Texas Transportation Institute	$239,760

0-6631 - Best Practices for Utility Investigations in the TxDOT Project Development Process

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: The purpose of this project is to review the state of the practice in utility investigations and develop best practices for timing and use of utility investigation services in the TxDOT project development process.

Underground utility facilities that are discovered late during design or construction can have significant negative impacts on project costs and the timely completion of the project. The benefits and cost effectiveness of using utility investigation services to collect data of existing utility facilities have been documented in several national studies. Using subsurface utility engineering (SUE) services, utility data can be collected at different quality levels (QL), including QLD (existing records), QLC (surveying of aboveground utility features), QLB (use of noninvasive geophysical methods) and QLA (exposing utility facilities at critical locations). Although TxDOT has successfully collected QLB and QLA data on several projects, most TxDOT projects currently do not collect this type of data or use it to its full potential.

Key research activities include synthesizing current techniques and best practices in utility investigations, reviewing utility investigation practices at TxDOT, developing best practices for utility investigations, developing utility investigation training materials, and recommending changes to relevant TxDOT manuals including the ROW Utility Manual.

Project Director

Stephen Stakemiller, HOU

Project Advisors

Jeff Richardson, ENV
Jim Heacock, HOU
Matt Mitchell, TYL
Tomas Trevino, CRP

Research Supervisor

Edgar Kraus, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$299,638	Texas Transportation Institute	$150,364

0-6634 - Potential Value Extraction from TxDOT's Right of Way and Other Property Assets

Start Date - 09/01/2010 ***End Date*** - 02/29/2012

Abstract

Objective: This project will recommend strategies for pursuing value extraction from TxDOT's right-of-way and other property assets

A number of interested parties have suggested that TxDOT extract additional value (be it economic or societal) from our ROW and other land holdings. A short list of potential uses that have been suggested include the following:

- solar arrays for electricity generation - including pre-fabricated pavement panels;
- wind energy and vehicle turbulence for electricity generation;
- extraction of geothermal energy, oil and gas;
- carbon sequestration;
- wildlife habitat;
- leasing air space for additional uses;
- long distance pipeline transportation; and
- Long distance communications and power transmission.

The research project will:

- Do outreach to all stakeholders to discuss applications, potential benefits, challenges, risks, and opportunities.
- Conduct a technical feasibility and economic viability examination of each potential value extraction application.
- Assess the value extraction potential of all viable applications against the overriding requirements to provide safe and adequate transportation.
- Assess legal issues of ownership / liability / revenue distribution that may result from potential viable applications
- Develop guidelines to assist TxDOT in determining when, where, and under what circumstances to pursue value extraction strategies.
- Develop recommendations for potential changes to legislation and regulations to accommodate feasible value extraction applications.

Project Director

Ron Hagquist, SPM

Project Advisors

Charon Williams, ROW
Elizabeth Hogeda-Romo, MNT
Mary Anne Griss, AUS
Monica Aleman-Smoot, GPA
Paul Campbell, FIN
Rodney Concienne, ENV

Research Supervisor

Jolanda Prozzi, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$202,000	Center for Transportation Research	$60,000

0-6635 - Water Quality Performance of Permeable Friction Course on Curbed Sections

Start Date - 09/01/2010 ***End Date*** - 08/31/2013

Abstract

Objective: The project will extend the applicability of Performance of Permeable Friction Course (PFC) by demonstrating that a comparable improvement in quality is also possible on highway sections that include curb and gutter allowing widespread use for highway widening projects in urban areas where limited ROW makes the rural cross-section infeasible.

The permeable friction course (PFC) has been demonstrated in TxDOT project 0-5220 to provide a substantial improvement in the quality of highway runoff. This reduction in pollutant concentrations is sufficient to meet the requirements of the Texas Commission on Environmental Quality (TCEQ) for use as a permanent BMP on the Edwards Aquifer recharge and contributing zones. However, that approval was only extended to the configuration tested, which was a rural highway cross-section with a vegetated shoulder.

One goal of this project is to develop the information necessary to receive approval from TCEQ to use PFC on highway sections with curb and gutter. We will install water quality monitoring equipment to document the quality of runoff from selected test sites in the Austin area.

We also recognize that retrofitting existing sections of highway with PFC might also impact the drainage characteristics, particularly the flooded width of the shoulder during intense storm events. Consequently, the project will also investigate the hydraulic performance of PFC in this new configuration. In addition, the analysis will consider the effect of PFC pavement on drainage system sizing. PFC may reduce the rate of runoff or increase the time of concentration so that smaller pipes and inlets might be sufficient to convey the design storm.

Project Director

Gary Lantrip, AUS

Project Advisors

James Harris, CRP
Lucas Short, AUS
Richard De La Cruz, SAT
Richard Izzo, CST

Research Supervisor

Michael Barrett, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$502,247	Center for Transportation Research	$164,080

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

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: 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 NOx and VOCs from air samples, the tests have not been designed to be representative of outdoor air conditions. Laboratory tests in this project will 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 will also examine the performance of the materials in real near-roadway locations in two 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 Director

Pat Henry, HOU

Project Advisors

Andy Naranjo, CST
Christopher Klaus, NCTCOG
Clifton (Cliff) Coward, CST
Elizabeth (Lisa) Lukefahr, CST
Jackie Ploch, ENV
Mark Sather, EPA
Ruben Casso, EPA

Research Supervisor

Maria Juenger, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$672,546	Center for Transportation Research	$316,097

0-6638 - Preparing for EPA Effluent Limitation Guidelines

Start Date - 09/01/2010 ***End Date*** - 08/31/2013

Abstract

Objectives: In this project, monitoring and testing experiments will be conducted to determine "typical turbidity" representative of TxDOT's construction site discharges, collect performance data on innovative erosion and sediment control measures that might be expected to meet a forthcoming federal discharge standard, and produce Guidance Measures and Sampling Protocols for TxDOT to negotiate with TCEQ in the development of statewide monitoring/sampling procedures.

On December 1, 2009, the US Environmental Protection Agency (EPA) finalized and published a rule in the Federal Register establishing non-numeric and, for the first time, numeric effluent limitation guidelines (ELGs). The numeric ELGs include turbidity limits and sampling requirements for stormwater discharges from construction sites. All sites that disturb 20 or more acres of land at one time are required to comply with a turbidity limit. The EPA is requiring Texas to implement these new requirements when the Texas Commission on Environmental Quality (TCEQ) next renews the Texas Construction General Permit (CGP).

Three research institutes (Texas Transportation Institute, The University of Texas at Austin and Texas Tech University) will collaborate on this project to cover the statewide differences in climate, soil types, slopes, and other factors that affect the performance of erosion control measures.

Project Director

Amy Foster, ENV

Project Advisors

Cindy Hooper, TCEQ
John Mason, MNT
Jon Geiselbrecht, AUS
Kathleen Newton, BMT
Tasha Vice, DES

Research Supervisor

Jett McFalls, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$736,293	Center for Multidisciplinary Research in Transportation	$56,450
	Center for Transportation Research	$101,412
	Texas Transportation Institute	$117,803

0-6657 - Investigating Regional Dynamic Traffic Assignment Modeling for Improved Bottleneck Analysis

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objectives: The project will develop methodologies to adapt and apply a mesoscopic simulation-based dynamic traffic assignment (DTA) model to examine, characterize, and mitigate bottlenecks at a system level.

Bottleneck mitigation is a classic transportation problem. In fact, many congestion issues that impact Texas drivers daily can be traced back to a bottleneck, be it stationary or moving. Further, the causes of bottlenecks can be complex and if one is al1eviated, one or more unexpected bottlenecks can quickly emerge elsewhere. Traditional transportation modeling approaches that may be applied for the examination of bottlenecks can typically be categorized as planning or operational in nature. Unfortunately, either approach is ill-suited for a comprehensive treatment of bottlenecks. Operational models lack the regional scope and travel behavior capabilities (e.g., route-choice) necessary to holistically treat bottleneck mitigation's unexpected consequences. Moreover, planning models lack the precise representation of traffic needed to capture the intricacies of vehicular dynamics.

What is needed are tools that combine the dynamic representation of traffic with regional travel behavior. Over the past two decades, Dynamic Traffic Assignment (DTA) research has evolved to specifically address applications that fall into this gap. However, while numerous advances have occurred, most readily available dynamic traffic models do not meet the rigorous definition of regional DTA. To fully address bottleneck mitigation following the rigorous needs of transportation planning and operations, recently developed research models must be examined. These recently developed models can represent temporal and spatial traffic dynamics at a much finer resolution compared with the traditional static model while maintaining regional equilibrium convergence. This is made possible by the advent of mesoscopic traffic flow models (e.g. the Cell Transmission Model), which are used in certain DTA models to represent vehicular movements. Moreover, the simultaneous modeling of regional route-choice (made possible due to new advances in large-scale network optimization techniques) with traffic dynamics makes DTA models the ideal analysis tool for a systematic bottleneck examination, characterization, and mitigation.

The project will develop methodologies to adapt and apply a mesoscopic simulation-based DTA model to examine, characterize, and mitigate bottlenecks at a system level. The research team will develop a project evaluation framework to rank competing projects, which will aid the planning-level decision-making process while concurrently accounting for traffic operational issues. Data and model formats will be standardized to facilitate interfacing with specific external application models - planning and operational. The project will also examine the potential of DTA as an aid in the transportation planning process.

Specifically, outcomes from this research will include:
1. A comprehensive study of traffic bottleneck phenomena in a specific setting considering system-wide impacts and mitigation strategies
2. Guidelines for adapting DTA to model and mitigate bottlenecks more generally
3. Potential data formats and guidelines for interfacing DTA with the planning process
4. A framework for ranking bottleneck projects with DTA (inc1uding differences with static assignment)

Project Director
Joseph Carrizales, AUS

Project Advisors
Ed Collins, AUS
Janie Temple, TPP

Research Supervisor
Jennifer Duthie, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$300,000	Center for Transportation Research	$150,000

0-6688 - Evaluation of the I-10 Katy Freeway Managed Lanes

Start Date - 09/01/2011 ***End Date*** - 02/28/2013

Abstract

Objective: The purpose of this study is to perform a comprehensive evaluation of the Katy Freeway Managed Lanes, including aspects such as congestion, safety, enforcement, maintenance, pricing, access design, lane separation, operating policy, public perception, and project delivery.

The Katy Freeway Managed Lanes on I-10 in Houston became fully operational in 2009. The managed lane facility, also referred to as the Katy Tollway, is the first constructed managed lane project in Texas and the first variably-priced operation in the state since the implementation of the QuickRide program on US 290 and I-10 HOV lanes in Houston more than ten years ago. The four-lane facility, which was constructed within the center of the existing freeway, can be described as a "second generation" managed lanes project that is more complex than earlier generation HOV-to-HOT conversions. In addition to the facility's unique operating characteristics, TxDOT developed the project in partnership with other local entities in an innovative delivery process for funding, operating and maintaining the managed lanes.

Using a combination of available data and new data collection, the evaluation will cover many of the critical areas of project development, design and operation with the purpose of supporting successful implementation of managed lanes across Texas.

Project Director

Lucio Vasquez, TTA

Project Advisors

Alex Power, TRF
Marcy Saenz, TTA
Mike Alford, HOU
Patrick Gant, HOU

Research Supervisor

Ginger Goodin, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$294,800	Texas Transportation Institute	$227,200

0-6690-CTR - Selected 2012-2014 Trade Flows and Texas Gulf Ports: Panama Canal and South American Markets

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this study is to anticipate the likely impact on Texas of maritime trade developments as the widened Panama Canal opens.

Trade between the U.S., South America, and Asia highlights a growing opportunity for Texas ports. They are in a position to capture a larger share of Asian and South American imports to their customers, expand Texas export markets, and serve as global hubs. However, the ability of Texas ports to succeed and increase their significance in statewide transportation planning requires an understanding of how and why trade is conducted between these regions. The first year of this study examines a range of trade and marine transportation factors required to provide this understanding. U.S. trade with South American and Asian markets will be researched in a Policy Research Project (PRP) project and documented in a first-year report. Concurrently, a CTRJTTI team will undertake an evaluation of two specific technical areas: port channels and vessel operating costs. The PRP and technical work integrates to form the basis for a second-year work plan addressing strategic issues related to future South American and Asian trade volumes handled at Texas deep water ports, the role played by the expansion of the Panama Canal, and the impact of increased trade on the Texas transportation system.

Project Director

Gus Khankarli, RSC-NORTH

Project Advisors

John Sabala, SPM
Mark Werner, RRD
Raul Cantu, TPP
Scott Cunningham, AUS

Research Supervisor

Robert Harrison, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$322,134	Center for Transportation Research	$115,000
	Texas Transportation Institute	$45,220

0-6691 - Managing the TDM Process: Developing MPO Institutional Capacity

Start Date - 09/01/2011 ***End Date*** - 02/28/2013

Abstract

Objective: The goal is to assist MPOs in developing institutional capacity to undertake travel-related technical analyses in a complete and timely manner.

Within Texas, the development of urban travel models is a cooperative process between the Texas Department of Transportation and Metropolitan Planning Organizations. Though TxDOTTransportation Planning and Programming Division is responsible for developing and validating an MPO's travel model, MPOs play an important role in model development by providing the demographic data and regional roadway information required for model development and forecast applications. Like other MPOs nationwide, Texas MPOs struggle with the difficulties of limited resources, time, and staff for the development of accurate and reliable travel models.

Owing to the collaborative process between TxDOT and Texas MPOs, and the different sizes and staff resources among Texas MPOs dedicated to model development, the MPOs in Texas have different needs and challenges in this regard. This project will research current practices, trends, and innovations by MPOs in Texas and nationwide for managing this process. While the results from the study will include tiered recommendations appropriate for MPOs of all sizes, the focus will be on small and medium-size MPOs with limited staff and data resources for providing information for developing models.

Project Director

Janie Temple, TPP

Project Advisors

Greg Lancaster, TPP
Isidro Martinez, SAMETROPLN
Michael Medina, ELPMPO
Mike Carrizales, TPP

Research Supervisor

Karen Lorenzini, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$210,000	Center for Transportation Research	$45,000
	Texas Transportation Institute	$102,174

0-6692 - Truck-Rail Intermodal Flows: A Corridor Toolkit

Start Date - 09/01/2011 ***End Date*** - 06/30/2013

Abstract

Objective: The objective of this project is to combine mechanistic models for both trucks and rail into a PC model, calibrated for Texas and implemented through a series of study workshops for TxDOT and MPO planning staff.

Texas faces increased freight demands from population growth and economic success, with little prospect of adding substantial lane miles to the TxDOT principal highway networks. In Texas's truck-dominated intrastate corridors, can railroads offer competitive service and reduce truck volumes? Current mode choice models cannot capture the effects of weight, speed, engine power, grade, or curvature—key elements of any mechanistic approach. Moreover, they are incapable of fully internalizing external or social costs into their calculations. Therefore, in two critical areas for transportation planners—fuel costs and emissions—existing models are deficient. This project combines mechanistic models for both trucks and rail into a PC model, calibrated for Texas and implemented through a series of study workshops for TxDOT and MPO planning staff. The output of the toolkit allows planners to compare truck and rail service over a series of corridors in terms of overall cost, fuel costs, emissions per ton-mile, and related secondary costs such as pick-up and delivery costs for rail freight. Class One railroad companies—including BNSF, UP, and CSX—have expressed interest in calibrating the rail model, while the truck costs will be derived from TxDOT project 0-5974 and related models.

Project Director

Orlando Jamandre, RRD

Project Advisors

Gus Khankarli, RSC-NORTH
Rakesh Tripathi, HOU
Scott Cunningham, AUS
Raul Cantu, TPP

Research Supervisor

Robert Harrison, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$295,815	Center for Transportation Research	$170,000

0-6693 - Equipment Replacement/Retention Decision Making

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objectives of this project are to examine the new Equipment Replacement Optimization process under conditions of uncertainty while also assessing the impacts of "Right-Sizing" the equipment fleet.

Maintenance of a robust TxDOT vehicle fleet is essential to accomplishing the daily departmental mission but costly. On one hand, reductions in fleet costs are potentially beneficial to the department as a whole and thereby beneficial to the taxpayers of the State of Texas. On the other hand, not being able to respond adequately under disaster/emergency conditions is unacceptable and therefore maintaining a fleet robust enough to capably respond in a multi-event contingency is also critical.

TxDOT's new equipment replacement optimization software (TERM2) produced through project 0-6412 can optimize the equipment keep/replacement decision process potentially resulting in substantial cost savings. However, as future funding levels become more uncertain, nonavailability of funds for vehicle replacement when optimally suggested by the software is very likely. If optimal timely replacement is impossible, then what is the cost to the department of NOT replacing equipment when it should be replaced? How will down time costs change as equipment ages and what are the potential impacts of future uncertain equipment purchase costs? How to determine "robust" alternatives for critical primary and support equipment assets - quantities and placement? The purpose of this project is to address these questions and provide robust optimal solutions for TxDOT.

Project Director

Johnie Muller, GSD

Project Advisors

Brandye Munn, MNT
David Bennett, MNT
David Fernandez, TSD
Karen Dennis, GSD
Magdy Mikhail, CST
Michelle Veale, BRG
Ron Hagquist, SPM
Scott Hamilton, RSC-SOUTH

Research Supervisor

Wei Fan, UTTYL

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$256,746	Center for Transportation Research	$62,653
	University of Texas at Tyler	$64,458

0-6694 - Identifying Best Practices for Managing Operating Costs for Rural and Small Urban Public Transportation Systems

Start Date - 09/01/2011 ***End Date*** - 03/31/2013

Abstract

Objective: The purpose of this project is to develop a guidebook for rural and small urban public transit providers to manage operating costs better.

Rural and small urban transit providers across the United States face fiscal challenges caused by the growing gap between the cost of providing transit service and available federal and state funding. In Texas, the fiscal challenges facing rural and small urban transit providers are compounded by an increasing population and growth in urbanization in some counties and declining population with increasing demand for transit service for an aging population in other counties. This research will better equip public transportation providers to understand, predict, and manage operating costs.

The guidebook will meet five objectives: (1) serve as a reference to better understand various drivers of operating costs; (2) explain how organizational structure, service characteristics, and management structures impact costs; (3) provide a tool for transit providers to analyze costs based on resource allocation; (4) demonstrate benchmarking and peer comparisons as a way to monitor costs and share best practices to manage costs; and (5) present an overview of national trends and innovative approaches to contain costs.

Project Director

Kelly Kirkland, PTN

Project Advisors

Chris Willrich, PTN
Delma Childress, SJT
Gary Rushing, HTCG
Gregory (Greg) Davis, WAC
Sonya Hudson, ATL

Research Supervisor

Suzie Edrington, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$148,600	Texas State University - San Marcos	$7,163
	Texas Transportation Institute	$102,650

0-6696 - Incorporating Greenhouse Gas (GHG) Emissions in Long Range Transportation Planning

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The aim of this research is to equip TxDOT with the necessary tools and information to address potential rules and regulations relating to long range transportation planning and GHGs.

Greenhouse gas (GHG) emissions continue to be an important focus area for state, local and federal agencies. Transportation agencies are also moving towards tackling the issue of GHG emissions. It is also likely that, in the future, transportation funding may be tied to demonstration of GHG reductions in long range transportation plans. TxDOT plays a major role not just in statewide long range transportation planning, but in working with MPOs and other stakeholders on their plans, in allocating federal funds, and planning and implementing transportation projects. This research will conduct a review of literature, policy and regulation, practices of other agencies, as well as TxDOT-specific practices, issues and needs. The research will then develop a framework by which GHG emissions can be incorporated into long range transportation plans, through appropriate control strategies, analysis methods, and performance measures. The outcome of this research project will directly benefit TxDOT and its partner agencies, including MPOs, by allowing TxDOT to proactively address the topic of GHG emissions through long range transportation planning.

Project Director

Bill Knowles, TPP

Project Advisors

Greg Lancaster, TPP
Jackie Ploch, ENV
Karie Brown, RSC-NORTH

Research Supervisor

Josias (Joe) Zietsman, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$300,000	Center for Transportation Research	$50,000
	Texas Transportation Institute	$80,000

0-6698 - Examining the Use of Existing Public Rights-of-Way for High-Speed Rail or Other Infrastructure

Start Date - 09/13/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The primary purpose of this research work plan is to determine if and how existing TxDOT, public, utility and freight rail ROW can potentially accommodate high-speed intercity passenger rail (HSIPR) and/or dedicated freight transportation systems.

The administrative difficulties, delays, costs, and environmental impacts associated with the acquisition of property for transportation projects point to a need to consider utilizing existing right-of-way (ROW) resources to the greatest extent possible.

A number of states have considered and have chosen existing highway, public, freight rail, and utility ROW for preferred alignments for HSIPR, such as Florida (I-4, freight rail, utility, and Orlando airport ROW) and California (I-5, I-10, and freight rail).

To answer the research question for Texas, all potential ROW routes in Texas will be identified and their key characteristics considered for utilization by a spectrum of HSIPR and dedicated freight systems. At least four of those routes will be evaluated in greater detail for technical, political, and legal feasibility. For those four case studies, the study will develop potential solutions to engineering challenges encountered in the ROW, such as highway interchanges and narrow ROW width. The case study research will include meetings and interviews with affected ROW owners and critical stakeholders.

Project Director

Charon Williams, ROW

Project Advisors

Dan Perry, PAR
Don Toner, TTA
Roger Beall, TTA

Research Supervisor

Stephen Mattingly, UTA

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$387,943	Center for Transportation Research	$85,000
	Texas Southern University	$23,998
	University of North Texas	$30,977
	University of Texas at Arlington	$62,339

0-6701 - Linking Regional Planning with Project Planning in Support of NEPA

Start Date - 09/01/2011 ***End Date*** - 12/31/2012

Abstract

Objective: The objectives of this research study are to (a) review the effectiveness of the practices and efforts that have been implemented in Texas to deliver planning documentation that supports the environmental clearance process, (b) review the effectiveness of the practices and efforts that have been implemented in other states to link planning with project planning in support of NEPA, (c) assess the challenges in implementing identified practices and the need for additional resources and guidance, and (d) recommend process revisions, procedures for developing robust planning studies and NEPA documents, and changes to the allocation of resources.

Multiple benefits can arise from a more efficient link between transportation planning and project planning in support of NEPA that will ultimately facilitate the preparation of legally sufficient documents and prevent delays in project implementation. These benefits include (a) agency benefits resulting, for example, from a reduction in paperwork; (b) socio-economic benefits if the time from planning to construction of a project is reduced so that the benefits of the project become available sooner to the traveling public, and (c) broader environmental benefits when multiple stakeholders are involved early in the process to ensure environmental protection through collaboration and the identification of mitigation sites. As we have highlighted, and as the FHWA and other resource guides have noted, there are, however, components of regional planning that are either not conducted, or conducted inadequately, which slows down the environmental clearance process. The results have been delayed construction, cost escalation, and challenges in acquiring right-of-way.

Project Director

Melissa Neeley, ENV

Project Advisors

Doug Booher, TTA
Karie Brown, RSC-NORTH
Matt MacGregor, DAL
Susan Theiss, HOU

Research Supervisor

Jolanda Prozzi, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$212,996	Center for Transportation Research	$140,300
	University of North Texas	$24,696

RMC 4 – Active Projects

Project	Title	Start Date	Page
0-6639	Testing of Alternative Support Materials for Portable Signs for Maintenance Work Zones	9/1/2010	70
0-6640	State of the Practice for Workers in Very Short Duration Work Zone Operations	9/1/2010	71
0-6641	Assessment of the Impact of Nighttime Work Zone Lighting on Motorists	9/1/2010	72
0-6642	Developing Warrants for Active Warning Devices at Low-Volume Highway-Rail Grade Crossings	9/1/2010	73
0-6643	Guidelines for the Effective Use of Flexible Pylons For Congestion Mitigation, Access Management, and Safety Improvement	9/1/2010	74
0-6644	Development of Operationally Effective Raised Medians and Use of Alternative Movements on Urban Roadways	9/1/2010	75
0-6645	Guidelines for Continuous and Safety Roadway Lighting	9/1/2010	76
0-6646	Safety and Integrity of Median Barrier-Mounted Hardware	9/1/2010	77
0-6647	Developing a Luminance-Based Mobile Highway Delineation Equipment and Level of Service Guidelines for Safe Nighttime High-Speed Travel	9/1/2010	78
0-6669	Best Practices for Emergency Operations	12/17/2010	79
0-6670	Synthesis Study of Traffic Signal Systems	9/1/2011	80
0-6702	Development of Pedestrian Crash Countermeasures and Appropriate Crash Reduction Factors (CRF)	9/1/2011	81
0-6703	Prevention of Backing Fatalities in Construction Work Zones	9/1/2011	82
0-6704	Reduction of Motorists' Delay and Crash Potential Upstream of Highway Work Zones	9/1/2011	83
0-6705	Effectiveness of Performance Based Pavement Marking Maintenance Contracts	9/1/2011	84
0-6706	Design and Scope of Impact of Auxiliary Lanes	9/1/2011	85
0-6707	Compare Trailer-Mounted Attenuators vs. Truck-Mounted Attenuators Protection for Workers	9/1/2011	86
0-6708	Traffic Control for Access Points Within a Lane Closure on a Two-Lane, Two-Way Road	9/1/2011	87
0-6711	Short Radius MASH TL-3 Guardrail Treatment	9/1/2011	88

RMC 4 – Active Projects

Project	Title	Start Date	Page
0-6712	Evaluation of Measures and the Development of a Plan to Reduce the Number and Mitigate the Severity of Crashes Involving Motorcyclists on Texas Highways	9/1/2011	89
0-6713	Quantitative Relationship Between Safety and Reduced Roadway Condition Maintenance	9/1/2011	90
0-6714	Surface Treatments to Alleviate Crashes on Horizontal Curves	9/1/2011	91
9-1001	Traffic Control Device Evaluation Program	9/1/2009	92
9-1002-12	Roadside Safety Device Crash Testing Program	9/1/2011	93

0-6639 - Testing of Alternative Support Materials for Portable Signs for Maintenance Work Zones

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objectives: This research project will examine wind loading on portable roll-up signs, find alternative materials to support the flexible faces of these signs, and propose designs for portable roll-up signs on modified supports, if necessary.

Portable roll-up signs are currently used by the Texas Department of Transportation (TxDOT) for identification of short-term maintenance/work zones and emergency operations. These signs have fiberglass frames to directly support the diamond-shaped and rectangular flexible sign faces. It has been reported that the fiberglass frames have failed due to bending-even in breezes caused by passing vehicles. The cost of these failures is more than the marginal cost of replacing the broken frame members that directly support the sign face. It includes the safety cost to workers and the traveling public. Research studies to date on sign structures have focused on permanent signs with rigid faces. However, there has been little formal and in-depth research on wind loading on roll-up signs with flexible facing materials. This research project is proposed to address three major issues: (1) understanding of wind loading on portable roll-up signs, (2) finding alternative materials to support the flexible faces of these signs, and (3) proposing designs of portable roll-up signs on modified supports, if necessary. The results of this research project will be presented in the form of specifications that can be incorporated into TxDOT General Services Division Specification Number 801-60-66 - Sign Face, Roll-up, Reflective, Construction and Work Zone.

Project Director

Christopher Freeman, AMA

Project Advisors

Charlie Wicker, TRF
Jacen Lemons, CHS
James Combes, LBB
Johnnie Miller, CST
Lewis Nowlin, SJT
Martin Kalinowski, HOU

Research Supervisor

Sangwook Bae, TECHMRT

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$312,755	Center for Multidisciplinary Research in Transportation	$106,378
	Texas Transportation Institute	$88,081

0-6640 - State of the Practice for Workers in Very Short Duration Work Zone Operations

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objectives: This project will develop a decision matrix to determine the appropriate traffic control to minimize risk to workers and highway users in very short duration one-time or seldom performed operations, as well as develop an educational module to train TxDOT workers to perform very short duration operations safely under various conditions.

Very short duration maintenance operations last for less than 15 minutes and usually involve operations such as removing an object from the roadway (either on the pavement or adjacent shoulder) or patching a pothole or small hand level up areas. These activities have the potential to interrupt traffic flow and can pose a safety risk for both workers and drivers.

As part of the research, risk to maintenance personnel as well as highway users will be assessed through an Expert Panel guided by a modified Delphi Process. Tasks included in this project are: i) review the current state of practice in very short duration operations available in literature; ii) identify dimensions needed in matrix; iii) identify technologies and methods for minimizing risk to workers in very short duration work zone operations; iv) develop a matrix to determine the appropriate traffic control in multiple scenarios and recommended response by workers; v) refine the matrix based on expert feedback; vi) develop an educational module and train TxDOT workers in a workshop session.

Project Director

Paul Montgomery, LFK

Project Advisors

Eddy Rentas, ODA
Gary Tarter, TRF
Jimmy Busby, WAC
Michael Lee, LFK
Michele Regis, OCC
Paul Lewis, TYL
Rodney Chesser, CRP
Zeferino Villarreal, LBB

Research Supervisor

Randy Machemehl, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$212,575	Center for Transportation Research	$132,522

0-6641 - Assessment of the Impact of Nighttime Work Zone Lighting on Motorists

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objectives: This project will assess the impact of work zone lighting on motorists and develop work zone lighting guidelines for nighttime operations, considering both worker and motorist needs.

The Texas Department of Transportation (TxDOT) is increasingly conducting road work on high-volume facilities at night to reduce traffic delays and complaints by the public that would typically be caused by doing the work during the day. Lighting is one of the most important factors for nighttime construction and maintenance operations as it affects driver and worker safety, work quality, worker productivity, and worker morale. However, currently TxDOT does not have a policy regarding the use of temporary lighting in nighttime operations. Thus, decisions pertaining to work zone lighting are usually left to the discretion of the site engineer and the contractor, which may feel that existing fixed lighting and/or conventional vehicle headlights are adequate to illuminate nighttime work.

Work zone illumination guidelines for nighttime highway work do exist, but they are solely based on the visual needs of workers. Research has not been conducted to assess the impact of work zone lighting on motorists approaching and driving through the work zone.

Project Director

Greg Jones, TRF

Project Advisors

Haydee Cannon (Contreras), TRF
Martin Kalinowski, HOU
Michael Olivo, TRF
Michele Regis, OCC

Research Supervisor

Melisa Finley, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$320,524	Texas Transportation Institute	$161,746

0-6642 - Developing Warrants for Active Warning Devices at Low-Volume Highway-Rail Grade Crossings

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: This two-year research project will develop a highway-rail crossing prioritization system based on a combination of a revised safety index and warrants for active warning devices at low-volume highway-rail grade crossings.

The research scope emphasizes, but is not restricted to, low-volume crossings in the lower-third of the priority list generated with the current Texas Priority Index (TPI). Tentative warrants and a list of eligible crossings (with cost estimates) will be delivered at the end of the first year for a trial implementation aimed at identifying how they should be further refined. Implementability is important when selecting variables to incorporate in the warrants and in the revised index. The variables to be used in the safety index present several peculiar mathematical characteristics and must be modeled using appropriate methods. The deliverables will facilitate rail-highway crossing management in Texas, ensuring proper consideration of low-volume roads when applying funding mechanisms such as Section 130 funds.

Project Director

Darin Kosmak, RRD

Project Advisors

David Valdez, TRF
Juanita Daniels-West, TYL
Marvin Wright, RRD
Robert Martinez, ODA
Roy Parikh, FTW
Troy Daniel, LBB

Research Supervisor

Jose Weissmann, UTSA

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$269,555	Texas Transportation Institute	$54,000
	University of Texas at San Antonio	$81,505

0-6643 - Guidelines for the Effective Use of Flexible Pylons For Congestion Mitigation, Access Management, and Safety Improvement

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: This research will develop guidelines for effective use of flexible pylons for different channelizing applications.

Flexible pylons are gaining popularity as traffic channelizing devices in a variety of applications, such as on HOV/Managed Lanes, freeway ramps, work zones, arterial turn lanes, and median closures. The increased popularity of flexible pylons is likely because they are less rigid (as compared to concrete barriers) enabling easier access by emergency vehicles, increased feeling of openness (as compared to concrete barriers), and providing more positive control than pavement markings in channelizing traffic. In general, flexible pylons are less expensive and easier to install than concrete barriers. However, there are also concerns with flexible pylons effectiveness as channelizing devices. Flexible pylons get hit frequently by motorists, sometimes due to distractions, and sometimes on purpose with disregard to the marking device intent, reckless lane changes, or poor visibility of pylons themselves. In some cases when pylons are struck, they break off, leaving large gaps and creating less safe conditions. While there are some standards to test durability of pylons, there is a lack of guidelines for implementation of pylons that can render them ineffective.

The objectives of this project are to develop guidelines on/to:

o When and where pylons are suitable for implementation,
o Which type of pylons (curb mounted or fixed to pavement) is suitable for various applications,
o Determine optimal spacing for pylons
o Determine buffer space requirements, and
o Determine daytime and nighttime visibility requirements.

This project will survey various agencies to synthesize qualitative and quantitative experiences to identify the best implementation practices of pylons. The synthesis will be supplemented with case studies and controlled experiments to develop guidelines for effective use of pylons for different channelizing applications.

Project Director

Michael Chacon, TRF

Project Advisors

Carlos Rodriguez, BRY
Guillermo Doughtery, LRD
Josh Verastique, TRF
Melanie Young, DAL
Sergio Rodriguez, HOU

Research Supervisor

Robert Benz, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$291,782	Texas Transportation Institute	$145,789

0-6644 - Development of Operationally Effective Raised Medians and Use of Alternative Movements on Urban Roadways

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: The project will develop guidelines for operationally effective raised medians and the use of alternative movements on urban roadways.

Raised medians can be used on urban arterials where it is desirable to control or restrict mid-block left-turns, U-turns or crossing maneuvers. To achieve the project goals, the research will: (1) examine the important issues related to the design and operations of raised medians, such as the placement and frequency of median openings, the appropriate length for the turning lanes at median openings, the width of raised medians; (2) synthesize the best practices on the use of alternative movements; (3) assess the operational and safety impacts of raised medians and the use of alternative movements; and (4) develop implementation-oriented guidelines for the use of raised medians and alternative movements.

Project Director

Ricardo (Rick) Castaneda, SAT

Project Advisors

Carlos Rodriguez, BRY
Cynthia Flores, TRF
Cynthia Landez, DES
Doug Skowronek, TRF
Geoffrey (Shane) Cunningham, TYL
Jim Heacock, HOU

Research Supervisor

Yi (Grace) Qi, TSU

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$242,804	Center for Transportation Research	$15,000
	Texas Southern University	$102,993

0-6645 - Guidelines for Continuous and Safety Roadway Lighting

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: This research project will evaluate the relationship between safety and lighting throughout the nighttime periods and develop criteria and guidelines for implementing lighting curfews.

The term "lighting curfews" refers to the concept of turning off or reducing the amount of roadway lighting during certain portions of the night when traffic volumes drop off. The TxDOT Highway Illumination Manual describes the concept of lighting curfews, but it does not give any criteria for when to implement them.

Research activities include the identification of previous research on the topic and surveys of other agencies, identification of existing TxDOT lighting characteristics, field measurements of lighting performance, a safety analysis of crashes with and without lighting as a function of time of night and traffic volume, a visibility assessment at selected sites, identification of other technical and non-technical issues associated with lighting curfews, a feasibility assessment of lighting curfews including the identification of benefits and costs, and a field evaluation of the preliminary lighting curfew guidelines. The final guidelines developed by this project will be prepared for inclusion in the Highway Illumination Manual and may include options such as turning off lighting at specific times/volumes, trimming lighting, or dimming lighting.

Project Director

Greg Jones, TRF

Project Advisors

Ed Kloboucnik, SJT
Gabriel Garcia, CRP
Juanita Daniels-West, TYL
Michael Olivo, TRF

Research Supervisor

Harvey (Gene) Hawkins, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$199,988	Texas Transportation Institute	$42,774

0-6646 - Safety and Integrity of Median Barrier-Mounted Hardware

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: This project will develop a design guideline and a standard that could be incorporated into TxDOT standards and specifications for median barrier-mounted hardware.

Concrete median barriers have been used throughout the State as permanent or temporary barrier for providing separation of traffic. Due to space restriction, a sign or a light pole is placed on top of such barriers. Typically these barriers are tested and considered crashworthy through crash testing according to NCHRP Report 350 or MASH. However, when signs or light poles are mounted on top of barriers, the crash worthiness of the system is not necessarily guaranteed. There is very limited research on how a combination of device and barrier would perform if impacted by an errant vehicle. Moreover, no full scale crash tests have been performed to accurately identify the influence of attachments on vehicular deceleration. Therefore, there is a need to identify existing practices of placing hardware on top of median barriers, as well as defining the crashworthiness of such combinations. In this project, a survey of the practice of mounting hardware on top of barriers will be performed. Analytical, computer simulation, and testing tasks will be conducted to define crashworthy hardware and placement guidelines.

Project Director

Jianming Ma, TRF

Project Advisors

Felicia (Roxanne) Cortez, DAL
Michael Chacon, TRF
Tomas Trevino, CRP

Research Supervisor

Akram Abu-Odeh, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$271,100	Texas Transportation Institute	$171,123

0-6647 - Developing a Luminance-Based Mobile Highway Delineation Equipment and Level of Service Guidelines for Safe Nighttime High-Speed Travel

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: This research will develop and calibrate a mobile luminance-based highway delineation measurement system.

This research project is focused on nighttime safety from the perspective of providing a quantifiable technique to assess the nighttime delineation of the roadway scene as a whole, and in terms of what the driver sees and needed. All of the nighttime traffic control devices that are intended to provide visibility in terms of the roadway scene are developed, deployed, and tested in isolation.

This research aims to develop a comprehensive way to assess the amount of delineation and provide a level of service framework that can be used to manage delineation in terms of safety and maintenance. It is envisioned that the mobile luminance-based highway delineation measurement system can be used to assess the nighttime delineation along the TxDOT system. The type of traffic control devices that would be quantified together would include signs, pavement markings, delineators, chevrons, guardrail reflectors, and others.

Project Director

Carlos Ibarra, ATL

Project Advisors

Alan Hagler, CST
Arturo Perez, CST
Darren Hazlett, CST
Doug Skowronek, TRF
Johnnie Miller, CST

Research Supervisor

Paul Carlson, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$298,565	Texas Transportation Institute	$155,352

0-6669 - Best Practices for Emergency Operations

Start Date - 12/17/2010 ***End Date*** - 10/31/2011

Abstract

Objectives: The objectives of this research are to determine or develop a best practices operations manual for winter weather operations to develop a Winter Weather Playbook for Winter Weather Storms in Texas.

In recognition of a growing need to identify actionable practices relative to winter weather operations, it has become increasingly important to ensure that these practices can be effectively employed as well as protect the health and safety of employees working in extreme conditions.

The research objective is to develop a winter weather operations manual that can be used by TxDOT districts vulnerable to weather related emergencies. Researchers will perform a synthesis of the best practices related to winter weather operations, highlight transferable best practices, and document this information in an operations manual that will help maintenance crews better understand how to work in weather related emergencies.

Project Director

Ted Moore, LBB

Project Advisors

Billy Taylor, WFS
Darwin Lankford, CHS
Gary Tarter, TRF
Gilbert Jordan, MNT
Keith Harris, FTW
Ron Herr, AMA
William Parrott, ATL

Research Supervisor

Judy Perkins, PVAM

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$128,347	Prairie View A&M University	$16,103
	Texas Transportation Institute	$14,125

0-6670 - Synthesis Study of Traffic Signal Systems

Start Date - 09/01/2011 ***End Date*** - 08/31/2012

Abstract

Objective: The objective of this research is to develop a synthesis of traffic control system practices that can be used by various Texas Department of Transportation (TxDOT) districts to improve traffic signal operations and reduce traffic signal system inefficiency and costs.

In recent years, several versions of traffic control systems have been established across the United States and within the state of Texas. There is a growing need to identify the various versions of these systems that exist including the system hardware components and communications. Such an effort will also help identify operational successes, deficiencies, cost effectiveness, and other attributes of the various traffic signal system components.

The research objective is to develop a synthesis of traffic control system practices that can be utilized by various Texas Department of Transportation (TxDOT) districts in the pursuance of improved traffic signal operations and reduction in traffic signal system inefficiency and related costs. Researchers will perform this synthesis by investigating current and state of the practice systems across the United States and within the state of Texas and also with an investigation of best international practices that might be of use to TxDOT.

Project Director

Henry Wickes, TRF

Project Advisors

Dan Maupin, HOU
Derryl Skinnell, TRF

Research Supervisor

Dazhi Sun, TAMUK

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$49,946	Texas A&M University – Kingsville	$25,456
	Texas Transportation Institute	$24,490

0-6702 - Development of Pedestrian Crash Countermeasures and Appropriate Crash Reduction Factors (CRF)

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objectives: The objectives of this project are to:

- Identify characteristics of pedestrian crashes in Texas;
- Identify potential safety treatments or combinations of treatments that reduce pedestrian fatalities and injuries;
- Evaluate selected pedestrian treatments; and
- Document findings so that the information can be used by TxDOT in selecting appropriate pedestrian treatments.

This TxDOT project is to assist the state with identifying characteristics of Texas pedestrian crashes and appropriate countermeasures to address those crashes. For Texas, the average number of pedestrian fatalities for the past five years is about 400 per year. Texas is considered by FHWA to be an "opportunity" state due to the high number of pedestrian crashes. This project can assist TxDOT with making decisions regarding pedestrian treatments. It will also provide a better understanding of the characteristics of crashes associated with pedestrians. Tasks within the proposed project include reviewing the literature, understanding the Texas environment, determining Texas pedestrian crash characteristics, identifying the best approach for evaluating pedestrian countermeasures, conducting evaluation of selected countermeasures, and documenting the findings from the research.

Project Director

Debra Vermillion, TRF

Project Advisors

Amanda Martinez, TRF
Christopher Lindsey, DES
Scott Cunningham, AUS
Steve Higgins, BRY

Research Supervisor

Kay Fitzpatrick, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$323,033	Texas Transportation Institute	$154,883

0-6703 - Prevention of Backing Fatalities in Construction Work Zones

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this project is to review current practices and procedures to prevent backing fatalities and test commercially available systems for prevention of backing fatalities. An educational module will be developed to consist of a set of guidelines demonstrating how to implement the recommended commercially systems for prevention of backing fatalities in construction work zones.

Construction, repair and maintenance work zones are always hazardous environments especially because of the dangerous combinations of pedestrian workers and large trucks, bulldozers, rollers and other moving machinery. Between 70 and 80 pedestrian construction workers are struck or killed each by construction vehicles within a work zone. From 1995 to 2002, 844 worker deaths occurred in roadway work zones, i.e. over 100 deaths annually. 91% of these deaths were related to motor vehicle traffic or construction equipment, or both. The American Road & Transportation Builders Association (ARTBA) named run-overs and back-overs as the leading cause of death for roadway construction workers, with over half occurring when workers were struck by construction vehicles or equipment inside the work zone. This study will seek to review current practices and procedures to prevent backing fatalities, identify and analyze appropriate responses, and test commercially available systems for prevention of backing fatalities, and provide worker training modules. This study will propose recommendations for TxDOT traffic control practices, incorporating commercially available systems for prevention of backing fatalities.

Project Director

Connie Flickinger, BRY

Project Advisors

Daniel Bly, PAR
Samuel Salazar, OCC
Tom Hunter, LFK

Research Supervisor

Wei Fan, UTTYL

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$296,864	Center for Transportation Research	$71,436
	University of Texas at Tyler	$71,725

0-6704 - Reduction of Motorists' Delay and Crash Potential Upstream of Highway Work Zones

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this research is to identify the appropriate lane control treatments for intermediate-and long-term highway lane closures due to work zones.

Lane closures due to highway work zones introduce many challenges to the goal of ensuring smooth traffic operations and a safe environment for drivers and workers. In addition, merging has been found to be one of the most stressful aspects of driving and a merge process that is viewed as "unfair" (e.g., due to queue-jumping) can lead to further unsafe behaviors stemming from "road rage." To address these issues, the work in this project will focus on lane control solutions for intermediate and long-term highway work zones. Tasks included in this project are i) evaluate innovative lane control measures such as fixed cycle signals and continuous merge signals; ii) collect and analyze observational data at workzones; iii) use mesoscopic dynamic traffic assignment modeling to estimate the diversion rate; iv) input the vehicle flow output from the mesoscopic model into a microscopic model to evaluate driver behavior; v) input the vehicle trajectories from the microscopic model into a safety analysis model for predicting conflict rates; vi) develop a decision tree to guide TxDOT towards the appropriate lane control measure in each potential scenario; and vii) present the results in a pilot training workshop and final report.

Project Director

Greg Malatek, AUS

Project Advisors

Brian Burk, AUS
Dustin Wiggins, TRF
Flor Tamez, TRF
Will Lockett, BRY

Research Supervisor

Randy Machemehl, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$215,184	Center for Transportation Research	$80,712
	Texas Southern University	$32,611

0-6705 - Effectiveness of Performance Based Pavement Marking Maintenance Contracts

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objectives: The objectives of this research are to gather information to evaluate the effectiveness of Performance Based Pavement Marking Maintenance Contracts (PBPMMCs). Some of the questions this research intends to answer are:

- What is the delivered pavement marking performance resulting from PBPMMCs?
- What is the safety performance of roadways under PBPMMCs?
- What are the potential cost savings ofPBPMMCs?
- What performance measures and measurement protocols are most suitable for inclusion in PBPMMCs?
- When and where should PBPMMCs be used?

Pavement markings play a vital role in the safe and efficient movement of traffic on the Texas Department of Transportation's (TxDOT's) roadways. In 2010, the Federal Highway Administration (FHWA) started rule making to adopt minimum pavement marking retroreflectivity levels. These minimum levels will require that pavement markings of adequate visibility are present on the nation's roadways. Performance-based pavement marking maintenance contracts (PBPMMC) are one of the latest mechanisms used to maintain adequate pavement marking performance and to share the risk of maintaining minimum performance levels. TxDOT has issued two PBPMMCs, but the effectiveness of these contracts as compared to other contracting mechanisms (annual district-wide, warranty, or hybrid contracts) from a risk management, cost, performance, or safety perspective has not been evaluated.

This project will gather information to evaluate the effectiveness of PBPMMCs by addressing the following objectives:

• What is the delivered pavement marking performance resulting from PBPMMCs?
• What is the safety performance of roadways under PBPMMCs?
• What are the potential cost savings of PBPMMCs?
• What performance measures and measurement protocols are most suitable for inclusion in PBPMMCs?
• When and where should PBPMMCs be used?

Project Director

Judith Friesenhahn, SAT

Project Advisors

Brian Stanford, TRF
David Valdez, TRF
James (Dale) Barron, WAC
Justin Obinna, MNT
Michael Fowler, AMA

Research Supervisor

Adam Pike, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$256,935	Texas Transportation Institute	$127,132

0-6706 - Design and Scope of Impact of Auxiliary Lanes

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this research is to develop guidelines on the design of freeway auxiliary lanes and provide methods for assessing the impacts of such design solutions.

While auxiliary lanes are widely used in urban freeway interchanges throughout Texas, broader understanding is necessary of the design and impacts of auxiliary lanes, and their role in access-controlled facility function and operations. The goal of this project is to define the conditions under which auxiliary lanes are implemented in design and rehabilitation projects, and to investigate the impacts of auxiliary lanes in a broad scope. To this end, the research will: (1) review and synthesize state-of-the-art/practice, (2) survey transportation engineers, (3) examine the operational impacts of the auxiliary lanes at both segment level and corridor level, (4) suggest performance measures that can effectively measure the impacts of auxiliary lanes, (5) synthesize best practices on the use of auxiliary lanes, and (6) develop implementation-oriented guidelines on the design and use of auxiliary lanes.

Project Director

Jane Lundquist, DES

Project Advisors

Cynthia Flores, TRF
Cynthia Landez, DES
Kevin Dickey, WAC
Richard Harper, PAR

Research Supervisor

Yi (Grace) Qi, TSU

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$251,213	Texas Southern University	$80,230
	University of Texas at El Paso	$48,133

0-6707 - Compare Trailer-Mounted Attenuators vs. Truck-Mounted Attenuators Protection for Workers

Start Date - 09/01/2011 ***End Date*** - 08/31/2012

Abstract

Objectives: The objectives of this research are to evaluate the level of protection provided to workers either by truck-mounted or trailer-mounted attenuators, and compare the level or protection offered by these devices.

While most transportation agencies are very familiar with truck-mounted attenuators (TMA), trailer-mounted attenuators are increasing in popularity. Trailer-mounted attenuators are commonly referred to as Towable Trailer-Mounted Attenuators (TTMA). There is a concern for the level of protection that attenuators provide for workers when they are mounted on trailers compared to trucks. The objective of this project is to compare the level of protection provided to workers by truck-mounted and trailer-mounted attenuators. This will be accomplished by gathering and comparing TMA and TTMA information, including their physical characteristics, utility, cost, and crashworthiness data. Guidance for the use of TMA versus TTMA, as appropriate, will be documented in the project final report.

Project Director

Ismael Soto, CRP

Project Advisors

Christopher (Chris) Mountain, PAR
Gary Tarter, TRF
Johnie Muller, GSD
Randy Clawson, OCC
Rick Swinson, WAC

Research Supervisor

LuAnn Theiss, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$45,000	Texas Transportation Institute	$45,000

0-6708 - Traffic Control for Access Points Within a Lane Closure on a Two-Lane, Two-Way Road

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objectives: The objectives of this research project are to identify and evaluate traffic control technologies and strategies that could be used to control traffic entering from access points, and develop guidelines regarding the appropriate traffic control for access points within a lane closure on a two-lane, two-way road.

When a lane is closed on a two-lane, two-way road provisions must be made to alternate oneway movement of the two original travel lanes through the work area using methods such as flagger control or portable traffic signals. However, quite often there are access points (such as residential or business driveways and county roads) within the one-lane section of roadway. There is the potential for drivers entering the roadway from these access points to misunderstand the direction of traffic, enter the roadway going in the wrong direction, and collide with a vehicle travelling through the work zone. While these access points should be monitored, flagger control or portable traffic signals are not always feasible based on conditions such as work duration, traffic volume, time of day, and cost of the method. Research is needed to identify and evaluate traffic control technologies and strategies that could be used to control traffic entering the onelane section from access points.

The technical objectives of the proposed research project are to:
• identify and evaluate traffic control technologies and strategies that could be used to control traffic entering from access points and
• develop guidelines regarding the appropriate traffic control for access points within a lane closure on a two-lane, two-way road.

Project Director

Charlie Wicker, TRF

Project Advisors

Kit Black, AMA
Michael Chacon, TRF
Will Lockett, BRY

Research Supervisor

Melisa Finley, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$297,911	Texas Transportation Institute	$141,534

0-6711 - Short Radius MASH TL-3 Guardrail Treatment

Start Date - 09/01/2011 ***End Date*** - 11/30/2013

Abstract

Objectives: The objectives of this research project are to develop a short radius guardrail design that is MASH TL-3 compliant to be used by TxDOT on roadways at intersections with restrictive features.

When a road intersects a highway with restrictive features, such as bridge rail or culvert, it is difficult to fit the proper guardrail length along the primary roadway. Site constraints, such as private driveways and county roads may intersect the primary road and not allow the placement of a properly designed guardrail. In these cases, the alternatives are to shorten the guardrail length, provide a curved guardrail design, or relocate the site constraint.

Although numerous tests have been conducted for different short radius guardrail designs, none of them passed National Cooperative Highway Research Program (NCHRP) Report 350 TL-3 requirements. The crash testing guidelines have been updated to the Manual for Assessing Safety Hardware (MASH) standards, which increases the impact severity for TL-3 tests. Satisfying such impact severity will be more challenging for the short radius systems.

The objective of this project is to develop a MASH TL-3 compliant short radius design for TxDOT. Conceptual designs will be developed and rated for their potential impact performance and cost-effectiveness. The candidate designs will then be evaluated through detailed computer simulations. The analysis results will be used to recommend a design for fullscale crash testing. A final design will be developed based on the testing.

Project Director

A. Rory Meza, DES

Project Advisors

Don Miller, WAC
Cindy Landes, DES
Christopher Lindsey, DES

Research Supervisor

Akram Abu-Odeh, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$625,776	Texas Transportation Institute	$133,129

0-6712 - Evaluation of Measures and the Development of a Plan to Reduce the Number and Mitigate the Severity of Crashes Involving Motorcyclists on Texas Highways

Start Date - 09/01/2011 ***End Date*** - 02/28/2013

Abstract

Objectives: The objective of this project is to develop a broad-based plan that includes countermeasures and outreach activities to prevent and/or mitigate motorcycle crashes and associated injuries and fatalities in Texas.

According to data from the TxDOT Crash Records Information System (CRIS), motorcycle fatalities fell by 19% – from 531 in 2008 to 432 in 2009. This is extremely good news considering that motorcycle deaths increased by 31% from 2007 to 2008 (CRIS, 2010) Although too early to determine, declines have been attributed to less motorcycle travel due to the economy, fewer beginning motorcyclists, and increased motorcycle safety and awareness among drivers and riders. While optimistic that these downward trends will continue, when compared to all traffic fatalities, the percentage of motorcycle deaths is still significant, representing 14 percent of Texas' motor vehicle fatalities, compared to 15 percent in 2008 (CRIS, 2010). While the overall decline in rider deaths is encouraging, nearly 1 in 7 people killed on our roadways last year were riding a motorcycle.

The principal goal of this project is to develop a broad-based plan that includes countermeasures and outreach activities to prevent and/or mitigate motorcycle crashes and associated injuries and fatalities in Texas. The plan will ultimately aid in the reduction of motorcycle crashes, fatalities and injuries on Texas roadways and provide a baseline from which the districts and TxDOT can effectively measure and track implemented countermeasures and programs, and, if necessary, make changes.

Project Director

Frank Phillips, LBB

Project Advisors

Debra Vermillion, TRF
James Bailey, WAC
Josh Verastique, TRF
Lloyd Wolf, BRG
Maurice Maness, BRY
Michael Jedlicka, BRY
Nicholas Nemec, BRG
Victor Vargas, AUS
Will Bozeman, AUS

Research Supervisor

Patricia Turner, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$184,305	Texas Transportation Institute	$121,100

0-6713 - Quantitative Relationship Between Safety and Reduced Roadway Condition Maintenance

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this research is to develop a relationship between skid resistance and accidents on Texas highways.

TxDOT is responsible for maintaining over 192,000 lane miles of highways. With an increase in material costs and a decrease in revenue, TxDOT will not be able to maintain roadways at previous levels with the current funding allocations. Not performing these types of treatments in a timely manner not only compromises the pavement's structural integrity, but it can also have a negative impact on safety. Since asphalt pavements are more susceptible to surface distresses such as cracking, raveling, rutting, and loss of skid resistance and make up the vast majority of TxDOT's roadway network, it is important to understand the long term impact of reduced maintenance funding. Extending the time interval between routine and preventive maintenance treatments can have a negative impact on the pavement's skid resistance. This can translate into an increase in wet surface related crashes also known as road departure accidents and an overall decrease in safety. Having fewer maintenance dollars to invest makes the project selection criteria a top priority. Understanding the relationship between skid resistance and accidents will allow TxDOT's pavement engineers to maintain highways with an acceptable level of skid resistance even under reduced program funding.

Project Director

Terry Paholek, BRY

Project Advisors

Debra Vermillion, TRF
Mark Shafer, BRY
Scot Reaves, WFS

Research Supervisor

Zhanmin Zhang, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$273,894	Center for Transportation Research	$135,080

0-6714 - Surface Treatments to Alleviate Crashes on Horizontal Curves

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objectives of this research are to determine contributing factors to run-off-the-road crashes at horizontal curves, identify appropriate surface treatments to alleviate crashes, conduct field analysis to determine operational benefits of surface treatments, and develop guidance regarding the application of surface treatments and other traffic control devices at horizontal curves.

Researchers believe that the application of such treatments at appropriate horizontal curve locations throughout the state will result in better driver performance and thereby reduce the number of crashes experienced at horizontal curves. The project will contain tasks that:

- Identify the current state-of-the-practice with regard to high-friction surface treatments;
- A crash analysis of horizontal curve characteristics factoring into run-off-the-road crashes;
- Evaluation of current high-friction surface treatments available; and
- Field studies of surface treatment installations at horizontal curves.

Project Director

Victor Vargas, AUS

Project Advisors

Bill Orr, DES
Darren McDaniel, TRF
Ellen Perry, PAR

Research Supervisor

Brooke Ullman, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$318,598	Texas Transportation Institute	$148,600

9-1001 - Traffic Control Device Evaluation Program

Start Date - 09/01/2009 ***End Date*** - 08/31/2013

Abstract

Objective: This project will provide the Texas Department of Transportation a mechanism to quickly and effectively conduct high priority limited scope evaluations of traffic control devices (TCD). The information provided through the project will support the development of TCD related policy, standards, guidelines, handbooks, and training.

The traffic control device issues to be evaluated in this project may represent a new device or technology, a new application of an existing device or technology, or a change in TxDOT practices regarding a traffic control device. The research efforts of this project are specifically oriented to provide results that will lead directly to implementation of results.

Project Director

Michael Chacon, TRF

Project Advisors

Arturo Perez, CST
Carlos Ibarra, ATL
Ismael Soto, CRP
John Gianotti, SAT
Johnnie Miller, CST
Ricardo (Rick) Castaneda, SAT
Roy Wright, ABL
Sylvester Onwas, HOU

Research Supervisor

Paul Carlson, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$800,000	Texas Transportation Institute	$200,000

9-1002-12 - Roadside Safety Device Crash Testing Program

Start Date - 09/01/2011 **End Date** - 08/31/2014

Abstract

Objective: The objective of this research is to identify roadside safety issues and address them through a series of safety evaluations for the benefit of the motoring public.

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 desired level of safety for the motoring public, these safety devices must be designed to accommodate a variety of site conditions, placement locations, and a changing vehicle fleet. As changes are made or in-service problems encountered, there is a need to assess the compliance of existing safety devices with current vehicle testing criteria and, if problems are identified, to modify the device or develop a new device with enhanced performance and maintenance characteristics.

Under this project, roadside safety issues will be identified and prioritized for investigation. The selected safety issues will be evaluated through crash data analyses, engineering analyses, computer simulation, dynamic impact testing, and full-scale vehicular crash testing as appropriate. Factors such as impact performance, maintenance, and cost will be considered. Each roadside safety issue will be addressed with a separate work plan, and the results will be summarized in an individual technical memorandum. Each technical memorandum will include new guidelines or drawings to be incorporated into design manuals and new or revised standard detail sheets, as appropriate.

Project Director

A. Rory Meza, DES

Project Advisors

Chris Hehr, DES
Duane Browning, BMT
John Holt, BRG
Jon Ries, BRG
Michael Chacon, TRF
Vincent Parker, DES

Research Supervisor

Roger Bligh, TTI

Total Project Budget	Research Universities	FY 2012 Budget
$1,500,000	Texas Transportation Institute	$500,000

RMC 5 – Active Projects

Project	Title	Start Date	Page
0-4562	Corrosion Resistance of Grouted Post-Tensioning Systems	9/1/2002	96
0-5722	Lap Splice and Development Length Performance in ASR and/or DEF Damaged Concrete Elements	9/1/2006	97
0-5831	Shear Behavior of Prestressed Concrete U-Beam End Blocks	9/1/2007	98
0-5997	Structural Assessment of "D" Region affected by Premature Concrete Deterioration	9/1/2007	99
0-6152	Shear in High Strength Concrete Bridges	9/1/2008	100
0-6332	Development of Predictive Model for Bridge Deck Cracking and Strength Development	9/1/2008	101
0-6348	Controlling Cracking in Prestressed Concrete Panels and Optimizing Bridge Deck Reinforcing Steel	9/1/2008	102
0-6359	Characterization of Backfill Materials for Prevention of Corrosion of MSE Wall Metallic Earth Reinforcement	9/1/2008	103
0-6374	Effects of New Prestress Loss Predictions on TxDOT Bridges	9/1/2008	104
0-6416	Shear Cracking in Inverted-T Straddle Bents	9/3/2009	105
0-6491	Non-Destructive Evaluation of In-Service Concrete Structures Affected by Alkali-Silica Reaction (ASR) or Delayed Ettringite Formation (DEF)	9/1/2009	106
0-6493	Pullout Resistance of Mechanically Stabilized Earth Reinforcements in Backfills Typically Used in Texas	9/1/2009	107
0-6549	Hydraulic Performance of Staggered-Barrel Culverts for Stream Crossings	10/13/2009	108
0-6564	Improved Cross Frame Details	9/1/2009	109
0-6603	Long-Term Performance of Drilled Shaft Retaining Walls	9/1/2009	110
0-6648	Characterization of Fly Ash	9/1/2010	111
0-6649	Development of Design Guidelines and Mitigation Strategies for Wind-Induced Traffic Signal Structure Vibrations	9/1/2010	112
0-6651	Continuous Prestressed Concrete Girder Bridges	9/1/2010	113
0-6652	Spliced Texas Girder Bridges	9/1/2010	114
0-6653	Hydraulic Performance of Rectangular Deck Drains	9/1/2010	115
0-6654	Empirical Flow Parameter Distributions --- A Tool for Hydraulic Model Validity Assessment	9/1/2010	116

RMC 5 – Active Projects

Project	Title	Start Date	Page
0-6656	ASR Testing: A New Approach to Aggregate Classification and Mix Design Verification	9/1/2010	117
0-6715	Interaction between Drilled Shafts and Mechanically Stabilized Earth (MSE) Walls	9/1/2011	118
0-6716	Design Parameters and Methodology for Mechanically Stabilized Earth (MSE) Walls	9/1/2011	119
0-6717	Investigation of Alternative Supplementary Cementing Materials (SCMs)	9/1/2011	120
0-6718	Strength of Horizontal Shear Reinforcement with Limited Development	9/1/2011	121
0-6719	Strengthening Continuous Steel Girders with Post-Installed Shear Connectors	9/1/2011	122
0-6720	Shear Behavior of Thin Prestressed Slab Beams in Bridges	9/1/2011	123
0-6722	Spread Prestressed Concrete Slab Beams	9/1/2011	124
0-6723	Development of Rapid, Cement-based Repair Materials for Transportation Structures	9/1/2011	125
0-6724	Assessment of the Effects of Regional Channel Stability and Sediment Transport on Roadway Hydraulics Structures	9/1/2011	126
0-6729	Synthesis on Cost Effectiveness of Extradosed Bridges	9/1/2011	127
0-6731	Repair Systems for Deteriorated Bridge Piles	9/1/2011	128

0-4562 - Corrosion Resistance of Grouted Post-Tensioning Systems

Start Date - 09/01/2002 ***End Date*** - 08/31/2013

Abstract

Objective: This project will identify and develop recommendations for implementation of alternate corrosion-resistant post-tensioning systems.

Numerous examples of corrosion in post-tensioning systems and failures of tendons have been observed in Europe and the United States in recent years. Examples have been cited recently in some of Florida's major bridges. The cause of corrosion and accelerated deterioration of post tensioning systems can be traced to several sources, including: incomplete flushing of water prior to the grouting process, incomplete grouting of post-tensioning tendons, excessive bleed water, leaky precast joints, cracking of polyethylene pipe, and poor post-tensioning system details that permit recharge of tendons, to list a few. The first phase of this project will identify oils or other products that will provide temporary corrosion protection in post-tensioned tendons which have not yet been stressed and grouted during the construction process. This first phase of the research will investigate how these oils affect friction losses during post-tensioning, determine the impact that emulsifiable oils have on bond strength of multi-strand tendons, and examine how flexural capacity is affected by the expected loss in bond strength. The second phase of the project will identify post-tensioning systems and materials candidates for alternate corrosion-resistant post-tensioning systems, examine physical and mechanical properties of new materials, identify and evaluate potential accelerated corrosion test methods, plan and implement a series of tests to examine the durability of post-tensioning materials and systems, consider the constructability and behavior of post-tensioning systems incorporating corrosion-resistant materials or details identified through durability testing, and develop recommendations for implementation of alternate corrosion-resistant post-tensioning systems.

Project Director

Brian Merrill, BRG

Project Advisors

Keith Ramsey, BRG

Research Supervisor

John Breen, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$1,170,144	Center for Transportation Research	$55,000

0-5722 - Lap Splice and Development Length Performance in ASR and/or DEF Damaged Concrete Elements

Start Date - 09/01/2006 ***End Date*** - 08/31/2014

Abstract

Objective: This research will assess the influence of ASR/DEF on bond.

Bridge structures in Texas are exhibiting damage from alkali silica reactions (ASR) and delayed ettringite formation (DEF). Significant work has been performed on evaluating the mechanisms of deterioration and methods to slow or stop these mechanisms. However, limited work has been performed to evaluate the implications of this damage on the performance of a structure exhibiting these deteriorating mechanisms. Some work has been performed on bending and shear of reinforced concrete structural members exhibiting damage from ASR and/or DEF. However, very limited work has been performed to assess the influence of ASR and/or DEF on the bond, development length, and lap length. Existing structures encounter significant forces at several locations where bond is critical to the structure performance. Cracking resulting from ASR or DEF can reduce this bond and development length. The research proposed herein is to perform a comprehensive, statistically valid research program that will assess the influence of ASR/DEF on bond. The study will generate sufficient data such that visual inspections can be correlated with structural reliability, and will evaluate various repair strategies such that recommendations can be made when there is a future potential for bond failure.

Project Director

Ricardo Gonzalez, FTW

Project Advisors

Keith Ramsey, BRG

Research Supervisor

Paolo Gardoni, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$1,277,512	Texas Transportation Institute	$14,607

0-5831 - Shear Behavior of Prestressed Concrete U-Beam End Blocks

Start Date - 09/01/2007 ***End Date*** - 08/31/2012

Abstract

Objective: To develop and test a more simplified design of the end regions of U-beams and box beams with various skew angles.

The Texas Department of Transportation (TxDOT) has been a leader in the design of cost effective prestressed concrete bridges for nearly 50 years. During this time, typical spans have increased from 50 to more than 100 ft, intermediate and end diaphragms have been eliminated, and prestressed concrete deck panels have been introduced as stay-in-place formwork for cast-in-place bridge decks. Each of these improvements has increased the speed of construction, reduced the cost of bridge construction in Texas, and demonstrated TxDOT's commitment to incorporating innovative design concepts into practice. A current concern for TxDOT is the simplification of the details used in the end regions of prestressed concrete U-beams and box beams with end blocks. To achieve this goal, two major aspects of the behavior (shear and bursting behavior) of prestressed concrete U-beams and box beams with skewed ends will be studied in a comprehensive manner. The research herein is tailored to:

i. Understand the behavior of the end regions of beams with skewed and non-skewed interior voids with skewed ends at release.

ii. Understand the behavior of the end regions of beams with skewed and non-skewed interior voids with skewed ends under shear loads

iii. Use the understanding gained in items (i) and (ii) to simplify the design of the end regions of U-beams and box beams with various skew angles.

iv. Test the simplified details at release (bursting and spalling study) and under shear loads to ensure satisfactory performance at release, under service loads and over-loads.

It is anticipated that the volume of concrete used in the end regions of box beams and U-beams will be reduced as a result of the testing conducted and understanding gained in this research study. In addition, the reinforcing details in the end blocks will be simplified. These simplifications will expedite the fabrication of U-beams and box beams, reduce cost, and improve durability by reducing curing temperatures within the end blocks and keeping them below the DEF threshold (roughly 160°F). These simplifications will promote the use of U-beams and box beams in more projects.

Project Director

Dean Van Landuyt, BRG

Project Advisors

Amy Eskridge, BRG
Graham Bettis, BRG
John Holt, BRG

Research Supervisor

Oguzhan Bayrak, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$995,691	Center for Transportation Research	$199,912

0-5997 - Structural Assessment of "D" Region affected by Premature Concrete Deterioration

Start Date - 09/01/2007 ***End Date*** - 08/31/2014

Abstract

Objective: The objective of project is to develop guidelines for applying strut-and-tie models to large structural elements subject to varying conditions of premature concrete deterioration.

Recent TxDOT studies (0-1857,0-4069, and 0-5218) have developed techniques for evaluating the extent of structural damage to concrete elements with premature concrete deterioration and for delaying or mitigating such damage. In addition, TxDOT study 0-5722 is developing similar techniques for evaluating the bond performance of critical column splice sections affected by premature concrete deterioration. TxDOT studies 0-4371 and 0-5253 have provided insight into the use of strut-and-tie modeling and results indicate reassurance with respect to many reinforced and prestressed concrete elements commonly used by TxDOT. However, much less assurance exists with respect to large structural elements that are affected by premature concrete deterioration, such as the bents of the San Antonio "Y" (such as Bents H19C and I5C). The safety of such structures can be evaluated using strut-and-tie models suggested either by the configuration of existing cracks, or by the configuration of cracks that form during destructive testing. However, few reliable guidelines currently exist for such evaluations and strut-and-tie provisions of AASHTO LRFD Specifications are based on sound concrete. While premature concrete deterioration reduces the elastic modulus and tensile strength of concrete much more than the compressive strength, it is not clear if these reductions will impact the ultimate strength of such large elements as computed by strut-and-tie modeling and if modification factors can be used to accurately predict their ultimate strength. Using a combination of strut-and-tie modeling and large-scale physical testing, the objective of this research is to develop guidelines for applying strut-and-tie models to large structural elements subject to varying conditions of premature concrete deterioration.

Project Director

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Yuan Zhao, BRG

Research Supervisor

John Mander, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$926,349	Texas Transportation Institute	$14,569

0-6152 - Shear in High Strength Concrete Bridges

Start Date - 09/01/2008 ***End Date*** - 08/31/2012

Abstract

Objective: This research will use Loov's rational approach to study the shear behavior of prestressed girders with high strength concrete, and to develop a set of design recommendations suitable for Texas highway bridges.

Prestressed concrete has become the predominant construction method in highway bridge girders. However, current AASHTO design guidelines for shear are very complicated and inaccurate. Because of their empirical nature, they are difficult to extrapolate to high-strength concrete. This research will use Loov's rational approach to study the shear behavior of prestressed girders with high strength concrete, and to develop a set of design recommendations suitable for Texas highway bridges.

TxDOT project 0-4759 has established a simple and accurate shear design method for prestressed concrete girders by proposing an equation with a new set of Vc and Vs terms. This rational method can be extended for application to high-strength concrete girders. Full-size girders of Type A, Tx46 and Tx62, made of concrete up to 14,000psi, will be tested to investigate their shear behavior and to establish two design provisions: First, a simple formula to determine the maximum shear strength of girders with concrete up to 14,000psi. Second, a design provision to prevent the premature slippage of prestressing strands at end regions. Once these two provisions are established, new AASHTO LRFD provisions can be formulated which unify the shear design of girders for normal-strength and high-strength concrete.

Project Director

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Project Advisors

John Holt, BRG
Kenneth Ozuna, HOU
Nicholas Horiszny, HOU
Yongqian Lin, HOU

Research Supervisor

Yi-Lung Mo, UH

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$999,961	University of Houston	$250,056

0-6332 - Development of Predictive Model for Bridge Deck Cracking and Strength Development

Start Date - 09/01/2008 ***End Date*** - 12/31/2011

Abstract

Objective: The study will develop a bridge deck cracking model that will ultimately be integrated into ConcreteWorks, a suite of software programs developed for TxDOT by this same research team.

In ASCE's 2003 Progress Report, our national infrastructure was given an overall grade of D+ (ASCE, 2003). A few years earlier, a specific evaluation of bridge decks in the United States identified more than 100,000 bridge decks that exhibited early-age transverse cracking (Krauss and Rogalla, 1996). This early-age cracking, typically caused by drying shrinkage (and often coupled with autogenous and thermal shrinkage), can have several detrimental effects on longterm behavior and durability. Cracking can also provide ingress of water that can drive chemical reactions, such as alkali-silica reaction (ASR) and sulfate attack.

Because of the problems associated with cracking observed in bridge decks, and the impact of early-age cracking on long-term performance and durability, it is imperative that bridge decks be constructed with minimal early-age cracking and that exhibit satisfactory long-term performance and durability. To achieve these goals for bridges in the state of Texas, a research team has been assembled that possesses significant expertise and background in cement chemistry, concrete materials and durability, structural performance, computational mechanics (finite difference/element), bridge deck construction and maintenance, monitoring of in-site behavior of field structures, and the development of test methods and specifications aimed at practical implementation by state highway departments. A laboratory- and field based research program will develop a bridge deck cracking model that will ultimately be integrated into ConcreteWorks.

Project Director

Kevin Pruski, BRG

Project Advisors

Andy Naranjo, CST
Hector Garcia, FHWA

Research Supervisor

Kevin Folliard, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$548,500	Center for Transportation Research	$50,000

0-6348 - Controlling Cracking in Prestressed Concrete Panels and Optimizing Bridge Deck Reinforcing Steel

Start Date - 09/01/2008 ***End Date*** - 08/31/2012

Abstract

Objectives: This research will focus on reducing the initial circumferential tensile stresses at release, and thereby reducing the total tensile stresses and the rate of rejected panels. The research on top mat reinforcement is directed towards identifying and quantifying serviceability implications of reducing top mat reinforcement everywhere in a bridge deck except on top of fascia girders and overhangs, and to develop different design alternatives.

The comprehensive work plan is intended to address both precast prestressed concrete deck panels and top mat reinforcement, and their interaction with each other.

Deck Panel Research: About 200,000 square feet of deck panels are rejected every year. In most cases, they are not rejected at prestress transfer, but afterwards, due to cracking parallel to the strands from a combination of tensile stresses from release, handling at the precast yard, and transportation to the job site. The research is focused on reducing the initial circumferential tensile stresses at release, and thereby reducing the total tensile stresses and the rate of rejected panels. The research is not directed towards finding ways of getting cracked panels accepted. At prestress transfer, "tensile rings of concrete" form around the strands as the highly tensioned strands transfer the prestressing force into the concrete. While the concrete is compressed along the strands, the bursting effects are resisted by circumferential tension in concrete. This is particularly critical at the ends of the panels, and over the transfer length due to the complex nature of the stress state there. The proposed experimental research is aimed at proving that the actual prestress losses are less than those typically assumed in design (45 ksi). In this way, the initial prestress and bursting effects can be reduced and the final prestressing force can be kept consistent with the current design calculations. By reducing bursting, the panel rejection rate can be reduced, resulting in a reduction in the average cost of panels.

Top Mat Reinforcement Research: Based on evaluations of test data from prior TxDOT studies, the research team has hypothesized that current top-mat reinforcement based on strength requirements may be reduced everywhere except on top of the fascia girders and in overhangs. The research on top mat reinforcement is directed towards identifying and quantifying serviceability implications of reducing top mat reinforcement everywhere in a bridge deck except on top of fascia girders and overhangs. In addition, to develop different design alternatives, tests will be conducted on the cast-in-place portion of a typical bridge deck to evaluate the structural feasibility of using fiber reinforced concrete, welded wire mesh, and standard reinforcing bars.

Project Director

Manuel (Bernie) Carrasco, BRG

Project Advisors

Graham Bettis, BRG
John Holt, BRG
Kirk Krause, WAC

Research Supervisor

Richard Klingner, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$938,755	Center for Transportation Research	$206,634
	University of Texas at Arlington	$29,963

0-6359 - Characterization of Backfill Materials for Prevention of Corrosion of MSE Wall Metallic Earth Reinforcement

Start Date - 09/01/2008 ***End Date*** - 08/31/2012

Abstract

Objective: This research project will use corrosion techniques that will more adequately assess the degradation of galvanized carbon steel and uncoated carbon steel from a porous backfill, and will develop a two-fold model predicting short-term and long-term corrosion behavior of the MSE strands.

Mechanically Stabilized Earth (MSE) walls have been and are being constructed throughout the State of Texas. These walls are economical to construct and have the potential to exhibit good serviceability over long durations. However, this long-term performance depends on the characteristics of the backfill material. The use of coarser backfill materials raises the question as to the proper method of measuring the electrochemical properties of these backfill materials and establishing the proper threshold values to insure the 75-year wall design life. More specific research is needed in how to measure and assess backfill characteristics and how they influence the corrosion and resulting service life of MSE wall systems. In addition, work is needed to connect more accurately laboratory tests with on-site corrosion behavior or "real-world" performance so as to assess and to repair MSE walls. To address the objectives of this project, a multi-disciplinary team consisting of faculty with expertise in geotechnical engineering, geochemistry and corrosion has been assembled to address the goals of this project.

Project Director

Marcus Galvan, BRG

Project Advisors

Jimmy Si, CST
Miguel (Mike) Arellano, AUS

Research Supervisor

Soheil Nazarian, UTEP

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$490,824	University of Texas at El Paso	$46,000

0-6374 - Effects of New Prestress Loss Predictions on TxDOT Bridges

Start Date - 09/01/2008 ***End Date*** - 08/31/2012

Abstract

Objectives: This project will examine the conservativeness and accuracy of the new prestress loss equations in ASASHTO LRFD.

In the 2005 interim of the AASHTO LRFD Design Specifications, a refined prestress loss procedure was updated based on the recommendations of the NCHRP Report 496. For the most part, the long-term material property equations developed in the NCHRP Report 496 were adopted into the AASHTO Specifications. The new expressions created a substantial amount of curiosity as the new prestress losses appear to be considerably less than the old losses in most cases. The University of Texas researchers have previously looked into these expressions from the perspective of estimating initial cambers of beams fabricated in Texas (elastic shortening loss is the only relevant component.) The initial cambers of 223 prestressed concrete beams fabricated at various fabrication plants in Texas were estimated more accurately with the new NCHRP expressions. This is solely related to the modulus of elasticity expression and local material correction factors used in the NCHRP approach.

The focus of this research is not on camber estimations. The primary focus is on prestress loss estimations. With that in mind, past results can be re-examined to conclude that NCHRP expressions were calibrated for accuracy rather than conservativeness for the purposes of modulus of elasticity. In other words, losses due to elastic shortening can be estimated more accurately (rather than conservatively) by using the NCHRP expressions. While the PI of this project can reach this conclusion based on the 223 data points previously examined by his research team, he can not comment on the long-term loss components associated to shrinkage and creep of concrete and relaxation of strands. This research is tailored to answer those questions. In short, the work outlined in this project is focused to examine the conservativeness and accuracy of the new prestress loss equations in ASASHTO LRFD. This is an important issue as TxDOT beam standards are typically based on the worst-case scenarios. In this particular case, at the time a bridge is designed the origin of the beams, i.e. the fabrication plant, is not known. Bearing that in mind, we want to make sure that the final or effective prestress loss is estimated conservatively, so that beams do not develop flexural cracks due to an insufficient amount of prestress, which is directly linked to the total prestress loss estimate.

Project Director

Alanna Bettis, BRG

Project Advisors

Graham Bettis, BRG
Greg Turco, BRG
John Holt, BRG
Michael Hyzak, BRG
Tim Bradberry, BRG

Research Supervisor

Oguzhan Bayrak, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$787,521	Center for Transportation Research	$249,765

0-6416 - Shear Cracking in Inverted-T Straddle Bents

Start Date - 09/03/2009 ***End Date*** - 08/31/2012

Abstract

Objective: This project will determine the cause of shear cracking in inverted-T straddle bents and develop new design criteria to prevent or minimize such cracking under service loads.

In the state of Texas there are 13 documented inverted tee straddle caps with unexpected web cracking. Such cracks have been observed in Austin, Houston, El Paso, and Waco. Many of the affected inverted tee straddle bent caps are less than eight years old. The primary technical objective of this project is to determine the cause of cracking and to develop new design criteria to prevent or minimize such cracking under service loads. The research includes structural inspection/evaluation of the existing inverted tee straddle caps to determine the causes of diagonal cracking. There will also be extensive laboratory testing of various different straddle cap configurations. The findings of this research project will be used to modify the structural design criteria of straddle caps to ensure the durability and safety of these structures. The repair of shear cracking observed in straddle caps is very costly. Such repairs result in lane closures and inconvenience to travelling public. The findings of this project will be used to minimize the necessity of such costly repairs in the future.

Project Director

Jamie Farris, BRG

Project Advisors

Courtney Holle, BRG
Dean Van Landuyt, BRG
Glenn Yowell, ATL
Mike Stroope, LBB
Nicholas Nemec, BRG
Roger Lopez, HOU

Research Supervisor

Oguzhan Bayrak, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$696,964	Center for Transportation Research	$238,672

0-6491 - Non-Destructive Evaluation of In-Service Concrete Structures Affected by Alkali-Silica Reaction (ASR) or Delayed Ettringite Formation (DEF)

Start Date - 09/01/2009 ***End Date*** - 08/31/2012

Abstract

Objective: This project will evaluate the potential use of non-destructive testing (NDT) to assess structures affected by ASR and/or DEF.

The project involves a variety of NDT-based studies, ranging from small laboratory scale specimens to large-scale structural specimens, to field structures. The work plan seeks to take advantage of synergies between other past and ongoing projects (most funded by TxDOT), and the research team will have the unique opportunity to perform a range of NDT measurements on specimens of varying age, conditions, reinforcement details, etc. It is hoped that the products of this research, coupled with the findings of other TxDOT-funded activities related to ASR and DEF, will aid in the development of an overall protocol to help TxDOT to manage their deteriorating infrastructure.

Project Director

Andy Naranjo, CST

Project Advisors

Brian Merrill, BRG
Dingyi Yang, BRG
Eliza Paul, HOU
Geetha Chandar, BRG
Jefferey Tomkins, BRG
Leon Flournoy, BRG
Paul Rollins, BRG

Research Supervisor

Kevin Folliard, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$997,998	Center for Transportation Research	$213,168
	Texas Transportation Institute	$141,312

0-6493 - Pullout Resistance of Mechanically Stabilized Earth Reinforcements in Backfills Typically Used in Texas

Start Date - 09/01/2009 ***End Date*** - 08/31/2012

Abstract

Objectives: This research study involves a comprehensive and detailed review of the pullout resistance of backfill reinforcements used in MSE walls constructed in Texas and the development of guidelines for implementation of reinforcement details around obstructions.

There are two major thrust areas in the study: (a) evaluation of pullout resistance factors for specific backfill-reinforcement combinations used by TxDOT, and (b) review and testing of typical reinforcement details used to circumvent vertical and horizontal obstructions. The research plan to accomplish the above research objectives relies heavily on a comprehensive, large-scale pullout test program. At the outset, the researchers will collect available information pertaining to pullout resistance and reinforcement detailing around obstructions and document them. Then the researchers will select specific backfill- reinforcement combinations and obstruction reinforcement details to be included in the test program. Once substantial data has been generated through testing, data analysis will begin. New reinforcement pullout resistance factors will be developed for conditions representative of TxDOT construction and the impact on their use in wall design will be evaluated. Data obtained from tests conducted on obstruction details will be used to identify optimum reinforcement configurations to address commonly encountered obstruction situations. Based on these findings guidelines will be developed for implementation of reinforcement details around obstructions. These guidelines will be refined based on review by industry representatives as well as through a field constructability review. Final products will include: a database of pullout resistance, a field guide (field manual) and necessary training material.

Project Director

Marie Fisk, BRG

Project Advisors

John Delphia, BRG
Steve Beard, BRG

Research Supervisor

William (Bill) Lawson, TECHMRT

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$393,374	Center for Multidisciplinary Research in Transportation	$129,380

0-6549 - Hydraulic Performance of Staggered-Barrel Culverts for Stream Crossings

Start Date - 10/13/2009 ***End Date*** - 08/31/2012

Abstract

Objective: The objective of this research project is to develop through literature interpretation, laboratory experimentation, and statistical analysis the knowledge to address the issue of solids accommodation in Texas stream crossings, and develop design guidelines to assist in building multiple barrel systems that mimic the necessary stream behavior to facilitate solids migration, yet still provide the sufficient clear-water hydraulic capacity to meet their transportation infrastructure drainage needs.

Quoting from the research project statement, "Some types of stream crossings exhibit large accumulations of bed sediment both upstream and downstream from the crossing. Over a period of time, the sediment may block the crossing culvert, resulting in reduced flow capacity during frequent events and forcing higher flows to overtop the roadway. In extreme cases, bed materials accumulate to the point that they overtop the crossing requiring emergency maintenance. Less frequently, but resulting in more cost, are cases in which catastrophic failure of the crossing results from hydraulic pressure, sediment transport, or erosion of the crossing. In many cases, past and current standard procedures appear to result in inhibited bedload sediment movement and attendant stream instability that result in long-term problems."

The research team believes that the needed knowledge for developing designs and design guidelines for culvert systems that adequately pass large quantities of solids at such stream crossings will best be obtained through 1) the construction and analysis of a database containing all relevant past work, and 2) through physical modeling of the culvert system in the laboratory. Database development through digital capture of literature data pertaining to significant solids transport will be used to guide both the development of screening tools for identifying problematic stream crossing in-use in Texas and for guidance of the laboratory experiments.

The laboratory study is to examine several configurations of staggered barrel and conventional culverts both in-line with the stream axis and skew to that axis to develop hydraulic charts and relationships that can be used to predict performance. Important to the laboratory study is the determination of what configurations behave in a manner where superposition applies and existing analytical, design, and gaging technologies apply, and what configuration features introduce significant departure from such behavior and will require separate approaches.

The results are envisioned to be an extensively documented report, as well as design guidelines, charts, and equations for such structures.

Project Director

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Project Advisors

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Gregg Freeby, BRG
Heath Bozeman, LBB
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John Wright, PAR
Matthew Wingfield, SJT
Tracy Cain, AMA

Research Supervisor

Theodore Cleveland, TECHMRT

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$580,000	Center for Multidisciplinary Research in Transportation	$30,000
	United States Geological Survey	$30,000
	University of Houston	$17,000

0-6564 - Improved Cross Frame Details

Start Date - 09/01/2009 ***End Date*** - 08/31/2012

Abstract

Objective: The research consists of designing and developing improved details for cross frame systems.

The critical stage for the stability of straight and curved steel I-girder systems generally occurs during placement of the concrete bridge deck. The capacity of the girders is improved by incorporating bracing in the form of cross-frames that restrain twist of the girders. The cutting, fitting, and welding of the cross frame members are very labor intensive. Cross frames are the most expensive component per unit weight on the steel bridge and a significant component of the final cost of the superstructure. Conventional cross frames are usually fabricated using two diagonals and two horizontal struts. The cross frames are typically fabricated from steel angles for the diagonals and either angles, WT, or W-sections for the horizontal struts. The angles are connected along one leg producing eccentric connections that cause bending of the angle and relatively poor structural behavior because of their low bending stiffness. In addition, connection requirements for the intersecting diagonals and top and bottom struts typically necessitate turning over the cross frame during fabrication. Torsional deformations in the girders often result in a tension diagonal and a compression diagonal of the cross frame; however because of the relatively low buckling strength of angles, traditional cross frames are normally designed by conservatively neglecting the compression diagonal thereby relying on a "tension-only" diagonal system cross frame. Better structural behavior and a significant reduction in the handling requirements may be possible if tubular members are used for the cross frame. Since tubular members have a substantial buckling strength, cross frames with a single diagonal member are possible, resulting in fewer connections and a reduction in the handling requirements for the braces. Tubular members will lead to better structural behavior since the connection can be made concentric with the centroid of the symmetric tubular member. The difficulty in utilizing the tubular members is developing a practical connection method for the tubes that is simple and reliable.

The use of tubular sections can lead to significant improvement in the structural behavior and ease of fabrication of these critical bracing elements. The research team has extensive experience at identifying the strength and stiffness requirements of stability bracing systems. This experience will be used to aide in identifying the range of stability design forces that frequently occur in Texas steel bridges. These forces will be used to standardize the tubular member sizes required for stability considerations. Researchers will work with casting manufacturers to develop a practical yet effective connection design and conduct laboratory and computational studies to evaluate the performance of the cross frame system. The use of the improved cross frame details for bracing applications in straight and curved girders will be evaluated and design methodologies will be developed and verified.

Project Director

Michelle Romage-Chambers, AUS

Project Advisors

Dacio Marin, BRG
Estanislado Ybarra, BRG
Jamie Griffin, BRG
Teresa Michalk, CST
Yuan Zhao, BRG

Research Supervisor

Todd Helwig, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$451,912	Center for Transportation Research	$158,396

0-6603 - Long-Term Performance of Drilled Shaft Retaining Walls

Start Date - 09/01/2009 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this project is to provide TxDOT with guidance for the design of drilled shaft retaining walls in expansive clay soils.

The range of assumptions being used today in design practice when dealing with expansive clay soils produces more than factor of two differences in the maximum bending moment in the shaft, which could lead to either excessively costly walls or under-designed walls. The guidance produced from this project will include the following:

1. Design recommendations for the distribution of lateral earth pressures for drilled shaft retaining walls in expansive clay soils, including the magnitude of the earth pressures and the shape of the distribution with depth above and below the cantilever.
2. Design recommendations for how to consider the effects of time and moisture cycles in expansive clay soils on the distribution of lateral earth pressures.
3. Guidelines on how to analyze these walls using software such as LPILE, including assumptions for p-y curves in the foundation soil.

The work plan will involve instrumenting a full-scale drilled shaft retaining wall constructed in an expansive clay soil and monitoring its performance over three years. The wall will be instrumented with Optical Strain Gauges, which are the state-of-the-art in measuring strains in drilled shafts, particularly over a long time duration. These optical strain gauges are not susceptible to zero drift in electronics, to moisture and to changes in temperature, making them far superior to conventional gauges that measure electrical resistance. Inclinometers will be used to measure the deflected shape of the shaft versus time. We will also continuously monitor the moisture content of the soil behind the wall at different depths below the ground surface.

The strain gauge and inclinometer data will be analyzed to estimate the lateral earth pressures applied by the retained soil as a function of depth below the ground surface and time. This analysis will be conducted with LPILE, the state-of-the-art in modeling soil-structure interaction for drilled shaft retaining walls.

In addition to the instrumented wall, we also propose to assess existing drilled shaft retaining walls constructed by TxDOT in expansive clay soils. This assessment will include determining their design basis and documenting available performance information.

An External Advisory Panel of distinguished practicing engineers has been assembled to ensure that the information and design guidance produced from this project are relevant and practical.

Project Director

Dina Dewane, BRG

Project Advisors

Eliza Paul, HOU
John Delphia, BRG
Mark Sturrock, TYL
Steve Beard, BRG

Research Supervisor

Robert Gilbert, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$731,754	Center for Transportation Research	$152,921

0-6648 - Characterization of Fly Ash

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objective: This project will characterize fly ash and relate these findings to key fresh, hardened, and durability properties of concrete, with particular emphasis on alkali silica reaction (ASR) and external sulfate attack.

Fly ash is a by-product material produced from coal-combustion power plants and is one of the most commonly used supplementary cementing materials (SCMs) in the world. Prudent use of fly ash as a replacement for portland cement can have several major technical benefits, including reduced heat of hydration, reduced permeability, and improved resistance to alkali-silica reaction (ASR), sulfate attack, and delayed ettringite formation (DEF). Fly ash also enhances the sustainability of concrete as a building material because for every ton of portland cement replaced by fly ash, CO2 emissions are reduced by approximately 0.9 tons.

Although fly ash can and typically does impart all of the above benefits to concrete, there are several technical and practical issues that still must be addressed. First, all fly ashes are not created equally. The chemical/mineralogical/physical properties can vary significantly from one source to another, based on differences in fuel sources (coal), combustion conditions, and cooling regimes. Furthermore, the fly ash industry is quite dynamic and is rapidly changing due to recently imposed environmental regulations. As such, fly ash produced from a given power plant may be considerably different than fly ash produced from the same plant just a few years ago. Therefore, it is becoming increasingly important to be able to characterize fly ash in a way that best predicts how it will perform in concrete, and this is the primary focus of this project.

The research team has a comprehensive, ambitious program to characterize fly ash and relate these findings to key fresh, hardened, and durability properties of concrete, with particular emphasis on ASR and external sulfate attack. The research team will take advantage of its extensive database of mortars and concretes containing fly ashes from throughout Texas and subjected to a wide range of laboratory and field testing conditions, thereby eliminating the need for initiating new long-term tests under this project. This will allow the team to focus on advanced characterization techniques and to complete this project in two years, as opposed to the longer project durations that are inherent in projects involving durability-related issues.

Project Director

Andy Naranjo, CST

Project Advisors

Brian Merrill, BRG
Clifton (Cliff) Coward, CST
David Fowler, BWD
Edward Morgan, CST
Ryan Barborak, CST

Research Supervisor

Kevin Folliard, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$320,000	Center for Transportation Research	$160,000

0-6649 - Development of Design Guidelines and Mitigation Strategies for Wind-Induced Traffic Signal Structure Vibrations

Start Date - 09/01/2010 ***End Date*** - 08/31/2013

Abstract

Objectives: The research project will develop guidelines for the design, fabrication, and implementation of traffic signal structures, such as limitations on placement and sizes of items placed on signal pole arms, and develop mitigation strategies for reducing or eliminating wind induced vibrations.

It has now been well-documented that mast-arm type structural supports for traffic signals can exhibit large-amplitude vibrations under wind excitation. Such vibrations can result in reduced fatigue life of the arm to pole shaft connection, and are believed to be the cause of many failures of traffic signal structures that have been reported in the state of Texas as well as in other states within the US. Extensive research has been conducted to study the causes of the vibrations and to develop corresponding mitigation strategies. To this date, however, the excitation mechanisms and the vibration characteristics are yet to be fully understood, and countermeasures that are both effective and efficient remain to be successfully developed.

The objectives of this research project are: (1) to further understand the mechanisms of traffic signal structure vibrations and to develop analytical models that enable statistically assessing the failure risk of Texas standard traffic signal structures; (2) to develop guidelines for the design, fabrication, and implementation of traffic signal structures , such as limitations on placement and sizes of items placed on signal pole arms; and 3) to develop mitigation strategies for reducing or eliminating wind induced vibrations.

We will conduct four phases of study to achieve the prescribed objectives. In phase I, we will conduct full-scale field measurements of representative traffic signal structures and wind tunnel tests of sectional models to further understand the excitation mechanisms and the vibration characteristics. In phase II, we will develop analytical models based on understandings from phase I for predicting wind-induced vibration characteristics and estimating fatigue loads of traffic signal structures of various configurations. In phase III, we will develop statistical methodologies for assessment of failure risk by integrating structure-specific vibration characteristics and fatigue capacity with site-specific wind climate data. In phase IV, we will use the combination of analytical simulation and full-scale measurements to develop guidelines for design, fabrication, and implementation of traffic signal structures, as well as to develop, test, and optimize mitigation devices for reducing or eliminating wind-induced vibrations of support structures for traffic signals.

Project Director

Karl Janak, CST

Project Advisors

Jim Yang, BRG
Mark Johnson, TRF
Michael Smith, CST
Tim Bradberry, BRG

Research Supervisor

Delong Zuo, TECHMRT

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$358,472	Center for Multidisciplinary Research in Transportation	$117,823

0-6651 - Continuous Prestressed Concrete Girder Bridges

Start Date - 09/01/2010 ***End Date*** - 08/31/2013

Abstract

Objective: This project will review, evaluate, and recommend details for the design of durable and constructible connections that achieve structural continuity between specific precast, prestressed concrete girder sections.

Aesthetic and economic demands often result in the need for longer spans, fewer columns and minimal bent cap cross sections in bridges. Urban areas often require long-span bridges to cross over major roadways. Although prestressed bridges constructed to have continuous spans have been in service for many years in a number of states, there has been limited verification of the ability of the connection to provide the predicted continuity. As a result, some states, including Texas, design the girders as simple spans for both dead load and live load, neglecting any moment resistance of the connection.

The objectives of this project are to review, evaluate, and recommend details for the design of durable and constructible connections that achieve structural continuity between the specific precast, prestressed concrete girder sections that are used in Texas with a goal of longer span-to-depth ratios and greater economy. This will include consideration of continuity for deck weight, superimposed dead load, and live load. Alternatives include cast-in-place connections between girders over the piers and the use of inflection point and other in-span splices. Other promising approaches will also be investigated. Specifications and continuity details will be recommended, along with evaluation of proposed details through experimental testing.

Project Director

Dacio Marin, BRG

Project Advisors

Geoffrey (Shane) Cunningham, TYL
John Holt, BRG
Kevin Pruski, BRG
Michael Hyzak, BRG
Thomas Stout, BRG

Research Supervisor

Mary Beth Hueste, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$716,551	Texas Transportation Institute	$279,940

0-6652 - Spliced Texas Girder Bridges

Start Date - 09/01/2010 ***End Date*** - 08/31/2014

Abstract

Objective: The findings from this study will be used to support the development of design specifications and standards for spliced girder construction within the State of Texas.

The recent introduction of the TX girder series has sparked tremendous interest in low-cost spliced girder technology within the State of Texas. In anticipation of TxDOT's full-scale implementation efforts, this project will resolve two outstanding issues related to the strength and serviceability of spliced TX girder bridges:

- Shear Performance of Post-Tensioned TX Girders: Large-scale shear tests will provide results relating to the shear performance of TX Girders with post-tensioning ducts. The effects of the duct diameter to web width ratio, duct material, and grout consolidation will be examined. A complementary panel-testing effort will provide a basis for comparison to the current design code approach.
- Detailing of Cast-in-Place Splices: A comprehensive literature review and industry survey will provide an understanding of the design and construction considerations unique to cast-in-place girder splices. Following a review of successful past practices, the best splice details will be evaluated experimentally through splice region testing. Large-scale testing will ensure that conditions necessary for safe efficient force transfer in field-spliced structures are simulated in the laboratory.

Project Director

Greg Turco, BRG

Project Advisors

Alanna Bettis, BRG
Leon Flournoy, BRG
Michael Hyzak, BRG

Research Supervisor

Oguzhan Bayrak, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$999,923	Center for Transportation Research	$249,753

0-6653 - Hydraulic Performance of Rectangular Deck Drains

Start Date - 09/01/2010 ***End Date*** - 08/31/2012

Abstract

Objectives: This project will evaluate whether the adapted slotted drain FHWA method is adequate and accurate to predict the hydraulic performance of the scupper, determine if a correction factor should be applied or a new equation developed, and develop a procedure to allow simulation of the scupper with existing software.

A new type of rectangular deck drain - scupper - has been developed by the TxDOT Bridge Division. An approximation equation developed by FHWA for slotted drains is adapted to model its hydraulic performance. The difference between the two drain widths has been neglected. To better understand and model the hydraulic performance of the scupper, an accurate prediction model is necessary. The objectives of this project are to evaluate whether the adapted slotted drain FHWA method is adequate and accurate to predict the hydraulic performance of the scupper, to determine whether a correction factor should be applied or a new equation development is required, and to develop a procedure to allow simulation of the scupper with existing software such as VisualUrban or WinStorm. A physical modeling study is proposed to confirm the hydraulic performance of rectangular scupper drain based on drain size, number of drains in series, spacing of drains in series, flow rate, cross slope and grade profile.

Project Director

Matthew Jasso, AVN

Project Advisors

Adrian Lopez, CRP
Amy Ronnfeldt, DES
Jaime Villena-Morales, RSC-WEST
James Mercier, DES
Michael Hyzak, BRG
Paul (Siong Z) Wong, ATL

Research Supervisor

Qin Qian, LAMAR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$317,948	Center for Transportation Research	$54,718
	Lamar University	$60,288

0-6654 - Empirical Flow Parameter Distributions --- A Tool for Hydraulic Model Validity Assessment

Start Date - 09/01/2010 ***End Date*** - 08/31/2013

Abstract

Objective: This research will develop an independent way to assess computed velocities (of streamflow measurements) based on prior, authoritative, observational experience.

Water-surface profile modeling assembles models based on generalizations of parameter values from textbooks, professional literature, computer program documentation, and from engineering experience. Stage-discharge relations or measurements of streamflow at or adjacent to the modeling locale are seldom available for use in refining model parameters. In streamflow measurement at least three components are important; depth, width, and velocity. At field scale depth and width are straightforward but the velocity measurement is a significant contributor to overall uncertainty, complicated because a mean section velocity (as reported in a model) requires a spatial integration of the measured velocity field. As a result, modeling efforts by even experienced engineers are assembled and often judged to be valid based entirely on experiences from earlier modeling efforts for hydraulically similar settings.

This situation often leads engineers in good faith to report velocities (needed for assessing forces on bridge piers, and assessing erosion and scour potential) that are unusually large and in some instances absurd.

The results of this research will permit an engineer to rapidly evaluate or review modeling efforts and determine if the modeled results are comparatively common or unusual, with the explicit caveat that unusual results could very well be reliable, but that additional explanation should be expended in these unusual situations. The results of this research (graphs and statistical distributions) will additionally provide an assessment of modeling risk that could be used to balance the cost of additional modeling with the cost of accepting an unusual result for design.

Project Director

Stan Hopfe, AUS

Project Advisors

Amy Ronnfeldt, DES
Jaime Villena-Morales, RSC-WEST
John Delphia, BRG
Jorge Millan, DES
Matthew Wingfield, SJT

Research Supervisor

Theodore Cleveland, TECHMRT

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$519,485	Center for Multidisciplinary Research in Transportation	$45,464
	United States Geological Survey	$75,000
	University of Houston	$36,146
	University of Texas at San Antonio	$34,650

0-6656 - ASR Testing: A New Approach to Aggregate Classification and Mix Design Verification

Start Date - 09/01/2010 ***End Date*** - 08/31/2013

Abstract

Objective: The main objective of this study is to develop a fast, reliable test method to determine aggregate alkali silica reactivity (ASR) with respect to the overall alkalinity of the concrete.

A volumetric expansion measurement device (VEMD) developed at Texas Transportation Institute will aid in this research. The VMED simulates the aggregate-pore solution reaction in concrete and measures free ASR volume expansion over time. This test uses as-received aggregates and occurs over a short period of time (4 days). The expansion-time trend is modeled to determine the rate constant. The rate constants at multiple temperatures are then used to determine activation energy (Ea) based on rate theory. Researchers will determine the Ea of a large number of aggregates and develop an Ea-based aggregate classification system. A relationship between Ea and alkalinity will be developed and will be the basis to determine reactivity at field level of alkalinity and threshold alkalinity. The proposed fast, reliable test method could be used as a replacement for ASTM C 1567 and improve the protection provided under option 8 of item 421. An effective way of tailoring mix design depending on the level of protection needed will be developed based on threshold alkalinity and concrete pore-solution chemistry.

Project Director

Elizabeth (Lisa) Lukefahr, CST

Project Advisors

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Brian Merrill, BRG
Edward Morgan, CST
Jason Dupree, ATL
Ryan Barborak, CST

Research Supervisor

Anol Mukhopadhyay, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$433,823	Texas Transportation Institute	$144,828

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

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this project is to study the interaction between drilled shafts and MSE walls and propose design guidelines.

Due to space constraints, drilled shafts supporting superstructures are often constructed within 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 3 sites and a series of numerical simulations will be performed. The field study will consist of instrumenting two TxDOT sites identified by TxDOT 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 and 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 affects the wall and vice versa. The load on the drilled shaft and the earth pressures to be resisted by the MSE wall will be quantify for each case.

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

Project Director

Dina Dewane, BRG

Project Advisors

Bryan Esmaili-Doki, PAR
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Marcus Galvan, BRG
Sean Yoon, BRG
Taya Retterer, BRG
Michael Steward, ELP

Research Supervisor

Jean-Louis Briaud, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$314,699	Texas Transportation Institute	$130,097
	University of Texas at San Antonio	$33,997

0-6716 - Design Parameters and Methodology for Mechanically Stabilized Earth (MSE) Walls

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this project is to develop recommendations for the update and modification of current TxDOT design parameters and methodologies for mechanically stabilized earth (MSE) walls, and construction practice.

Since its appearance in 1970s, MSE walls have become a majority among all types of retaining walls due to their economics and satisfactory performance. TxDOT has primarily adopted the guidelines published by FHWA and AASHTO for design of MSE walls. However, TxDOT engineers have expressed concerns about both design assumptions and methodology, including soil parameter selection, required factor of safety (FOS), and possible failure modes. Some of the concerns relate to the deviations of TxDOT practice from FHWA/AASHTO guidelines, while others relate to intrinsic assumptions of the guideline. Validation of the assumptions and design methods are needed now since these uncertainties may lead catastrophic failure. This project will examine the assumptions and the analysis methods based on: data collected from TxDOT and other projects, laboratory testing, statistical analyses, back analyses of the historical data, and numerical simulations. The main assumptions to be examined include material parameters used for TxDOT backfills, minimum reinforcement length, and the FOS required for external stability. To validate the MSE walls design method, the bearing capacity analysis method will be evaluated for its rationality and adequacy. The possible modes for compound failure will be checked and an improved method for compound failure analysis will be recommended.

Project Director

Sean Yoon, BRG

Project Advisors

John Delphia, BRG
Dina Deware, BRG
Jon Kilgore, SAT
Marcus Galvan, BRG

Research Supervisor

Charles Aubeny, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$227,436	Texas Transportation Institute	$75,250
	University of Texas at San Antonio	$37,068

0-6717 - Investigation of Alternative Supplementary Cementing Materials (SCMs)

Start Date - 09/01/2011 ***End Date*** - 08/31/2014

Abstract

Objective: This project will identify, screen, and thoroughly test alternative sources of SCMs for use in Texas concrete.

Supplementary cementing materials (SCMs) provide many benefits to concrete mixtures in terms of cost, long-term strength, and durability. Fly ash is the most widely used SCM in Texas. However, the dependence in Texas on fly ash for improving concrete performance is risky because the future availability of this material is questioned. Therefore, it is imperative to identify, screen, and thoroughly test alternative sources of SCMs for use in Texas concrete. There are many potential sources of alternative SCMs in Texas, including natural materials such as zeolites, diatomaceous earth, and calcined clays, and waste materials such as agricultural waste ashes and spent fluid cracking catalysts. In order to implement these materials into concrete mixtures, they must be thoroughly characterized and their performance in concrete mixtures thoroughly tested. The work aims to (1) identifY all low cost, high availability sources of SCMs in Texas, (2) chemically and physically characterize them, (3) rapidly screen them for reactivity and performance, (4) determine optimum dosage amounts based on workability, reactivity/strength, and durability, and (5) test their performance in concrete mixtures. Particular attention will be paid to areas where SCMs traditionally have excellent or poor performance, including setting time, workability, early and long-term strength, drying shrinkage, and resistance to alkali silica reaction and sulfate attack. Because many of the lowest cost and most available materials that possess some pozzolanic reactivity may not meet current ASTM C618 Class N specifications, methods for enhancing their performance will be explored to enable their successful use. Further, because the performance of these materials may be different in concrete mixtures than currently used SCMs, guidelines for incorporating them into concrete mixture designs will be suggested.

Project Director

Andy Naranjo, CST

Project Advisors

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Darlene Goehl, BRY
Kevin Pruski, BRG
Robert Owens, FTW
Terry Paholek, BRY

Research Supervisor

Maria Juenger, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$495,000	Center for Transportation Research	$180,000

0-6718 - Strength of Horizontal Shear Reinforcement with Limited Development

Start Date - 09/01/2011 ***End Date*** - 08/31/2014

Abstract

The objective of this project is to determine if adequate horizontal shear capacity is provided by the 5-inch concrete deck on slab and box beams, despite lack of reinforcement development. Horizontal cracks between the precast beams and the cast-in-place decks were noticed in several TxDOT bridges. Those cracks could be due to stresses induced by shrinkage or shear forces. In any case, this shows that that current TxDOT details might not provide sufficient horizontal shear resistance in those members.

The work plan is to first conduct small scale tests to investigate the three major components of horizontal shear resistance: (1) cohesion and/or aggregate interlock, (2) friction between the crack faces, and (3) dowel action of the reinforcement. A simple bar pullout test will also be used to evaluate the influence of the bend curvature on the bond and slip characteristics of the horizontal shear reinforcement. Alternative details for surface roughness and bar geometries will be investigated. The second phase of this research will be testing several full-scale composite box and slab beams with current and proposed alternative details to investigate the overall composite behaviors that may be overlooked in the small scale tests.

Project Director

Amy Eskridge, BRG

Project Advisors

Andrea Keller, BRG
Geetha Chandar, BRG
Nicholas Nemec, BRG
Peter Ross, HOU

Research Supervisor

Shih-Ho Chao, UTA

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$413,142	University of Texas at Arlington	$115,265

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

Start Date - 09/01/2011 ***End Date*** - 08/31/2015

Abstract

Objective: The objective of this research is to identify ways to econmically strengthen older continuous steel girder bridges using post installed shear connectors.

A number of older bridges in Texas are constructed with floor systems consisting of a noncomposite 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. TxDOT 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 Project 0-4124 to permit the use of postinstalled 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 Director

Yuan Zhao, BRG

Project Advisors

Dingyi Yang, BRG
Jamie Farris, BRG
Manuel Padron, FTW
Michelle Romage-Chambers, AUS
Paul Rollins, BRG

Research Supervisor

Michael Engelhardt, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$854,454	Center for Transportation Research	$184,667

0-6720 - Shear Behavior of Thin Prestressed Slab Beams in Bridges

Start Date - 09/01/2011 ***End Date*** - 08/31/2014

Abstract

Objective: The objective of this project is to develop shear design provisions for thin prestressed slab beams.

A precast prestressed concrete (PPC) slab beam has been recognized as a good alternative to a fully cast-in-place (CIP) reinforced concrete (RC) slab beam in terms of constructability, costeffectiveness, structural performance, and maintenance. Accordingly, TxDOT plans to add an 8 in. thick PPC slab beam up to 30 ft. long to its current 12 in. and 15 in. thick PPC slab beams spanning from 25 ft. to 50 ft. for creek crossing, especially on off-system roadways. There is concern whether the shear provision in current AASHTO LRFD code is cost-effective and safe for one-way PPC slab beams. This research project will conduct the experimental and analytical investigation on the one-way shear behavior of PPC slab beams with respect to; i) shear span-todepth (a/d) ratio, ii) shear reinforcement (none/minimum per code/reduced), iii) concrete strength (normal/high), iv) alternate shear reinforcement (welded wire reinforcement), and v) effect of bearing pad (punching shear). Shear provisions of existing design codes, especially AASHTO LRFD code, will be reevaluated through the experimental approach. Detailed analysis will be carried out to support the experimental observation and enhance the weak archival data encompassing unconsidered parameters. Finally, a rational shear design method will be established for the one-way PPC slab beams.

Project Director

Thomas Stout, BRG

Project Advisors

Michael Carlson, HOU
Victoria McCammon, BRG
Yongqian Lin, HOU

Research Supervisor

Thomas Hsu, UH

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$448,781	University of Houston	$145,786

0-6722 - Spread Prestressed Concrete Slab Beams

Start Date - 09/01/2011 ***End Date*** - 08/31/2014

Abstract

Objective: The objective of this project is to explore the use of slab beams that are spread apart.

TxDOT uses prestressed slab beam bridges for shorter spans, such as stream crossings. These bridges have precast, pretensioned slab beams placed immediately adjacent to one another with a cast-in-place slab made composite with the beams. While these bridges are used extensively, they are more expensive than traditional prestressed I-beam and I-girder structures on a per square foot basis. This modified bridge type could significantly reduce the cost of shorter span bridges, while being easily mass produced, transported and constructed.

The project objectives will be met through a series of tasks. The research team will review the literature and the current state-of-the-practice, and develop preliminary designs to assess the potential of this system. Laboratory and field testing will provide important information on the in-service and ultimate performance of the spread slab beam system. In addition, the AASHTO LRFD approximate live load distribution factors for spread box beams will be reviewed for their applicability to spread slab beams, and new factors will be developed, if appropriate. Finally, the research team will develop design guidelines and examples, along with the final project reports.

Project Director

Mark Steves, BRG

Project Advisors

Jefferey Tomkins, BRG
John Holt, BRG
Manuel Padron, FTW
Rex Costley, PHR
Tommy Abrego, BRG

Research Supervisor

Mary Beth Hueste, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$509,890	Texas Transportation Institute	$163,550

0-6723 - Development of Rapid, Cement-based Repair Materials for Transportation Structures

Start Date - 09/01/2011 ***End Date*** - 08/31/2014

Abstract

Objective: The focus of this research is to evaluate potential approaches (materials, mixture proportions, placement techniques, etc.) and to provide recommendations on the most efficient, economical, and durable repair materials and methodologies.

The state of Texas has been plagued by various durability-related issues in recent years, including deterioration from alkali-silica reaction (ASR), delayed ettringite formation (DEF), corrosion of reinforcing steel, and volume changes (plastic shrinkage, drying shrinkage, thermal effects, etc.), just to name a few. These durability-related issues, coupled with other factors that contribute to reductions in service life (e.g., service loads, defects, etc.), have resulted in the need to repair concrete structures and to do so in a timely, efficient fashion, with minimal disruption to the traveling public. Thus, the need for rapid, cement-based repair materials has emerged, especially in highly-congested urban areas. This project involves a comprehensive laboratory-based program, as well as a significant field component, and the research team will evaluate the key technical characteristics that govern rapid and durable repairs, especially for horizontal applications (e.g., full- or partialdepth bridge deck repairs). A wide range of materials will be evaluated in this project, and key data on fresh, hardened and durability properties will be generated.

Project Director

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Project Advisors

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Leon Flournoy, BRG
Ryan Barborak, CST

Research Supervisor

Kevin Folliard, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$493,500	Center for Transportation Research	$160,000

0-6724 - Assessment of the Effects of Regional Channel Stability and Sediment Transport on Roadway Hydraulics Structures

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this project is to develop analysis procedures for assessing regional channel stability and design guidelines for hydraulic structures that interface with streams.

Water and sediment regimes in rivers evolve all the time. As a result, no stream channel is absolutely stable. Channels evolve at various speeds both vertically (degradation/aggradation) and horizontally (planform migration). They also respond to man-made changes ranging from instream modifications (such as bridges) to watershed changes (such as land use change and urbanization). Design of roadway hydraulic structures should consider their dynamic coupling with the river channels at various geomorphic scales (from local to regional). However, the current practice of using HEC-RAS in TxDOT to calculate local scour around hydraulic structures does not fully consider the effects of regional channel stabilities. The lengthy Federal Highway Administration (FHWA) guidelines on steam instabilities (e.g., HEC-11, 18, 20, and 23 series) are not consulted unless risks are apparent. This project will conduct a comprehensive investigation of the subject and synthesize findings from literature review, survey of existing models, and field observations. Effective analysis procedures and guidelines will be proposed for the design of roadway hydraulic structures in unstable channels in Texas. The results will permit an engineer to rapidly determine whether the regional geomorphic change in a channel could result in reduced safety and how engineering enhancement should be sought.

Project Director

Daniel Richardson, ABL

Project Advisors

Amy Ronnfeldt, DES
Chuck Steed, CHS
James Good, PAR
Jorge Millan, DES
Kathleen Newton, BMT
Matthew Wingfield, SJT

Research Supervisor

Xiaofeng Liu, UTSA

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$248,247	Texas Transportation Institute	$40,000
	University of Houston	$19,823
	University of Texas at San Antonio	$63,535

0-6729 - Synthesis on Cost Effectiveness of Extradosed Bridges

Start Date - 09/01/2011 ***End Date*** - 08/31/2012

Abstract

Objective: The objective of this project is to gather a baseline analysis of the cost effectiveness of extradosed bridges and bridge selection procedures.

An extradosed bridge is a bridge that combines concrete cable stressed girders with a cablestayed bridge design. The unique characteristics of an extradosed bridge is likely to initially cost more than a conventional girder or cable-stayed bridge of the same length, but is also likely to be less expensive to maintain over a long term. A synthesis study examining overall cost effectiveness of choosing an extradosed bridge is therefore needed. This study will summarize the advantages and disadvantages of utilizing extradosed bridges, and methods for cost effectiveness analysis and bridge selection procedures through a comprehensive literature review. Survey and interviews will be conducted to obtain additional information and insights concerning selecting an extradosed bridge. Feasibility of applying methods including life cycle cost analysis (LCCA), Value Engineering (VE) analysis, criteria-based bridge selection approaches in cost effectiveness analysis and bridge selection will then be evaluated through case studies on selected extradosed bridges. The synthesis study will summarize best practices and existing methodologies in determining how and when an extradosed bridge is cost effective and in the best interests of the public.

Project Director

Nicholas Nemec, BRG

Project Advisors

Brian Merrill, BRG
Dean Van Landuyt, BRG
Gregg Freeby, BRG
Paul Cepak, WAC

Research Supervisor

Jiong Hu, TSUSM

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$49,984	Texas State University - San Marcos	$49,984

0-6731 - Repair Systems for Deteriorated Bridge Piles

Start Date - 09/01/2011 ***End Date*** - 10/31/2014

Abstract

Objective: The objective of this research is to develop a durable repair system for deteriorated steel bridge piles that can be implemented without the need for dewatering.

The objective of the research 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-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 proposed 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 longterm monitoring will be conducted at two bridge sites. Based on the research findings, guidelines for the design, construction, and maintenance of the proposed 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 Director

Leon Flournoy, BRG

Project Advisors

Bernie Holder, PAR
Dingyi Yang, BRG
Greg Timmons, FTW
Nicasio Lozano, DAL
Rex Costley, PHR

Research Supervisor

Mina Dawood, UH

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$457,548	Center for Multidisciplinary Research in Transportation	$78,229
	University of Houston	$88,822

RMC P – Active Projects

Project	Title	Start Date	Page
0-6581-CT	TxDOT Administration Research	10/23/2008	130
0-6581-TI	TxDOT Administration Research	10/10/2008	131
0-6672	Intelligent Transportation System (ITS) Strategic Plan	10/25/2010	132
0-6727	Using "Fair Division" Methods for Allocating Transportation Funds	9/1/2011	133
0-6730	Examining Engineering Costs for Development of Highway Projects	12/22/2010	134
0-6733	Evaluation of Generic and Branded Herbicides	5/24/2011	135
0-6734	Center for Transportation and Electricity Convergence (CTEC)	5/31/2011	136
0-6735	Best Practices for TxDOT on Handling Wildfires	6/6/2011	137

0-6581-CT - TxDOT Administration Research

Start Date - 10/23/2008 ***End Date*** - 08/31/2012

Abstract

Objective: This research project will evaluate numerous individual transportation issues and develop findings and/or recommendations based on results. This project has been structured to: 1) respond to transportation research needs that are identified in a manner that necessitates a quick response that does not fit into the normal research program planning cycle, and 2) individual transportation research needs that are not large enough to justify funding as a stand-alone research project, despite the fact that the issue may be an important one.

Project Director

Rick Collins, RTI

Project Advisors

Research Supervisor

Khali Persad, CTR

Total Project Budget	***Research Universities***	***FY 2012 Budget***
$855,000	Center for Transportation Research	$300,000

0-6581-TI - TxDOT Administration Research

Start Date - 10/10/2008 ***End Date*** - 08/31/2012

Abstract

Objective: This research project will evaluate numerous individual transportation issues and develop findings and/or recommendations based on results. This project has been structured to: 1) respond to transportation research needs that are identified in a manner that necessitates a quick response that does not fit into the normal research program planning cycle, and 2) individual transportation research needs that are not large enough to justify funding as a stand-alone research project, despite the fact that the issue may be an important one.

Project Director

Rick Collins, RTI

Project Advisors

Research Supervisor

Josias (Joe) Zietsman, TTI

Total Project Budget	***Research Universities***	***FY 2012 Budget***
$800,000	Texas Transportation Institute	$100,000

0-6672 - Intelligent Transportation System (ITS) Strategic Plan

Start Date - 10/25/2010 ***End Date*** - 08/31/2013

Abstract

The Texas Department of Transportation (TxDOT) is facing unprecedented financial constraints while being asked to maximize the safety and mobility of the existing state transportation system. TxDOT's public agency partners are facing similar constraints delivering transportation services as well. The ability of TxDOT' s partners to support and lead aspects of operating and managing the transportation network varies by region of the state. At the same time, technology and communication are evolving as well as the private sector's ability to deliver data, equipment, and services. Within this environment, TxDOT needs to set a new direction for participating and delivering intelligent transportation systems. Recent efforts to solicit stakeholder input have produced data important to long range decision making, as well as promoting good will with the stakeholders. Strategic planning for ITS-related services has similar strong potential. Through effective listening to key stakeholders, TxDOT will be able to identify the highest priority needs with which stakeholders may be willing to assist, as well as low priority services that all agree can be discontinued. The focus can be directed to critical outcomes, regardless how delivered, rather than on legacy equipment or services that mayor may not actually be beneficial. With the focus on the priority outcomes, TxDOT can then explore alternative approaches to accomplishing the goals. During the course of this project, theTexas Transportation Institute (TTl), will solicit input from key (but not all) stakeholders in each region that currently enjoys any meaningful level of ITS services. To the degree possible, these interviews will be done in small groups, organized to include people with common, not conflicting, interests. TTl will work to build consensus among participating agencies in the production of planning documents for ITS Strategic Solutions.

Project Director

Carol Rawson, TRF

Project Advisors

Brian Fariello, SAT
Charlie Farnham, TRF
David Fink, HOU
Edgar Fino, ELP
Meg Moore, TRF
Natalie Bettger, NCTCOG
Rick Cortez, DAL
Stuart Corder, HOU

Research Supervisor

Edward Seymour, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$1,112,022	Texas Transportation Institute	$555,938

0-6727 - Using "Fair Division" Methods for Allocating Transportation Funds

Start Date - 09/01/2011 ***End Date*** - 08/31/2013

Abstract

Objective: The objective of this project is to investigate fair division algorithms and methods for the allocation of transportation funds and/or resources among competing interests at TxDOT. The project involves identifying critical tier allocation areas and formulating an overall comprehensive model to enhance current allocation decision making processes. Enhanced allocation methods should lead to envy-free, efficient, and equitable distribution of funds and resources.

Project Director

Ron Hagquist, SPM

Project Advisors

John Ibarra, TPP
John Sabala, SPM
Michelle Veale, BRG
Sarah Bagwell, ADM
Teresa Lemons, ADM

Research Supervisor

Carlos Chang Albitres, UTEP

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$187,185	University of Texas at El Paso	$86,561

0-6730 - Examining Engineering Costs for Development of Highway Projects

Start Date - 12/22/2010 ***End Date*** - 12/31/2011

Abstract

The Texas Department of Transportation's (TxDOT) focus is to act in the best interest of the citizens of Texas in every endeavor. TxDOT's administration is actively engaged in determining the appropriate engineering staff levels to conduct the business of the department in the most efficient manner possible while implementing various laws and regulations. TxDOT's administration realizes the valuable role both in-house staff and consultant staff play in the business of the state. Numerous studies, including one conducted by the Comptroller of Public Accounts in response to Rider 57 last session, have examined the question of engineering costs for TxDOT projects internally developed by staff and externally developed by consultants. Despite these numerous studies, the answer to the question of engineering costs remains clouded. This cloud results from several sources including a lack of readily available data, the fact that many projects are developed partially internally and partially externally and a lack of definition on what costs should be included for an complete analyses.

Project Director

Teresa Lemons, ADM

Project Advisors

David Casteel, ADM
Raymond Martinez, AUD

Research Supervisor

Roselyn Morris, TSUSM

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$233,680	Texas State University - San Marcos	$45,818

0-6733 - Evaluation of Generic and Branded Herbicides

Start Date - 05/24/2011 ***End Date*** - 05/31/2012

Abstract

As with other generic brand products in the marketplace, generic herbicides often have a lower initial product cost than their brand-name counterparts. Herbicide formulations are patented for 17 years with proprietary rights for name, formula and production. Once the patent expires, the formula becomes available to anyone that wishes to manufacture or distribute the same formulation as the original. Generic product manufacturers can typically offer much lower prices because they do not have to pay for the initial development, testing and patent fees which makes up the majority of costs associated with agricultural chemicals today. While the purchase price of herbicides is important to TxDOT, it is essential to look at more than just initial costs to determine whether generic or branded products is the best practice. One should consider safety, effectiveness, and application rates/procedures as well as product availability and equipment requirements. This project will focus on three herbicides (Roundup PROMAX, Escort XP and Transline) currently used by TxDOT. The multi-disciplinary research team will conduct a literature review, survey of practice, and costlbenefit analysis to determine whether generic herbicides meet equivalent performance, toxicology, environmental impact, and safety requirements as branded herbicides with significant cost-savings.

Project Director

Dennis Markwardt, MNT

Project Advisors

Brad Haugh, ATL
John Mason, MNT
Walter Hambrick, HOU

Research Supervisor

Jett McFalls, TTI

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$125,815	Texas Transportation Institute	$103,100

0-6734 - Center for Transportation and Electricity Convergence (CTEC)

Start Date - 05/31/2011 ***End Date*** - 08/31/2012

Abstract

The University of Texas at Austin has joined with Texas A&M University and the National Science Foundation to operate the "PHEVIEBVs: Transportation and Electricity Convergence Center (The Center). The Center provides an opportunity for researchers, industry and government agencies to work together to understand how public policy goals for transportation systems may be impacted if a significant plug-in hybrid electric vehicle (PHEV) or electric battery vehicle (EBV) fleet is achieved in the United States.

The Texas Department of Transportation (TxDOT) is providing support for operation of The Center to bring a state department of transportation perspective to the operations of The Center and to the selection of specific research projects for study by The Center.

Project Director
Rick Collins, RTI

Project Advisors
Scott Burford, GSD

Research Supervisor
Randy Machemehl, CTR

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$176,000	Center for Transportation Research	$118,000

0-6735 - Best Practices for TxDOT on Handling Wildfires

Start Date - 06/06/2011 ***End Date*** - 08/31/2012

Abstract

Objective: The proposed research project 0-6735 will document lessons learned for recent wildfire events and study the role of TxDOT in the mitigation, containment and response to wildfires. It will develop a comprehensive protocol to help TxDOT effectively respond to wildfire situations that may occur in the State. This protocol will be presented in the form of "Best Practices" based on information gathered from many sources both from within TxDOT and from agencies outside the Department. This research will also develop a training course lor TxDOT personnel who have to deal with wildlire situations and will conduct four regional training workshops.

Project Director

Darwin Lankford, CHS

Project Advisors

Gilbert Jordan, MNT
Michele Regis, OCC
Richard Schiller, FTW

Research Supervisor

Phillip Nash, TECHMRT

Total Project Budget	*Research Universities*	*FY 2012 Budget*
$114,342	Center for Multidisciplinary Research in Transportation	$64,528

Project Index

Proj #	page	Proj #	page	Proj #	page	Proj #	page
0-4562	96	0-6619	25	0-6675	35	0-6730	134
0-5722	97	0-6620	26	0-6676	36	0-6731	128
0-5831	98	0-6621	27	0-6677	37	0-6733	135
0-5836	7	0-6622	28	0-6679	38	0-6734	136
0-5949	45	0-6623	29	0-6681	39	0-6735	137
0-5997	99	0-6624	49	0-6683	40	9-1001	92
0-6005	8	0-6626	50	0-6686	41	9-1002-12	93
0-6009	9	0-6628	51	0-6687	42		
0-6092	10	0-6629	52	0-6688	59		
0-6132	11	0-6631	53	0-6690-CTR	60		
0-6152	100	0-6634	54	0-6691	61		
0-6255	12	0-6635	55	0-6692	62		
0-6263	46	0-6636	56	0-6693	63		
0-6274	13	0-6638	57	0-6694	64		
0-6332	101	0-6639	70	0-6696	65		
0-6348	102	0-6640	71	0-6698	66		
0-6359	103	0-6641	72	0-6701	67		
0-6374	104	0-6642	73	0-6702	81		
0-6404	47	0-6643	74	0-6703	82		
0-6416	105	0-6644	75	0-6704	83		
0-6444	14	0-6645	76	0-6705	84		
0-6487	48	0-6646	77	0-6706	85		
0-6491	106	0-6647	78	0-6707	86		
0-6493	107	0-6648	111	0-6708	87		
0-6549	108	0-6649	112	0-6711	88		
0-6564	109	0-6651	113	0-6712	89		
0-6581-CT	130	0-6652	114	0-6713	90		
0-6581-TI	131	0-6653	115	0-6714	91		
0-6591	15	0-6654	116	0-6715	118		
0-6603	110	0-6656	117	0-6716	119		
0-6607	16	0-6657	58	0-6717	120		
0-6610	17	0-6658	30	0-6718	121		
0-6611	18	0-6663	31	0-6719	122		
0-6613	19	0-6665	32	0-6720	123		
0-6614	20	0-6669	79	0-6722	124		
0-6615	21	0-6670	80	0-6723	125		
0-6616	22	0-6672	132	0-6724	126		
0-6617	23	0-6673	33	0-6727	133		
0-6618	24	0-6674	34	0-6729	127		

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