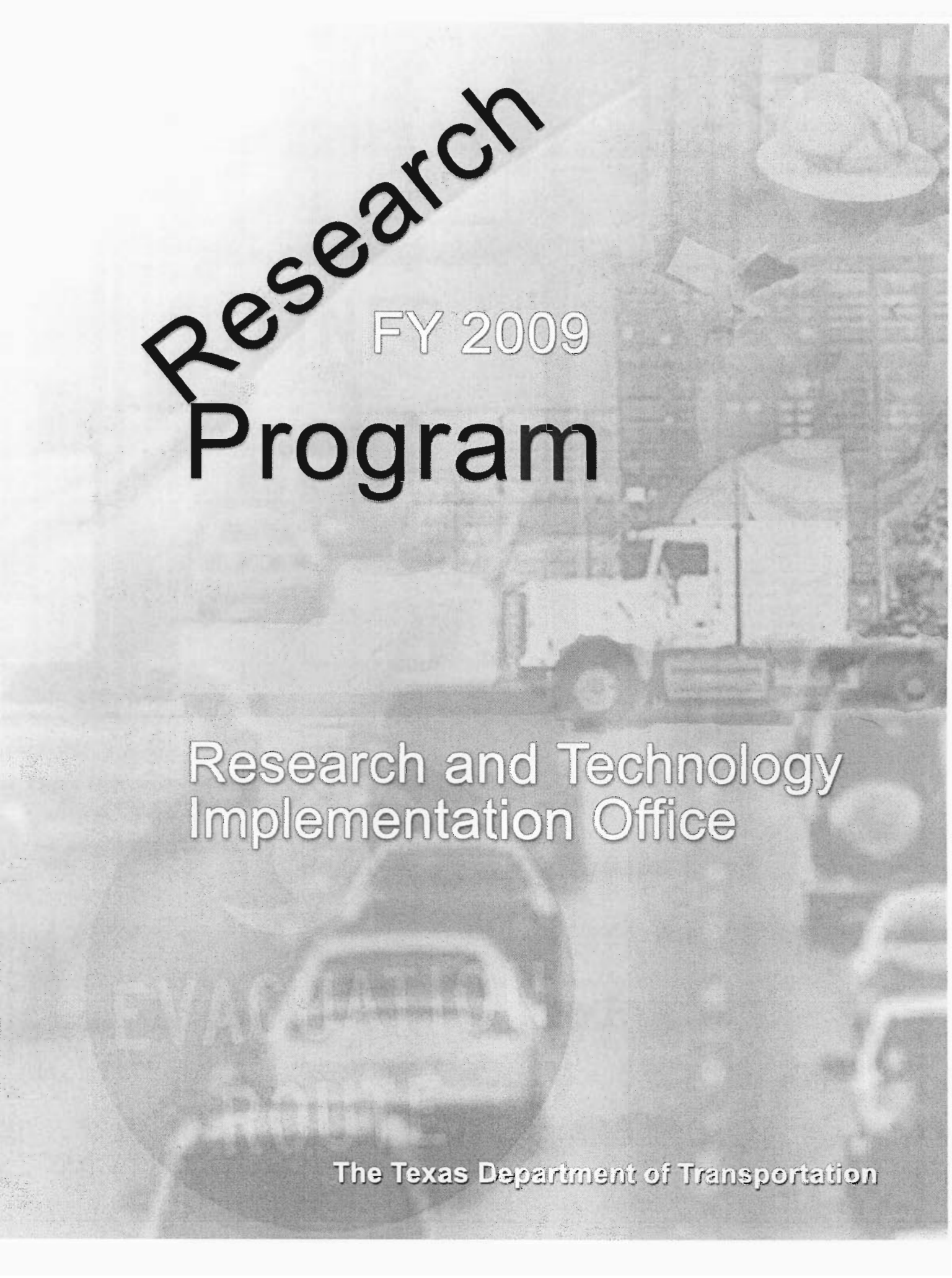
Research Program

FY 2009

Research and Technology Implementation Office



The Texas Department of Transportation

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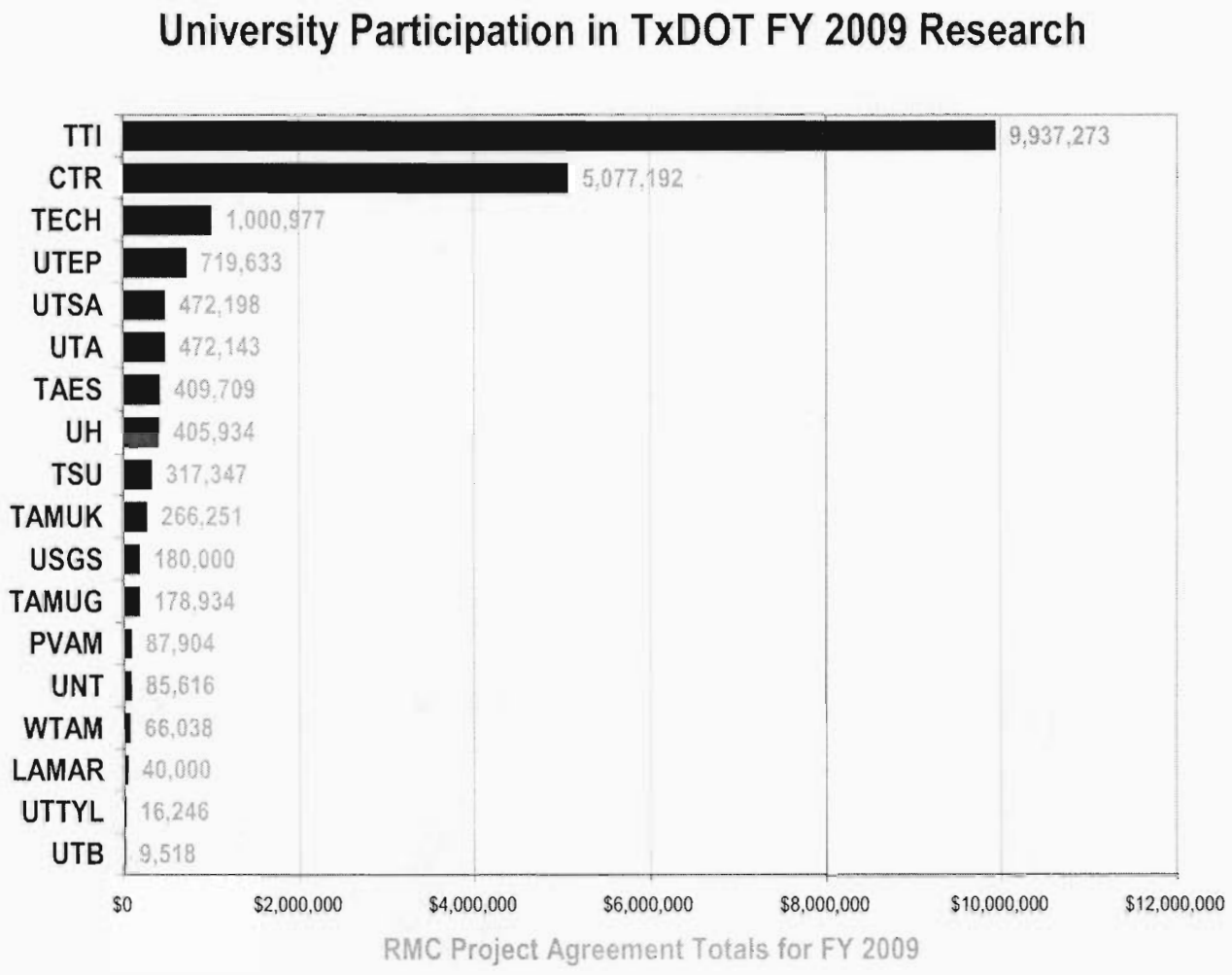
Institutions Active in TxDOT's 2009 Research Program

Acronym	University / Research Institution
CTR	Center for Transportation Research, University of Texas at Austin
LAMAR	Lamar University
PVAM	Prairie View A&M University
TAES	Texas AgriLife Research
TAMUG	Texas A&M University at Galveston
TECHMRT	Center for Multidisciplinary Research in Transportation, Texas Tech University
TSU	Texas Southern University
TSUSM	Texas State University – San Marcos
TTI	Texas Transportation Institute
TAMUK	Texas A&M University – Kingsville
UH	University of Houston
UNT	University of North Texas
USGS	United States Geological Survey
UTA	University of Texas at Arlington
UTB	University of Texas at Brownsville
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 2009 RESEARCH PROGRAM

University Participation

TxDOT's fiscal year 2009 research program consists of 136 projects, with budgets totaling $19.7 million. This work is contracted to seventeen Texas state-supported universities and the United States Geological Survey (USGS). The figure below shows project agreement totals by university / research institution.



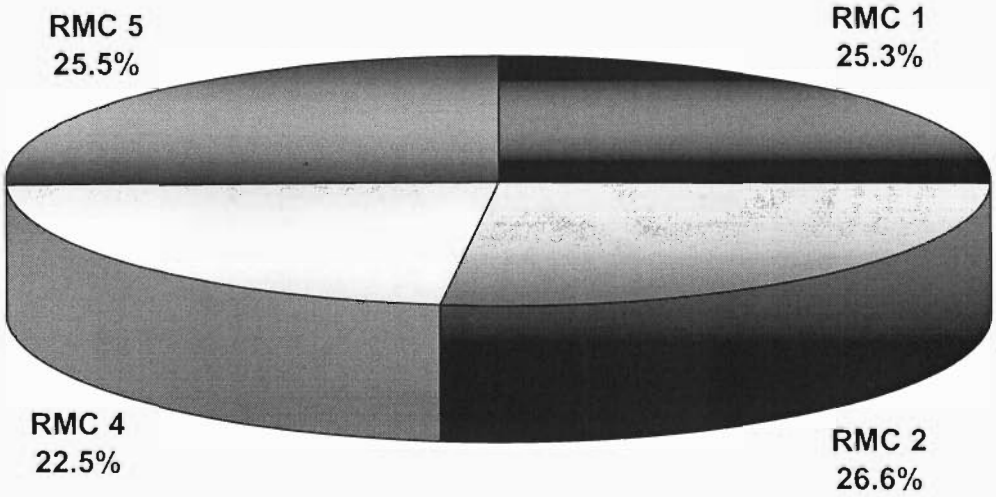
Research Management Committee (RMC) Funding

The table below shows a summary by RMC of the number of continuing and new projects, and total funding, for fiscal year 2009.

RMC	Focus Areas of RMC	Number of Continuing Projects	Number of New Projects	Total Project Funding
1	Construction and Maintenance	17	17	$ 5,004,207
2	Planning and Environment	19	20	$ 5,259,805
4	Safety and Operations	16	16	$ 4,446,277
5	Structures and Hydraulics	20	11	$ 5,032,624
Total		72	64	$ 19,742,913

The figure below shows each RMC's proportion of the total FY 09 program.

Fiscal Year 2009 Program by RMC
Total = $19,742,913



RMC 1 – Active Projects

Project	Title	Start Date	Page
0-4822	Monitor Field Performance of Full-Depth Asphalt Pavements to Validate Design Procedures	9/1/2004	7
0-5270	A Logical Guideline for Superheavy Load Review Policy	9/1/2007	8
0-5549	Horizontal Cracking in Concrete Pavements	9/1/2006	9
0-5566	Strategies to Improve and Preserve Flexible Pavement at Intersections	9/1/2008	10
0-5597	Evaluation of Warm Mix Asphalt New Technology	9/1/2006	11
0-5608	Practical Applications of FTIR to Characterize Paving Materials	9/1/2007	12
0-5627	Aggregate Resistance to Polishing and its Relationship to Skid Resistance	9/1/2006	13
0-5635	Develop Guidelines for Effective Prime Coats	9/1/2007	14
0-5798	Develop Test Procedures to Characterize Material Response Behavior, and Transfer Functions for TxDOT M-E Design	9/1/2006	15
0-5812	Development of Application Guide and Specifications for Geotextiles in Soil and Base	9/1/2007	16
0-5832	Develop Mechanistic/Empirical Design for CRCP	9/1/2007	17
0-5836	Performance of Permeable Friction Course (PFC) Pavements Over Time	9/1/2008	18
0-6004	Develop a Portable Profiler for Maintenance and Construction Applications	12/7/2007	19
0-6005	Developing a Testing Device for Total Pavements Acceptance	9/1/2008	20
0-6009	Evaluation of Binder Aging and its Influence in Aging of Hot Mix Asphalt Concrete	10/2/2007	21
0-6022	Recommendations for Design, Construction, and Maintenance of Bridge Approach Slabs	9/1/2007	22
0-6037	Alternatives to Asphalt Concrete Pavement Subbase for Concrete Pavement	9/1/2007	23
0-6045	Laboratory Evaluation of Influence of Operational Tolerance (Acceptance Criterion) on Performance of HMAC	9/1/2007	24
0-6080	Performance Histories of Thermally Segregated HMA	12/11/2007	25
0-6084	Cement Treated RAP	10/16/2008	26
0-6085	Considerations for Rigid vs. Flexible Pavement Designs When Allowed as Alternate Bids	11/5/2007	27
0-6092	Performance Evaluation and Mix Design for High RAP Mixtures	9/1/2008	28

RMC 1 – Active Projects

Project	Title	Start Date	Page
0-6132	Development and Field Evaluation of the Next Generation of HMA Mix Design Procedures	9/1/2008	29
0-6190	Use of Dowel Bars at Longitudinal Construction Joints	10/1/2008	30
0-6255	Use of Manufactured Sands for Concrete Paving	9/1/2008	31
0-6271	FDR (Full-Depth-Reclamation) Performance-Based Design, Construction and Quality Control	10/16/2008	32
0-6274	Project Level Performance Database for Rigid Pavement in Texas, Phase II	11/14/2008	33
0-6326	Rational Use of Terminal Anchorages in Portland Cement Concrete Pavement	10/1/2008	34
0-6357	Monitoring of Experimental Sections Using a Pavement Database	9/1/2008	35
0-6361	Development of a New Mix Design Method and Specification Requirements for Asphalt Treated Base (Item 292)	9/1/2008	36
0-6362	Rapid Field Detection of Sulfate and Organic Content in Soils	9/1/2008	37
0-6386	Evaluation and Development of Pavement Scores, Performance Models and Needs Estimates	11/7/2008	38
0-6387	Performance Based Roadside Maintenance Specifications	10/28/2008	39
0-6388	Synthesis Study on Innovative Contract Techniques for Routine and Preventive Maintenance Contracts	11/17/2008	40

0-4822 - Monitor Field Performance of Full-Depth Asphalt Pavements to Validate Design Procedures

Start Date - 09/01/2004 **End Date** - 08/31/2009

Abstract

On March 29th, 2001 a memorandum was sent to all District engineers providing guidance on the design of pavements when more than 30 million ESAL's are exceeded. This guidance was developed by the Flexible Pavement Design Task Force whose objective was to develop new asphalt concrete specifications and pavement designs that could meet the demands of heavy truck traffic. A suggested typical section was prescribed similar to the perpetual pavement concept developed by the Asphalt Institute. Thirty-three high truck use routes were listed in the memorandum. When a district proposes to use an asphalt concrete pavement on these routes it is the "expressed intent" of the Task Force to use the SMA / Stone Filled hot mix and suggested typical section. Since publication, three Districts have constructed sections using these pavement concepts. The Waco District constructed a section on IH 35, the Laredo District built a section on IH 35 near Cotulla in Lasalle County, and Fort Worth is currently constructing a section on SH 114. The goal of Study 4822 is to monitor the performance of the existing projects, to test the materials in the field and laboratory and to identify the lessons learned for these initial projects in order to improve future full-depth designs. The purpose of this study is as follows:

1. To validate the full-depth pavement design concept by relating field and laboratory results to pavement performance monitored after construction,
2. To create a database of design parameters for the current FPS design system and the NCHRP 1-37A mechanistic design process and the Asphalt Alliance design methodology, and
3. To use the data collected to verify and enhance TxDOT's design, materials and construction specifications.

Project Director
Joe Leidy, CST

Project Advisors
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Dar Hao Chen, CST
Patrick Downey, SAT
Miles Garrison, ATL

Research Supervisor
Tom Scullion, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$906,370	Texas Transportation Institute	$161,112

0-5270 - A Logical Guideline for Superheavy Load Review Policy

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

In current practice, Texas Department of Transportation (TxDOT) requires a pavement review for superheavy load moves when the gross vehicle weight (GVW) is over 500 kips, or when the tire load exceeds 6 kips. The research project statement noted that recent moves of superheavy loads created damage on fresh seal coats in the Corpus Christi District. The objective of this project is to develop a rational pavement review procedure and routing system for superheavy load moves which takes into account seal coat and other construction activities to prevent rerouting. Researchers plan to incorporate features that evaluate allowable wheel loads or damage per application due to superheavy load moves. This proposed work will include field monitoring to investigate the impact of multiple overweight and superheavy loads traveling over the same route. A recent methodology for triaxial pavement design that includes a comprehensive database of strength parameters and soil water characteristic curves for representative soils found in each of the 254 Texas counties provides a valuable source of information on material properties required to conduct engineering evaluations of proposed superheavy load routes. For this reason, researchers proposed to use this database as a tool in the pavement review procedure to be established from this project. The pavement review procedure shall be demonstrated with pilot tests to characterize superheavy load routes in the Corpus Christi District (and other districts as selected by the Project Monitoring Committee), using TxDOT's integrated FWD-GPR-Video log system to detect problem areas to establish the need for finding alternate routes or further testing.

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Research Supervisor

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Total Project Budget	*Research Universities*	*FY 2009 Budget*
$245,067	Texas Transportation Institute	$117,105

0-5549 - Horizontal Cracking in Concrete Pavements

Start Date - 09/01/2006 **End Date** - 08/31/2009

Abstract

Two major distresses in continuously reinforced concrete pavement (CRCP) in Texas are punchout and spalling. Spalling is a surface distress and rarely presents a structural distress. It is also well understood that spalling has more to do with the coarse aggregate type used in concrete. Therefore, the only structural distress in CRCP is punchout. Punchout is a serious distress in CRCP which needs to be repaired as soon as possible since un-repaired punchout can cause a safety hazard to the traveling public. To address punchout issues, TxDOT made a few changes in the mid-1980's, which included the use of thicker concrete slabs, stabilized subbase (either 6-in cement stabilized base or 4-in asphalt stabilized base) and tied concrete shoulders. These changes have been effective, substantially reducing the frequency of punchout. However, during the full-depth repair of what appears to be punchout, it was observed that there was a different form of punchout, which the above three changes did not appear to alleviate. Further evaluation of this form of distress revealed that this distress is caused by horizontal cracks in concrete at the depth of close to the longitudinal steel (mid-depth of the slab).This distress type was not acknowledged in the AASHO Road Test (CRCP was not included in the Road Test), and has not been well recognized by researchers and practitioners until recently. Neither the current 1993 AASHTO Guide nor proposed Mechanistic-Empirical (ME) Pavement Design Guide address this form of distress. A research study is needed to understand the mechanism of this type of distress, to identify the factors responsible, and to develop guidelines that will mitigate this problem.

Project Director

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Moon Won, TECHMRT

Total Project Budget	Research Universities	FY 2009 Budget
$446,023	Center for Transportation Research	$40,000
	University of North Texas	$35,299
	Center for Multidisciplinary Research in Transportation	$67,749

0-5566 - Strategies to Improve and Preserve Flexible Pavement at Intersections

Start Date - 09/01/2008 ***End Date*** - 08/31/2010

Abstract

Many rural intersections originally constructed with thin untreated flexible base and hot mix or a two-course surface treatment experience severe pushing, shoving and rutting. These failures cause an extremely rough surface that can cause damage to small vehicles and potentially cause motorists to loose control of their vehicle. These distresses almost always result in complete failure of the existing pavement that must be repaired several times during the life of the roadway by maintenance forces. Pavement sections constructed with the same materials adjacent to the intersection perform adequately until the approach (approximately 150 ft in advance) of the intersection and in the intersection itself when the failures become apparent. This project would seek to understand the mechanisms of intersection pavement failures and determine the best practices to minimize the failures at existing intersection pavements. The outcome of this project should help to reduce the frequency of maintenance needed at rural intersections. This project would also determine how the mechanisms causing the surface failures at intersections can be mitigated through design and construction modifications.

Project Director
Tracy Cumby, LBB

Project Advisors
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Research Supervisor
Soheil Nazarian, UTEP

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$275,500	University of Texas at El Paso	$133,000

0-5597 - Evaluation of Warm Mix Asphalt New Technology

Start Date - 09/01/2006 ***End Date*** - 08/31/2009

Abstract

The asphalt paving industry is studying warm mix asphalt (WMA) technology as a method for reducing asphalt mixture placement temperature which could bring several cost, environmental, and performance benefits. This new technology presents several challenges to the current mixture design and construction process. The two goals of this project are to develop a mixture design and analysis method for WMA and to produce construction specifications for these mixtures to ensure adequate performance. Researchers will first conduct a worldwide literature search and survey on WMA mixture design, construction, and performance. Laboratory characterization and field demonstration/evaluation experiments will then be designed and completed to assist in the development of a mixture design process and draft construction specifications. Based on analysis and evaluation of the test results and field evaluations, this project will produce a summary report and two research reports that document the information search, recommended mixture design and analysis method, and construction specifications.

Project Director

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Magdy Mikhail, CST
Miles Garrison, ATL

Research Supervisor

Joe Button, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$310,036	Texas Transportation Institute	$50,000

0-5608 - Practical Applications of FTIR to Characterize Paving Materials

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

Fourier Transform Infrared Spectrophotometry (FTIR) technique offers many attractive attributes for paving materials characterization that has the potential to provide valuable qualitative and quantitative data. Traditionally, FTIR has been utilized on a limited basis in evaluation of deicing compounds, antistrip agents, from quality assurance point of view and quantitative analysis of polymer content in asphalt. Speed and ease of instrument operation, accuracy, reliability, ease of spectra interpretation are among many features that makes FTIR an ideal technique for routine qualitative and quantitative characterization of materials. Possible applications of FTIR to paving materials include cement, paint, thermoplastics, epoxies, sealants, and lime. Practical applications of FTIR in determination of quality and uniformity of anti-stripping additives, curing membranes, epoxy materials, and cement will be investigated. In addition, quantitative analysis of anti-stripping agents in emulsions, cut-backs, and neat binders, as well as polymer content in asphalt binders will be explored. Separate practical protocol for each kind of analysis will be developed for identification and quantification (where applicable) for paving materials constituents. Results obtained by FTIR for a given analysis will be validated using at least one other appropriate techniques of X-ray diffraction, X-ray fluorescence, Scanning Electron Microscopy, Energy Dispersive Spectroscopy, Differential Scanning Calorimetry, etc. Results of this investigation could be directly implemented by fully training CST laboratory personnel on a one to one basis.

Project Director
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Research Supervisor
Seifollah Nasrazadani, UNT

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$99,622	University of North Texas	$50,317

0-5627 - Aggregate Resistance to Polishing and Its Relationship to Skid Resistance

Start Date - 09/01/2006 **End Date** - 08/31/2009

Abstract

TxDOT project 5-1707 developed an effective method to measure aggregate shape, angularity and texture and the changes of these characteristics as a function of polishing time. Research project 0-5627 will relate the results of the new test method developed in 5-1707 for measuring aggregate characteristics to real-life field pavement skid resistance measured using the TxDOT standard method for measuring skid resistance (ASTM E 274, "Standard Test Method for Skid Resistance of Paved Surfaces Using a Full-Scale Tire," at 50 mph using a smooth tire meeting the requirements of ASTM E 524). The work plan for this project will be in two phases.

Phase I:

1. Assist the Geotechnical, Soils and Aggregates Branch of the Construction Division in developing a new aggregate classification system using the following tests, as applicable: Micro-Deval, Aggregate Imaging System (AIMS) test (particle texture and shape), five cycle magnesium sulfate soundness, and acid insoluble residue. The aggregate classification system must render consistent and repeatable results for the same materials and quarries or similar materials.
2. Evaluate the capability of the new aggregate classification to predict skid resistance through the measurement of friction and texture in laboratory specimens.
3. Develop a surface abrasion test that can be used to measure the changes in friction and texture of the laboratory specimens for different aggregate classifications. The abraded specimens should then be measured in friction and macro-texture (as done in step 2) to evaluate if the new aggregate classification (together with gradation) provides good prediction of friction and macro-texture.

Phase II.

1. Develop and execute a factorial experiment of field test sections on in-service roads for different surface mixes and aggregate classification to complete the correlation to the skid trailer data and field texture data.
2. Revise aggregate selection criteria utilized by Wet Weather Accident Reduction Program (WWARP).

Project Director

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Project Advisors

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John Wirth, CST
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Research Supervisor

Eyad Masad, TTI

Total Project Budget	Research Universities	FY 2009 Budget
$364,785	Texas Transportation Institute	$85,917
	University of Texas at El Paso	$30,157

0-5635 - Develop Guidelines for Effective Prime Coats

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

The Texas Department of Transportation is in need of guidelines and draft construction specifications on the construction of prime coats constructed directly on base courses. Information will be gathered from the literature, other state DOTs and other countries. The most important source of information, however, is believed to be within specific personnel of TxDOT. The main objective of this project is to evaluate the effectiveness of prime coats and determine which combinations of methods and materials provide the most benefit. The work plan to meet this objective includes the following tasks.

1. Conduct Information Search
2. Determine Effects of Adhesion of Prime Coats
3. Determine Effect of Prime Coats Methods and Materials on Base Course
4. Develop Guidelines, Draft Specifications, Test Procedures, and Training Materials

Task 1 will identify any effective prime coat materials and techniques that others may have developed and published. Task 2 will focus on determining the impacts of the bond between the surface layer and base course. Task 3 will identify which materials and methods provide the best resistance to the effects of traffic and rainfall. Task 4 will develop guidelines for prime coats in different climatic regions as well as base material and prime coat combinations and provide draft specifications.

Project Director

Paul Montgomery, LFK

Project Advisors

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Caroline Herrera, CST
Glen Dvorak, YKM
Paul Hoelscher, ABL
Dennis R. Cooley, LFK

Research Supervisor

Thomas Freeman, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$261,180	Texas Transportation Institute	$144,800

0-5798 - Develop Test Procedures to Characterize Material Response Behavior, and Transfer Functions for TxDOT M-E Design

Start Date - 09/01/2006 ***End Date*** - 08/31/2009

Abstract

This project will develop the framework for the development and implementation of the next level of MEPDG (Mechanistic-Empirical Pavement Design guide) for TxDOT. As specified in the Project Statement this initial study will focus on the following areas:

1. To identify and evaluate test procedures that characterize material properties needed to predict pavement response,
2. To assemble existing performance prediction models (transfer functions) and evaluate the feasibility of their being implemented in Texas. Key considerations will be the models' performance in basic sensitivity analysis, the practicality of the data input requirements and their performance at simulating results from accelerated pavement testing (APT), and
3. To calibrate the selected transfer functions with available performance data from the Long Term Pavement Performance (LTPP) data bases, various test track studies and whatever performance data is available from the data bases being assembled in Texas.

The current version of the NCHRP's MEPDG guide will "not be implementable for at least 8 - 10 years." However the research team feels that there are several excellent features in the new proposed guide which must form the starting point for any future development effort. In particular, the models proposed for predicting performance are considered to be some of the best available and the Enhanced Integrated Climatic Model (EICM) is "State of the Art" at predicting the impact of seasonal changes on pavement properties. TTI will start by reviewing the models that are proposed in the NCHRP project. We propose to compare and contrast these with those implemented by other DOTs (Caltrans, for example) and other countries (South Africa, Australia, etc). Recommendations will be developed on which models appear to be the most appropriate for implementation in Texas.

Project Director

Joe Leidy, CST

Project Advisors

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Mark McDaniel, CST
Richard Boles-Gracia, LFK
Darrin Grenfell, FHWA

Research Supervisor

Tom Scullion, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$436,801	Texas Transportation Institute	$113,627

0-5812 - Development of Application Guide and Specifications for Geotextiles in Soil and Base

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

Geotextiles, one among the different geosynthetic products, can be used for a number of functions or applications in pavement design. Specifically, woven or nonwoven geotextiles have been used in pavements to fulfill the functions of separation, filtration, drainage, reinforcement, and mitigation of crack propagation. Indeed, geotextiles often perform more than one function simultaneously depending on the type of geotextile and its location within the pavement system. The benefits of using geotextiles in pavements and other transportation applications have triggered a proliferation of products. While this abundance of new products has led to reduction in costs, it has also made it difficult for TxDOT personnel to choose appropriate products based on their engineering properties. As a consequence, opportunities for more cost-effective pavements are probably being missed by not using (or by incorrectly using) geotextiles in pavement construction. In addition, selection of geotextiles in TxDOT is further deterred because the available DMS is not comprehensive enough (it refers to a single function and a single type of geotextiles) and because AASHTO guidelines (AASHTO M288) are reportedly generic in nature. Consequently, a thorough work plan has been prepared in this investigation to address TxDOT's need for properly selecting geotextiles for pavement design. The scope of work for this project has been tailored to develop: (i) guidelines for proper use and selection of geotextiles in pavements, (ii) material specifications for geotextiles in pavement applications, and (iii) draft construction specifications. Furthermore, the Research Team will implement the findings of this research by developing a pilot short course for TxDOT engineers. Overall, this research is expected not only to provide TxDOT with the tools for correct selection of geotextiles, but also with opportunities for education on the benefits of using geotextiles in pavement design.

Project Director

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Project Advisors

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Marcus Galvan, BRG
Paul (Siong Z) Wong, ATL
Pete Stricker, CRP
Miles Garrison, ATL

Research Supervisor

Jorge Zornberg, CTR

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$175,005	Center for Transportation Research	$93,284

0-5832 - Develop Mechanistic/Empirical Design for CRCP

Start Date - 09/01/2007 **End Date** - 08/31/2010

Abstract

At the early days of CRCP usage in Texas, distresses due to structural deficiencies including improper support conditions under the concrete slab were prevalent. Over the years, TxDOT made necessary changes to address the distresses in CRCP. Those changes included the use of thicker slabs, tied concrete shoulders, and non-erodible subbases, which resulted in substantial improvements in CRCP performance. However, these improvements were made with little mechanistic analysis, and further improvements could be made to current TxDOT's CRCP designs. The benefits of mechanistic-empirical (ME) pavement design are well documented in a number of studies. They include reducing early failures of pavements and economic benefits to highway agencies and highway users by lowering facility construction and rehabilitation costs as well as reducing delay time and costs. However, these benefits can only be materialized if the results from the ME pavement design procedure are reasonably accurate. Major efforts have been made to develop ME pavement design procedures under the NCHRP 1-37(A), called MEPDG (mechanistic-empirical pavement design guide), and the procedures developed are the most advanced so far. However, there appear to be a few short-comings in MEPDG for CRCP design that could be further improved. They include prediction models for crack width, load transfer efficiency, punchout, and international roughness index and the lack of spalling prediction model. This study will evaluate the accuracy and reasonableness of those models, identify any deficiencies that need to be improved, and develop or improve the models. For crack width and load transfer efficiency, information from TxDOT's rigid pavement database will be utilized. For punchout prediction model development, field experiments will be conducted with various gages embedded, which include vibrating wire gages, temperature and moisture sensors, and multi-depth deflectometers. For IRI evaluations, TxDOT's PMIS data will be utilized to evaluate whether IRI is a good performance indicator for CRCP design, or there is other performance indicator that could be included. The spalling model developed under previous TxDOT studies will be calibrated with further field data. It is anticipated that models developed in this project will eventually be incorporated into MEPDG; in case it is not feasible to incorporate the new models in MEPDG, a standalone program for TxDOT's use will be developed. It is expected that ME design procedures to be developed in this study will improve the efficiency of TxDOT's funding usage by an optimum utilization of pavement structures.

Project Director

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Project Advisors

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Darlene Goehl, BRY
James (Jim) Mack, CCT
Joe Leidy, CST
Mark McDaniel, CST
Elias Rmeili, BWD

Research Supervisor

Moon Won, TECHMRT

Total Project Budget	Research Universities	FY 2009 Budget
$774,580	Center for Multidisciplinary Research in Transportation	$96,013
	Center for Transportation Research	$60,000
	Texas Transportation Institute	$113,846

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

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

Abstract

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 proposed 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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John Wirth, CST
Mike Shearer, ENV
Bob Daigh, AUS

Research Supervisor

Amy Martin, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$663,214	Center for Transportation Research	$58,729
	Texas Transportation Institute	$100,854

0-6004 - Develop a Portable Profiler for Maintenance and Construction Applications

Start Date - 12/07/2007 ***End Date*** - 08/31/2009

Abstract

The objective of this research is to develop a single path, easy to use, portable profiler that can provide profile data or IRI values. The device should permit the TxDOT operator to mount and remove the portable profiler system to and from the front or rear bumper of the typical TxDOT vehicles for measurements. Profile and IRI computations as well as user interaction will be performed by a program that runs on a conventional notebook PC. The unit will produce data compatible with existing TxDOT formats.

Project Director
Phillip Hempel, CST

Project Advisors
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Magdy Mikhail, CST
Todd Copenhaver, CST
Miles Garrison, ATL

Research Supervisor
Roger Walker, UTA

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$264,577	Texas Transportation Institute	$61,317
	University of Texas at Arlington	$98,751

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

Start Date - 09/01/2008 ***End Date*** - 08/31/2011

Abstract

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 has 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 has 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 proposed 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
Joe Leidy, CST

Project Advisors
Dar Hao Chen, CST
Ed Oshinski, AVN
Michael Lee, LFK

Research Supervisor
Kenneth Stokoe, CTR

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$1,411,570	Center for Transportation Research	$163,000
	Texas Transportation Institute	$79,385

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

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 proposed 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 proposed 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.

Project Director

Jerry Peterson, CST

Project Advisors

KC Evans, ODA

Robert Lee, CST

Research Supervisor

Charles Glover, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$1,278,498	Texas Transportation Institute	$241,999

0-6022 - Recommendations for Design, Construction, and Maintenance of Bridge Approach Slabs

Start Date - 09/01/2007 **End Date** - 08/31/2010

Abstract

Settlement and heave related movements of bridge approach slabs relative to bridge decks create a bump in the roadway. Several problems arise from these bumps, which include poor riding conditions, potential vehicle damage, loss of vehicle control potentially causing injuries or even casualties, lowered perception of the Department's road works, increased maintenance works, and constant delays to rehabilitate the distressed lanes at a cost of $7 million dollars annually to repair them. All these make this bump problem as a major maintenance problem in Texas. Several mitigation methods have been employed and the results are not always satisfactory. Hence, there is an important research need to better understand mitigation technologies and then develop and evaluate technologies to reduce bumps for bridge approaches in Texas. Researchers from UTA and UTEP propose two phases to accomplish the research. The first phase is to compile the available documented information that covers various methods used for approach settlement mitigation technologies along with a few recommendations for new and proven technologies that need to be researched in the field environment. The second and final phase will focus on field evaluation of selected methods in producing approach slabs with no bumps. The final deliverables will include two products summarizing syntheses, available best practices, design and construction specifications of and cost-benefit studies along with a research report summarizing research findings.

Project Director

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Project Advisors

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Jon Holt, HOU
Mark McClelland, BRG
Stanley Yin, HOU
Taya Retterer, BRG
David Head, ELP

Research Supervisor

Anand Puppala, UTA

Total Project Budget	Research Universities	FY 2009 Budget
$502,067	University of Texas at Arlington	$157,216
	University of Texas at El Paso	$50,000

0-6037 - Alternatives to Asphalt Concrete Pavement Subbase for Concrete Pavement

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

Recently, TxDOT has become increasingly aware of the rising cost associated with the use of asphalt concrete bond breakers to meet the FHWA requirement of using a permanently stabilized, non-erodable subbase layer below a concrete slab. The main issue associated with this research project is the possible use and availability of cheaper alternatives for subbase construction while maintaining adequate performance. Subbase layers have certain functions that must be met (one of them being constructability) in order to assure adequate pavement performance. One key requirement of any subbase material will be the resistance to erosion and assessment of different alternatives in this regard (as well as other key functions) will be instrumental to understanding the capability of different alternatives to perform adequately. In addition, this project is to examine the design assumptions associated with the use of each alternative and provide recommendations accordingly to include test methods and material specifications.

Project Director

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Project Advisors

Buddy (Jere) Williams, ATL
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Doug Beer, WFS
Eric Ingamells, SAT
Hua Chen, CST
David Head, ELP

Research Supervisor

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Total Project Budget	*Research Universities*	*FY 2009 Budget*
$285,724	Center for Multidisciplinary Research in Transportation	$8,940
	Center for Transportation Research	$43,680
	Texas Transportation Institute	$93,185

0-6045 - Laboratory Evaluation of Influence of Operational Tolerance (Acceptance Criterion) on Performance of HMAC

Start Date - 09/01/2007 **End Date** - 08/31/2009

Abstract

The performance of flexible pavements relies heavily on the final quality of the hot-mix asphalt concrete (HMAC) as it is laid and compacted in the field. To account for production and construction variability while ensuring the quality of the projects, TxDOT has established a set of relevant requirements and specifications, which are incorporated into the 2004 Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges. In particular, Items 340/341, 342, 344, and 346 provide acceptance criteria for all HMA mixes used by the Department. The operational tolerances for a series of key control variables that affect performance are given as a guideline in QC/QA practices. However, the relationship between these tolerance levels and mixture performance is not well known. This research project will establish these relationships: how the operational tolerances affect the expected performance of the HMAC. Once these relationships are quantified, recommendations will be developed that indicate, if necessary, how the current tolerances should be modified. As a by-product of this process, performance-based pay adjustment factors for in-place air voids will be recommended to the Department. The research will be accomplished by carrying out a comprehensive laboratory experiment on lab-mixed, lab-compacted specimens, which will be tested to estimate their expected rutting and fatigue lives. The proposed plan consists of a factorial experiment design and performance testing. In the experiment design, the main variables recommended in the Specification will be accounted for. These key control variables include (i) gradation, (ii) asphalt content, and (iii) in place air voids. Each factor is characterized at a minimum of three tolerance levels: target level, lower bound, and upper bound, as specified in the operational tolerances. With regard to mixture performance, two indicator tests will be conducted: (i) the overlay test, which identifies mixtures of high cracking resistance; and (ii) the Hamburg Wheel Tracking Device, which identifies mixtures with high rutting resistance and resistance to moisture damage (stripping). These two tests, often referred to as torture tests, are excellent for identifying mixes that will not crack or will not rut: if the mix passes, it is very likely that it will perform. In addition, permeability tests will be performed because it is considered a very important aspect. Finally, through the test results, a statistically-based sensitivity analysis will be conducted to reveal the relationship between different tolerance levels and mixture performance for the individual mixtures types. This research will facilitate, for both TxDOT personnel and contractors, the evaluation of asphalt mixture performance under different tolerance levels, which will be performance-based and supported by a rigorous and sound statistical analysis.

Project Director
Rene Soto, LRD

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Research Supervisor
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Total Project Budget	Research Universities	FY 2009 Budget
$268,668	Center for Transportation Research	$118,855

0-6080 - Performance Histories of Thermally Segregated HMA

Start Date - 12/11/2007 ***End Date*** - 12/31/2010

Abstract

TxDOT is in the process of expanding implementation of the Pave-IR test system for thermal segregation detection on HMA construction projects. Although project 0-4126 found temperature differentials exceeding 25 °F typically indicated non-compliance with TxDOT specifications, no monitoring studies have been conducted on the consequences of these cold spots on long-term pavement performance. Additionally, recently collected thermal profile data reveal locations where the paver stops for extended periods, sometimes exceeding 30 minutes. In these areas the mat cools under the paver and in one instance, burners were left on resulting in hot spots in excess of 425 °F. The fear is that these paver stops may result in other defects such as bumps in the completed mat. The impact of paver stops on pavement properties also needs investigation. This project will document thermally segregated locations on TxDOT projects and track their performance history by identifying suitable test sites, documenting thermal segregation on the project, and monitoring the performance of the projects through time. Additionally one additional Pave-IR unit will be built.

Project Director

Richard Izzo, CST

Project Advisors

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Magdy Mikhail, CST
Stephen Smith, ODA
Elias Rmeili, BWD

Research Supervisor

Tom Scullion, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$272,100	Texas Transportation Institute	$84,893

0-6084 - Cement Treated RAP

Start Date - 10/16/2008 ***End Date*** - 08/31/2010

Abstract

Reclaimed asphalt pavement (RAP) has been used for several decades in hot mix asphalt (HMA) to make use of a valuable resource and reduce material costs. These RAP proportions are too small to absorb the amount of RAP being generated. Currently there is an enormous amount of RAP statewide that can be used for various other purposes such as stabilizing traffic lanes and intersections. RAP processing equipment and procedures have evolved over the years. RAP fractionating, crushing and screening of RAP into several predetermined sizes, allow for more uniform materials.

The use of cement treated RAP may ensure a stable platform that will withstand the traffic loading. With proper design, this process may be an economical and viable solution especially for the districts with little or no economical source of virgin aggregates. TxDOT currently does not provide formal recommendations and specifications for the use of stabilized RAP. Specifications and evaluation of mixes are hence needed to assure that satisfactory performance will result from the use of stabilized RAP mixes.

The purpose of this project is to develop a mix design procedure and guidelines for the construction of stabilized RAP. The procedure will provide proper processes and guidelines for using RAP with proper type and amount of additives considering the nature and source of the RAP, constructability, durability and economical factors. Appropriate processes will also be proposed for the best methods to characterize and evaluate the RAP materials. Performance evaluation methods for the final product will also be developed during the mix design process. The research team will also develop guidelines for field uses of the stabilized RAP and draft specifications for the construction of these materials.

Project Director

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Project Advisors

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Clifton Coward, CST
Richard Izzo, CST
Stanley Yin, HOU

Research Supervisor

Soheil Nazarian, UTEP

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$273,798	University of Texas at Arlington	$30,206
	University of Texas at El Paso	$105,001

0-6085 - Considerations for Rigid vs. Flexible Pavement Designs When Allowed as Alternate Bids

Start Date - 11/05/2007 ***End Date*** - 12/31/2008

Abstract

The objective of this project is to develop a protocol for designing pavement structure alternatives, providing guidelines on when to include alternative pavement designs in the plans, and a protocol for evaluating the competing bids of differing pavement types. User friendly software will also be developed to assist practitioners using the protocol. The protocol will provide the Texas Department of Transportation (TxDOT) with a solid and robust system to modify rigid and flexible pavement designs to produce equivalent designs and to consider the value of alternate bids between rigid and flexible pavements. The scope of the project includes reviewing the state-of-the-practice in methods used for pavement type selection, interviewing TxDOT key personnel with experience in developing pavement structure alternatives, a side-by-side comparison of current TxDOT pavement design methods, developing a protocol for designing pavement structure alternatives, providing guidelines for selecting pavement type, and developing of user-friendly software for pavement type selection analysis.

Project Director
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Project Advisors
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Hua Chen, CST
Lizette Colbert, SAT
Magdy Mikhail, CST

Research Supervisor
Andrew Wimsatt, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$120,000	Texas Transportation Institute	$18,794
	University of Texas at El Paso	$11,745

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

Start Date - 09/01/2008 ***End Date*** - 08/31/2011

Abstract

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 proposal will lay the foundation for addressing all three of these critical factors. The main focus of this proposal will be to address and develop good practices for designing and constructing mixes containing higher than normal RAP contents. 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. These issues will be described in the remainder of this background section and addressed in the proposed work plan.

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 proposes to 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

Robert Lee, CST

Project Advisors

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Darrin Grenfell, FHWA
Feng Hong, CST
Bob Daigh, AUS

Research Supervisor

Fujie Zhou, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$387,975	Texas Transportation Institute	$139,215

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

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 in the Universities or in 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. To address this important study TTI has assembled a team of full time experienced researchers including Tom Scullion and Fujie Zhou who have been active in evaluating and field testing new concepts in mix design for the past 10 years. Dr. Amy Epps will provide support in the areas of evaluating alternative fatigue tests and D.r Samer Dessouky from UTSA will support the further development of mix workability criteria. The team will be supported by the full time certified technician's from TTI's McNew research lab and this project will have access to all of TTI routine and advanced laboratory and field test equipment including X-Ray CT scanner and GPR for field density testing The Accelerated Pavement Testing will be performed on Texas mixes under a cooperative agreement with the LTRC in Louisiana. This will provide the research team with the ability to test our mixes in a similar environment to Texas. The LTRC's accelerated pavement testing program has been running successfully for almost one decade and that experience will ensure that the accelerated testing of our materials will be both successfully and efficiently completed.

Project Director
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Project Advisors
Hector Cantu, LRD
Miles Garrison, ATL
Robert Lee, CST

Research Supervisor
Tom Scullion, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$1,342,768	Texas Transportation Institute	$446,955
	University of Texas at San Antonio	$30,000

0-6190 - Use of Dowel Bars at Longitudinal Construction Joints

Start Date - 10/01/2008 **End Date** - 08/31/2010

Abstract

Tie bars in longitudinal construction joints (LCJs) in Portland cement concrete (PCC) pavement are placed to primarily keep the lanes together and secondarily provide load transfer between lanes or between lanes and tied shoulders. As traffic volumes have increased, the number of lanes tied together has also increased, raising concerns that tying too many lanes might increase the potential for longitudinal cracking. These concerns led to the use of dowels in LCJs. The concern is quite valid, as subgrade drag theory (SGDT) indicates that stresses in concrete in the transverse direction increase with the pavement width. To reduce the potential for longitudinal cracking when a number of lanes are to be tied together, the Houston District of the Texas Department of Transportation (TxDOT) started using dowels at LCJs. However, the decision on when and where to place dowels is made by design engineers without clear guidelines. Normally, LCJs under traffic barriers that separate normal traffic lanes from high occupancy vehicle (HOV) lanes have been the popular choices for dowel placements in lieu of tie bars. Well-researched guidelines on the use of dowels in LCJs based on technically sound engineering principles could improve the efficiency of TxDOT's operation in this area.

The primary objective of this research project is to develop rational guidelines on the use of dowels in LCJs. To achieve the primary objective of this study in a more effective way, detailed field testing needs to be conducted to thoroughly investigate concrete slab behaviors. The results of the field testing along with companion theoretical analysis will provide answers to the following valid questions:

Project Director
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Project Advisors
Abbas Mehdibeigi, DAL
Bill Brudnick, HOU
Hua Chen, CST
Tomas Saenz, ELP
Zheng (Jenny) Li, CST

Research Supervisor
Moon Won, TECHMRT

1) Are dowels needed at LCJ?
2) If they are, what's the maximum number of lanes that could be tied without risking longitudinal cracks?
3) If dowels are used at LCJ, what could be the potential problems and what could be done to address them?

Getting correct answers to the above questions is vital to the success of this research study, even though the third question above is beyond the scope of this project. The guidelines to be developed in this study will provide TxDOT design and construction engineers with an easy-to-use tool to utilize dowels in LCJs effectively. The implementation of guidelines is expected to result in better performing PCC pavement with minimum potential for longitudinal cracks.

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$220,481	Center for Multidisciplinary Research in Transportation	$67,749
	Center for Transportation Research	$41,114

0-6255 - Use of Manufactured Sands for Concrete Paving

Start Date - 09/01/2008 **End Date** - 08/31/2011

Abstract

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 project seeks to find solutions for using MFA for producing good quality paving concrete that has adequate surface friction. The research will:

• 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 TxDOT Districts.

• 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. 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 Advisors

Caroline Herrera, CST
Edward Morgan, CST
Elizabeth (Lisa) Lukefahr, CST
Hua Chen, CST
Ralph Browne, FTW
Rich Schezy, TACA
Ryan Barborak, CST
David Head, ELP

Research Supervisor

David Fowler, CTR

Total Project Budget	Research Universities	FY 2009 Budget
$400,000	Center for Transportation Research	$120,000

0-6271 - FDR (Full-Depth-Reclamation) Performance-Based Design, Construction and Quality Control

Start Date - 10/16/2008 ***End Date*** - 08/31/2010

Abstract

Full-depth reclamation (FDR) is a rehabilitation process showing great potential as an economical rehabilitation alternative that provides deep structural benefit, conserves highway construction raw materials and quickly returns the section to service. The FDR process generally consists of reclaiming the existing structure by pulverizing and mixing the surface and base materials together, applying a stabilizing agent (lime, fly ash, cement, asphalt emulsion, or some combination of these are most common), cutting the stabilizing agent (and moisture) in, then compacting the mixture. Finally, a riding surface is applied. The procedure can be highly cost effective if executed properly. However, lack of comprehensive guidance in the overall design and construction process, including formulating a mixture design of the reclaimed materials, controlling the construction process, performing quality assurance of the in-place product, and bonding the surface layer to the finished base have led to construction delays and poor performance on many projects. The results of Project 0-5223 "Effects of Pulverization on Design Procedures" indicated that construction issues associated with FDR projects widely affected the outcome of FDR and stabilization projects. These issues should be included in the guidelines of this project.

The goal of this project is to develop comprehensive guidelines based on best practices, outcome of previously conducted research, or through recommending new guidelines in the form of a new or modified specification items or control procedures to be implemented through special provisions to existing standard specifications.

Project Director

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Project Advisors

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Martha Gandara, ELP
Miguel Arellano, AUS
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Research Supervisor

Tom Scullion, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$270,050	Texas Transportation Institute	$137,300

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

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

Abstract

The research project statement for 0-6274 "Project Level Performance Database for Rigid Pavements in Texas, Phase II" states that "The main aim of this project is to update the existing database to provide the required information to develop and calibrate TxDOT M-E Design for continuously reinforced concrete pavement (CRCP)." It also states that "The goal of this research is to develop an advanced and user-friendly database to track the performance of typical and special concrete pavements in Texas." Accordingly, 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 wide range of condition 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 described in the 0-6274 research project statement.

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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Project Advisors
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Joe Leidy, CST
Karen VanHooser, TSD
Stacey Young, LBB

Research Supervisor
Moon Won, TECHMRT

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$817,015	Center for Multidisciplinary Research in Transportation	$63,689
	Center for Transportation Research	$89,330

0-6326 - Rational Use of Terminal Anchorages in Portland Cement Concrete Pavement

Start Date - 10/01/2008 ***End Date*** - 08/31/2011

Abstract

It has long been stated that Portland cement concrete (PCC) pavements can grow and push bridge structures, resulting in damages to bridge structures. To protect bridge structures from the expansion of PCC pavements, three terminal systems are currently used in Texas. They are anchor lug, wide-flange, and expansion joint systems. The anchor lug system tries to restrain concrete slab movements, while wide-flange and expansion joint systems allow the concrete slab to move rather freely. From the standpoint of how the slab movements are accommodated, there are two different philosophies. One is to control the expansion of the concrete slab by installing lugs (anchor lug system), and the other is to accommodate the slab movements by providing expansion joints (wide-flange and expansion joint systems). The Texas Department of Transportation (TxDOT) uses all three systems. However, only one statewide design standard exists and it is for anchor lug system; the standard does not provide detailed guidelines on the number of lugs that should be used. For the other two systems, there are no statewide design standards. Rather, some districts have their own design standards for the other two systems and some districts use the design standards other districts developed.

The frequency of distresses near the bridge terminal areas is relatively high compared with that of normal PCC pavements. However, what is not known is whether those distresses are due to the expansion of PCC pavement slabs, or to other distress mechanisms. Extensive field evaluations conducted under the inter-agency contract (IAC) with TxDOT revealed that most of the distresses were due to volume changes or instability in the embankment materials. The measurements made over 7 months under the same IAC indicate quite small slab movements at the end of the pavement, regardless of terminal types used. The magnitude of slab movements is too small to cause damages to bridge structures, including bridge approach slabs. However, the work conducted under the IAC was limited in scope and duration. The objective of this research is to do a more thorough and in-depth study is needed to determine whether thermal expansion of PCC pavement slabs is really causing damages to bridge structures and if it does, which terminal type is most cost-effective. TxDOT is the leader in the use of PCC pavements in the nation, and the findings from this study, if successful, could improve the efficiency of TxDOT operations substantially.

Project Director
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Project Advisors
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Stacey Young, LBB

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Total Project Budget	*Research Universities*	*FY 2009 Budget*
$413,548	Center for Multidisciplinary Research in Transportation	$59,289
	Center for Transportation Research	$52,200
	University of Texas at El Paso	$27,000

0-6357 - Monitoring of Experimental Sections Using a Pavement Database

Start Date - 09/01/2008 **End Date** - 08/31/2010

Abstract

The recently completed TxDOT Project 0-5472 entitled, "A Data Base for Successful Pavement Sections in Texas–Including Both Experimental and Non-Experimental Pavements," developed a database system that stores information on sections that have been deemed as "successful" according to criteria established by a panel of experts comprised of engineers from several TxDOT districts and the Texas Transportation Institute (TTI). The 1-mile minimum pavement sections were defined as "a structure that has met performance expectations over its service life with normally expected levels of maintenance for its age, materials utilized, traffic loads, and local conditions." In terms of performance data, the database only contains PMIS scores: pavement distress score, pavement condition score, and pavement ride score. Additionally, one Ground Penetrating Radar (GPR) survey, one Falling Weight Deflectometer (FWD) test, one Dynamic Cone Penetrometer (DCP) test, and some general laboratory results are included. Regrettably, the database design has a significant limitation: the database and website are designed to allow entry and storage of up to 10 years worth of PMIS performance score information (Krugler et al.., 2007). This means that if new data were to be imported, the older information would be overwritten and lost. This is a particularly serious flaw if the database is to be used to monitor the long-term performance of the sections. There should be no limit to the number of years of performance history allowed into the database because longer time series allow for more robust pavement performance analysis. In Research Report 0-5472-1, the research team actually recommended that sections from the project's database should be uploaded onto the "Texas Flexible Pavement Database" (Krugler et al., 2007). The Texas Flexible Pavement Database (TFPD), recently developed by The University of Texas at Austin (http://pavements.ce.utexas.edu/), has no such limit and is actually better suited to store pavement performance data. The philosophy behind the TFPD has two distinctive characteristics: "open-to-all" and "one-stop shopping." It is open to all because the database is available on the internet where anyone can display, query, and download the data. It is one-stop shopping because all data necessary to carry out pavement performance analysis is in the same database, available at the click of a button. However, the TFPD has an even greater advantage: it is linked to the PMIS, DCIS, and SiteManager databases, making it unique among its kind in the U.S. and worldwide. Additionally, the research team maintains a PC-based version of the database in MS Access, when web access is a limitation. We strongly believe that the TFPD is a superior database to meet the objectives of proposed Project 0-6357. The objectives of Project 0-6357 are to 1) select experimental sections that have the potential for greater impact in Texas, 2) develop and agree upon a data collection plan, 3) perform data collection and data population, 4) recommend a process for analyzing the data, and 5) develop a long-term plan for maintenance and management of the database by TxDOT. This database will also be a fully GIS-based system, thus making it compatible with the latest developments currently being undertaken by the Department.

Project Director
David Head, ELP

Project Advisors
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Richard Williammee, FTW

Research Supervisor
Jorge Prozzi, CTR

Total Project Budget	Research Universities	FY 2009 Budget
$243,416	Center for Transportation Research	$121,000

0-6361 - Development of a New Mix Design Method and Specification Requirements for Asphalt Treated Base (Item 292)

Start Date - 09/01/2008 ***End Date*** - 08/31/2010

Abstract

The asphalt stabilized bases in Texas are usually designed and constructed as per Item 292, "Asphalt Treatment (Plant Mixed)," of the 2004 Standard Specification book. This specification is a hybrid of base and hot mix asphalt concrete procedures and requirements, which are sometimes incompatible. Some districts have started using Tex-204-F, Part III, 'Mix Design for Large Stone Mixtures Using the Superpave Gyratory Compactor." However, this procedure was originally developed to design Type A and Type B hot mix at 96% density and produce a 6 x 4 ½ in. specimen molded to either 100 gyrations or as shown on the plans. Under Item 292, the unconfined compressive strength of the mix (as per Tex-126-E) is used to assess the quality of the mix. Under Tex-204-F, the specimens are not the appropriate size for this type of testing. As such, the quality of the mix is assessed with the indirect tensile strength. A new mix design procedure is needed for this type of material that can use standard equipment such as the Superpave Gyratory Compactor (SGC) to mold the mix design specimens. In this project, we propose to evaluate Item 292 and to improve the laboratory design protocols for this type of bases. In addition, we will concentrate on the practical issues of the construction including the quality control and quality assurance and what test should be used to control the quality in the field. To that end, we will also evaluate the applicability of Tex-227-F, "Theoretical Maximum Specific Gravity of Bituminous Mixtures," (Rice specific gravity) and Tex-207-F, "Determining Density of Bituminous Mixtures" for this type of materials.

Project Director

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Project Advisors

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Total Project Budget	*Research Universities*	*FY 2009 Budget*
$237,000	University of Texas at El Paso	$117,000

0-6362 - Rapid Field Detection of Sulfate and Organic Content in Soils

Start Date - 09/01/2008 ***End Date*** - 08/31/2010

Abstract

In recent years, the Texas DOT has experienced problems stabilizing subgrade soils with calcium-based additives (lime/cement). The problems often surface shortly after the road has been constructed making repairs costly. Many of these problems have been attributed to sulfate minerals in the soil or high concentrations of organic matter. These deposits can be unpredictable and are often restricted to small areas. TxDOT has test methods to measure these soil constituents, but they are taken at different intervals on the roadway. Since the deleterious deposits can be restricted to small areas, conventional tests may not sample from the problem areas and therefore not detect a problem with the soil. What is needed is a non-destructive test that can continuously gather data on a road and identify potentially problematic soils (sulfates over 3000 ppm and/or organics over one percent) on the fly. Samples can then be collected in potential problem areas for detailed laboratory analysis to determine if a problem exists and the best remediation technique in the problematic areas. By applying the work plan outlined on the following pages, the researchers hope to develop one or more NDT systems to identify potential sulfate and organic problem areas on the fly.

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Research Supervisor
John (Pat) Harris, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$221,911	Texas Transportation Institute	$109,282

0-6386 - Evaluation and Development of Pavement Scores, Performance Models and Needs Estimates

Start Date - 11/07/2008 **End Date** - 08/31/2011

Abstract

TxDOT's current pavement management Information System (PMIS) calculates a pavement score from 0 to 100 for every roadway in Texas. The overall Pavement score is computed using both a Condition score which is based on surface distress and a Ride score based on pavement roughness. These scores are weighted for pavement traffic, posted speed and environment. Over the past decade the final pavement score has become an increasingly important factor for both performance monitoring and fund allocation. Most Districts are using the pavement scores and associated color coded maps to plan their future rehabilitation and maintenance programs. There is a need to evaluate how road condition scores are calculated. With the growing importance of the PMIS pavement score there is an urgent need to review and update the current system.

The objective of this ambitious project is to develop improvements to the Texas Pavement Management Information System (PMIS) to meet the evolving needs of TxDOT. These improvements include reviews of current practices and pavement maintenance and repair assignments, prioritization, new pavement performance models and condition prediction procedures, decision trees, and improvements to budgeting and impact analysis scenarios.

Project Director

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Project Advisors

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Stephen Smith, ODA
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Research Supervisor

Andrew Wimsatt, TTI

Total Project Budget	Research Universities	FY 2009 Budget
$768,716	Texas Transportation Institute	$116,260
	University of Texas at El Paso	$55,464
	University of Texas at San Antonio	$66,739

0-6387 - Performance Based Roadside Maintenance Specifications

Start Date - 10/28/2008 ***End Date*** - 08/31/2010

Abstract

To better serve its customers, preserve and improve the value of its roadside assets, and optimize the use of its resources, the Texas Department of Transportation (TxDOT) is investigating the use of performance-based specifications and contracts in roadside maintenance. Under performance-based specifications, the highway agency does not specify any method or material requirements. Instead, it specifies measurable performance targets and outcomes that the maintenance contractor is required to meet or exceed within a certain timeframe. The objectives of this study are to 1) summarize best practices in performance-based contracting for roadside maintenance, 2) determine the optimum scope for this type of contract (asset types, maintenance activities, etc.), 3) develop methods for assessing the initial qualifications and continuing performance of contractors, 4) develop feasible and reasonable oversight methods for potential use by TxDOT, and 5) prepare performance-based roadside maintenance specifications for potential use by TxDOT. These objectives will be accomplished through a practical work plan that consists of five tasks: 1) identify and summarize best practices, 2) define feasible scope and performance requirements for the specifications, 3) develop draft performance-based specifications for roadside maintenance, 4) conduct field trials to test and revise the draft specifications, and 5) close out the research project.

Project Director

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Project Advisors

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Karen Clary, ENV
Randy Anderson, ROW

Research Supervisor

Nasir Gharaibeh, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$285,784	Texas Transportation Institute	$121,802
	University of Texas at Tyler	$16,246

0-6388 - Synthesis Study on Innovative Contract Techniques for Routine and Preventive Maintenance Contracts

Start Date - 11/17/2008 ***End Date*** - 12/31/2009

Abstract

In the past decade, the Federal Highway Administration challenged state highway agencies to focus on preserving and maintaining our existing highway system to prevent deterioration of a critical national asset. To achieve this goal, many states have shifted to greater outsourcing to augment their in-house personnel, bringing together in-house and contract staff to maximize cost, quality, expertise, and efficiency. However, while many reports suggest that contracting out maintenance services has generally been successful and cost-beneficial, there are some indications that not all efforts have been successful because outsourcing goals and agency needs have not been aligned with the appropriate contracting strategy.

Several districts within TxDOT have contracted out a significant portion of their maintenance activities because they do not have sufficient personnel to complete the work in-house. This lack of personnel has created voids in expertise that make outsourcing especially important so that maintenance tasks can be completed efficiently. Consequently, TxDOT may be faced with a need to expand their maintenance contracted services, and, as a result, they have a need to investigate efficient contracting strategies - beyond their current method - that might be implemented to help them achieve their maintenance goals. Previous studies have presented conflicting results about the effectiveness of innovative contracting strategies, creating confusion about the factors that contribute to success or how to align maintenance outsourcing goals with an appropriate contracting strategy. Therefore, this research will: (1) objectively evaluate innovative contracting strategies used by other states; (2) objectively evaluate the effectiveness of TxDOT's maintenance contracting strategies; (3) compare the innovative strategies used in other states to TxDOT's current methods, needs, and goals; and, (4) provide a decision method for selecting and implementing those innovative contracting strategies that may be appropriate for implementation by TxDOT to help them achieve their maintenance goals.

Project Director

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Research Supervisor

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Total Project Budget	*Research Universities*	*FY 2009 Budget*
$81,388	Center for Transportation Research	$69,092

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0-4570 - The South Texas Native Plant Restoration Project

Start Date - 05/15/2002 **End Date** - 08/31/2011

Abstract

The goal of the project is the development of adaptable and successful native seed mixes viable to South Texas that will be made available for commercial growers to supply the growing demand for native seed by public and private land managers and the development of effective planting strategies and revegetation techniques for this area of the state.

Project Director

Dennis Markwardt, MNT

Project Advisors

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Steve Prather, MNT
Barrie Cogburn, DES

Research Supervisor

Paula Maywald, TAMUK

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$1,288,819	Texas A&M University – Kingsville	$150,000

0-5200 - Transport Spill Containment for Texas Highways

Start Date - 09/01/2006 **End Date** - 08/31/2009

Abstract

Substantial amounts of hazardous materials are transported over Texas highways. Given the number of transport vehicles traversing the highways, a finite risk of a vehicular crash and subsequent release of hazardous materials exists. One of the tasks of first responders to a vehicular crash involving a transport vehicle is to determine if hazardous materials are present, and if so, to request personnel with specific training to take measures to prevent migration of spilled materials into sensitive receiving waters. The construction of spill containment structures is one approach to mitigating transport spills. Such structures could be installed as part of new construction or as a retrofit for existing locations. Guidelines are needed for the selection and design of appropriate structures. Marler and others (2005) conclude that structures designed for stormwater pollution prevention would likely be overwhelmed by a transport spill because of the volume of materials carried by the typical transport vehicle. Clearly additional research is needed to review existing design guidance from other agencies (if they exist) and develop design guidance for Texas-specific applications. The intent of this project is to develop such resources.

Project Director

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Stan Hopfe, DES
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Audra Morse, TECHMRT

Total Project Budget	Research Universities	FY 2009 Budget
$203,729	Center for Multidisciplinary Research in Transportation	$91,324

0-5220 - Investigation of Stormwater Quality Improvements Utilizing Permeable Pavement and/or the Porous Friction Course (PFC)

Start Date - 09/01/2006 **End Date** - 08/31/2009

Abstract

Preliminary monitoring of runoff from a section of a highway in the Austin area with a Permeable Friction Course (PFC) overlay indicates that, in addition to recognized safety benefits, PFC substantially reduces the concentration of many pollutants in stormwater runoff. The observed reduction in pollutants may allow TxDOT to incorporate stormwater treatment into the pavement itself, rather than constructing and maintaining the expensive structural treatment controls now used. To promote the use of PFC for this purpose, two parallel and complementary research tracks are underway. The objective of the first track is to document the water quality benefits associated with the use of PFC. Continued monitoring of the initial site and addition of a second site to provide confirmation will provide additional documentation of the water quality benefits. Data from a second site that could be outfitted with a flow meter and automatic sampler would also provide information on the effect of this highway surface type on the quantity and rate of stormwater runoff. The second research track involves characterization of the hydraulic properties of PFC. This track includes permeability and porosity testing of samples from existing installations. These tests will document the hydraulic properties and help determine the rate at which the pavement becomes clogged. Knowledge of these hydraulic properties in both the horizontal and vertical directions will allow the development of a model similar to those used for groundwater flow to predict the movement of runoff within the pavement itself. This information is useful in that the effect of cross slope, highway width, curves, and superelevation on flow within the pavement can be evaluated. This information will be useful for supporting the development of guidelines for the appropriate use of PFC. A final consideration in this research is the relative cost of PFC versus other paving options. The cost of PFC is normally considered to be somewhat higher than that of conventional hot mix asphalt. This comparison might be misleading if the PFC surfaced roadway would not have to include the structural Best Management Practices (BMP)s now constructed for conventional highways in the Edwards Aquifer recharge zone and other areas of the state. Consequently, an additional objective is a valid cost comparison that includes all elements of the highway project including design life, structural controls (and their maintenance), right-of-way requirements, and alternate paving materials.

Project Director
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James Williams, AUS
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Research Supervisor
Michael Barrett, CTR

Total Project Budget	Research Universities	FY 2009 Budget
$579,517	Center for Transportation Research	$194,448

0-5226 - Evaluation of Texas Native Grasses for TxDOT Right of Ways

Start Date - 09/01/2005 ***End Date*** - 12/31/2008

Abstract

Researchers at Texas A&M University-Kingsville, in conjunction with the Kika de la Garza Plant Materials Center, will evaluate hooded windmillgrass and shortspike windmillgrass to quantify the time and effectiveness of these native grasses to germinate, establish, and provide 70% land coverage on TxDOT right-of-ways with various soil textures. This study will also quantify and document the performance of these grasses under mowing regimes typical on TxDOT right-of-ways. This evaluation should provide the data necessary for replacing introduced plant species with native grasses in TxDOT specifications. It also should provide the necessary information for the seed commercialization of these two species and the subsequent release to the general public.

Project Director

Dennis Markwardt, MNT

Project Advisors

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Robert Watts, ODA
Steve Orchard, CRP
Barrie Cogburn, DES

Research Supervisor

Timothy Fulbright, TAMUK

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$156,306	Texas A&M University – Kingsville	$5,884

0-5335 - Guidance on Mitigating the Impacts of Large Distribution Centers on Texas Highways

Start Date - 09/01/2007 ***End Date*** - 12/31/2008

Abstract

Numerous distribution centers (DCs) have been built in Texas over the past 20 years. They serve retail, grocery, oil, motor vehicle, manufacturer, and other types of business. These DCs vary in size and truck traffic. Depending on the type of DC and roads providing access, a DC will have some level of traffic operations, safety, and pavement wear impact on those roads.

DC site selection often involves the DC owner/operator/developer negotiating with local agencies, including economic development corporations, to identify potential sites and obtain the best incentives. TxDOT is typically brought into the process very late and then must accommodate local agency and DC owner requests without having prior input.

This project will assess and provide TxDOT tools and guidelines to analyze the impacts of DCs on state highways as well as strategies and tools for gaining early collaboration with DC owners and local agencies in planning and engineering the DCs and their access and funding improvements to state highways. This project will analyze the obstacles resulting in TxDOT not being involved earlier in the DC site selection process. Research products will include a handbook, expanded and streamlined traffic impact analysis process and checklist, and updates to appropriate TxDOT manuals.

Project Director

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Project Advisors

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Mark Wooldridge, YKM
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Maria Burke, DES

Research Supervisor

Brian Bochner, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$249,646	Texas Transportation Institute	$68,266

0-5534 - Asset Management - Texas Style

Start Date - 09/01/2005 ***End Date*** - 08/31/2009

Abstract

The objective of this project is to advance asset management practices in conjunction with, and for, the Texas Department of Transportation (TxDOT). The Asset Management approach to be developed will be aligned to TxDOT goals and policies. The primary objective of phase one of this project will be to explore advantageous applications of simulation, optimization, and decision analysis methodologies to support TxDOT asset management. The specific focus area for phase one will be resource allocation decisions regarding advanced acquisition of right-of way (ROW). The scope of the project includes reviewing current information management and decision support systems inside and outside of TxDOT, conducting organizational analysis interviews with key administrators and managers within TxDOT, developing and refining approaches for creating state-of-the-practice asset management methodologies for TxDOT. The objective of phase two of this project is to develop a decision-support tool to assist TxDOT in determining when expediting acquisition of right-of-way (ROW) parcels is warranted.

Project Director

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Project Advisors

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Terri Evans, ROW
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Mary Meyland, TYL

Research Supervisor

Paul Krugler, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$661,868	Texas Transportation Institute	$107,920
	University of Texas at El Paso	$35,000

0-5711 - Improving Quality and Accuracy in Select Travel Surveys

Start Date - 09/01/2006 ***End Date*** - 08/31/2009

Abstract

The Texas Department of Transportation (TxDOT) has a comprehensive on-going travel survey program. This research examines areas within two select travel surveys concerning quality control issues involved in data collection and sampling error in the data caused by various assumptions, survey methods, and issues such as non-response. Quality control issues, sampling errors, and non-response in external and household travel surveys conducted in Texas are identified, examined, and evaluated. The impact of these issues is quantified and evaluated relative to the use of the data in travel demand models. The state of the practice in these types of surveys relative to quality control during and after the surveys are conducted and how sampling errors and nonresponse are treated (or corrected) in the survey analysis are reviewed and documented. Modifications to the survey bid specifications and survey designs are developed with experimental designs to implement, test, and evaluate in actual surveys. The data collected in the experimental designs are analyzed and evaluated relative to their effectiveness and benefit achieved including the cost of the survey modifications. The benefits and costs are assessed to formulate a final set of recommendations for incorporating into survey designs for the travel survey program.

Project Director

Charlie Hall, TPP

Project Advisors

Greg Lancaster, TPP

Bill Knowles, TPP

Research Supervisor

David Pearson, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$260,000	Texas Southern University	$5,000
	Texas Transportation Institute	$40,000

0-5731 - Synthesis and Study of the Establishment and Management of Roadside Vegetation

Start Date - 09/01/2006 ***End Date*** - 08/31/2010

Abstract

The Texas Pollutant Discharge Elimination System (TPDES), which is administered and enforced by the Texas Commission on Environmental Quality (TCEQ) requires that re-vegetation be completed in a timely manner when the project is completed and before a Notice of Intent can be issued to release the contractor. Failure to establish the vegetation can result in monetary penalties or closing a job site down. TxDOT roadway projects often terminate at times of the year when establishment of permanent vegetation is very difficult. Even when the construction calendar and the ideal growing season line up, it is still a constant challenge for TxDOT. If optimal seeding windows are not met, sites may become eroded, causing significant impacts on storm water runoff and receiving waters. The objective of this study is to provide a more diverse set of tools and options for TxDOT personnel that will help insure rapid vegetation establishment after construction. These will help prevent project delays and reduce long-term costs in vegetation development and management.

Project Director

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Research Supervisor

Beverly Storey, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$510,047	Texas A&M University – Kingsville	$25,000
	Texas Transportation Institute	$59,441
	West Texas A&M University	$24,988

0-5748 - Water Retention Techniques for Roadside Vegetation Establishment in Arid Regions of Texas

Start Date - 09/01/2007 ***End Date*** - 02/28/2009

Abstract

Water harvesting is the collection of runoff for its productive use and may aid in the germination and establishment of vegetation seeded in the roadside. This project is a synthesis study on the feasibility and implications of adapting water harvesting techniques to Texas roadsides in arid environments. The study uses a case-study approach via specific TxDOT roadway sites to investigate the potential application and impacts of adapting these techniques to roadside vegetation establishment and maintenance in a range of climate and soil conditions. The study seeks to develop alternative water harvesting techniques, specifically adapted to the demanding environmental and safety requirements of the roadside. Recommendations for adoption are included along with guidelines, standard construction detail sheets, and specifications. A cost-benefit analysis is provided for the various techniques and a recommendation for implementation studies to field-verify the synthesis report.

Project Director

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Randy Hopmann, LBB

Research Supervisor

Jett McFalls, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$182,795	Texas Transportation Institute	$36,950
	West Texas A&M University	$19,690

0-5881 - Quantifying the Effects of Network Improvement Actions on the Value of New and Existing Toll Road Projects

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

As population in Texas continues to increase at the rate considered to be one of the highest in the US, the transportation system is facing great challenges. Without installing additional capacity, the transportation system will experience congestion that can ultimately hinder further economic development. Revenue-generating roadway projects (toll roads) represent a type of project delivery method that can complement the existing tax-supported projects to bridge the gap between the needed and available funds for reconstruction and enhancement of the roadway network. Valuation of such toll road projects is inherently tied to the analysis of the supporting transportation network. The cost, capacity and condition of feeder, complementing (quasi-feeder) and competing routes in the supporting transportation network can significantly determine the project's performance. In such settings, certain aspects of long-term transportation planning (such as quantifying long-term uncertainty, risk, and link correlation) which were not as critical to the traditional analysis become absolutely paramount. By considering the effects of network actions (put simply, the effects of actions on competing versus the effects of improvement actions on feeder routes), TxDOT gains tools to judge which network improvements will add the most value to the existing and planned toll road projects. Such analysis will allow TxDOT to properly assess the value of its own non-tolled assets as well as plan for future toll roads in an optimal manner.

Project Director
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Research Supervisor
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Total Project Budget	*Research Universities*	*FY 2009 Budget*
$276,000	Center for Transportation Research	$64,000
	Texas Transportation Institute	$74,000

0-5930 - Potential Development of an Intercity Passenger Transit System in Texas

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

Rapid population growth in the state of Texas points to the need to evaluate potential development of an intercity passenger transit system comprised of intercity rail and express bus routes to enhance performance of the existing highway and aviation systems. This project will evaluate the overall need for an improved intercity mass transit system by identifying passenger demand between Texas cities - first, by examining the capacity of existing highway, rail, and air corridors throughout the state and, second, by assessing the ability of such a system to interface with local public transit systems in urban terminal areas. During its first year, the research will consider existing transit systems, examine available transit technologies, identify major intercity travel corridors, quantify demand for intercity trips, and recommend potential system solutions. The second year of research will estimate the costs and benefits of implementing such a system and determine how it would interact with existing transportation systems.

Project Director

Orlando Jamandre, TPP

Project Advisors

Catherine McCreight, HOU
Chad Edwards, NCTCOG
Deanne Simmons, ATL
Earl Washington, HGAC
Graciela Cantu, PHR
Jacques Fontenot, TYL
Kenneth Zigrang, SAT
Matt Penney, LNGVIEWTRA
Orlando Jamandre, TPP
Pat Bittner, PTN
Randy Isaacs, GRYHND
Stephen Salin, DART
Terry Frick, TYL
Tim Geeslin, TXARP
Jennifer Moczygemba, TPP

Research Supervisor

Curtis Morgan, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$264,117	Texas Transportation Institute	$132,362

0-5948 - Roadside Sediment Control Device Evaluation Program

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

One of the problems facing engineers in maintaining regulatory compliance with the Environmental Protection agency (EPA) and the Texas Commission on Environmental Quality (TCEQ) is the lack of quantifiable data to assist in selecting effective sediment control best management practices (BMPs). Although the two principles of erosion and sediment control are often used interchangeably, they are two separate issues and require different BMPs for mitigation. Erosion control is any practice that protects the soil surface and minimizes soil particle detachment by water or wind. Sediment control is any practice that traps the soil particles after detachment and transport. Typically, effective sediment control is more difficult and expensive than erosion control. While erosion can never be completely eliminated, combining erosion and sediment control practices can significantly reduce sediment loss. To help ensure compliance, TxDOT successfully evaluates the performance of erosion control materials and maintains an Approved Product List (APL). This project will develop the formal protocol for a performance-based, sediment retention device testing program that will assist the designer/engineer in the selection of the most effective sediment control BMP.

Project Director

John Mason, MNT

Project Advisors

Amy Foster, ENV
James Hill, DAL
Kori Rader, AUS
Lewis Nowlin, SJT
Barrie Cogburn, DES

Research Supervisor

Jett McFalls, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$269,949	Texas Transportation Institute	$119,945

0-5949 - Bioretention for Stormwater Quality Improvement in Texas

Start Date - 09/01/2007 ***End Date*** - 08/31/2011

Abstract

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

Stephen Ligon, ENV

Project Advisors

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

Research Supervisor

Ming-Han Li, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$462,967	Texas Transportation Institute	$121,817

0-5955 - Characterization of In-Use Emissions from Non-Road Equipment in the TxDOT Fleet

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

The Texas Department of Transportation (TxDOT) operates a very large fleet of major equipment. Understanding the emissions characteristics and pursuing methods to reduce these emissions has been identified as an important goal of TxDOT. In June 2005, the United States Environmental Protection Agency (EPA) issued a final rule (EPA420-F-05-021) requiring in-use testing of heavy-duty diesel engines and vehicles using a portable emissions measurement system (PEMS). The overall goals of this project is to (1) understand how results from the new federal in-use testing program may affect current estimates of NOx and other pollutant emissions in particularly ozone nonattainment areas; (2) evaluate the effectiveness of emerging fuels/fuel additives and retrofit technologies to reduce emissions; and (3) to identify emission control strategies, such as changes in operating practices, that may avoid the costs of retrofits. These goals will be achieved by carefully selecting TxDOT non-road equipment and emission reduction technologies to be tested, developing duty cycles for the selected equipment, measuring and analyzing baseline and treatment level emissions using the most complete PEMS equipment in Texas, and comparing the results with existing data sources.

Project Director
Don Lewis, GSD

Project Advisors
Jackie Ploch, ENV
Dianna Noble, ENV

Research Supervisor
Josias Zietsman, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$285,800	Texas Transportation Institute	$138,500

0-5973 - Emerging Trade Corridors and Texas Transportation Planning

Start Date - 09/01/2007 ***End Date*** - 02/28/2009

Abstract

Each state and region's trading relationships with the rest of the world have grown more complex, so too have the trade corridor linkages used for transporting goods from their point of manufacture to their end customer. The corridor options available to shippers for efficiently transporting goods in and out of Texas to foreign markets are highly limited at present, particularly when goods must utilize multimodal solutions. As the rate of growth in trade, primarily with Asia but also with other regions, begins to eclipse the ability of the Class I railroads and southern Californian terminals to improve their existing transcontinental routes, new intermodal corridors paired with new port capacity will need to be developed. This project examines the economic forces driving Texas' trade growth with other trade partners and, by analyzing capacity and cost considerations on existing corridors and proposed new corridors, estimates that comparative role that each of these new corridors will play in serving increased trade volumes in the future.

Project Director

Joseph Carrizales, AUS

Project Advisors

Gus De La Rosa, GPA
Hector Canales, LRD
Raul Cantu, TPP
Jack Foster, TPP

Research Supervisor

Robert Harrison, CTR

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$193,187	Center for Transportation Research	$47,844
	Texas Transportation Institute	$17,042

0-5974 - Estimating Texas Motor Vehicle Operating Costs

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

Vehicle operating costs (Vcost) play an important role in several TxDOT policy making areas ranging from the economic evaluation of highway construction, maintenance, and rehabilitation strategies to lane rental, liquidated damages and construction bonus calculations. Vcost relationships have not been studied in Texas for over two decades and these now risk obsolescence in the face of new design technologies, engine changes - both hybrid and improved gasoline/diesel - better tire performance (including super single tire adoption) and sharper forensic driven maintenance strategies. This study will develop a Vcost data base and use it to develop a fuel consumption model and an aggregate Vcost model for selected Texas representative vehicles. Also while not addressing the measurement of external costs associated with vehicle use, the results should form a platform for the future development of full transportation impacts, comprising both direct owner (as studied in this proposal) and social costs.

Project Director

Don Lewis, GSD

Project Advisors

Jackie Ploch, ENV
Janie Temple, TPP
Jo Woten, GSD
Paul Campbell, FIN
Peggy Thurin, TPP
Woody Raine, GSD
Robert Stuard, AUS

Research Supervisor

Robert Harrison, CTR

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$389,626	Center for Transportation Research	$195,424

0-5985 - Evaluating Mexican Transportation Planning Processes and Implications for Texas Transportation Assets

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

This project is intended to help TxDOT understand the legal basis, protocols and strategies used by Mexico in developing and maintaining its transportation assets. It will evaluate the current extent of Texas-Mexico coordination in transportation planning, develop strategies for improving this coordination, and demonstrate how major transportation improvements currently envisioned in Mexico may impact TxDOT planning decisions. The project will be deployed as a joint effort by the University of Texas Center for Transportation Research and the LBJ School of Public Affairs. The fundamental investigation will be performed by CTR researchers, however the research will be greatly expanded and enhanced by a year long Policy Research Project, run by Dr. Leigh Boske, that will engage the efforts of a group of graduate reserachers at the LBJ School, selected due to their interest and expertise in key project areas. The seven-task research project is designed to provide highly detailed, timely and broadly usable research results.

Project Director

Eduardo Calvo, ELP

Project Advisors

Christen Longoria, LRD
Efrain Esparza, ELP
Esther Hitzfelder, GPA
Joseph Leal, PHR
Leocadio Matias, GPA
Manuela Ortiz, GPA
Marty Boyd, ELP
Orlando Jamandre, TPP
Sasha Russell, GPA
Gus De La Rosa, GPA

Research Supervisor

Jolanda Prozzi, CTR

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$309,306	Center for Transportation Research	$165,804

0-6044 - Estimated and Actual Usage of Toll Facilities

Start Date - 04/11/2007 **End Date** - 08/31/2009

Abstract

Reliable traffic and revenue forecasts are critical to the success of tolling. However, a number of studies have shown that a majority of toll roads - almost 90 % of new toll roads in 8 states - failed to meet revenue expectations in their first full year. By year 3, 75 % remained poor performers. Specifically, a number of studies by Standard & Poor's showed that on average toll road forecasts exhibit an optimism bias, with an over estimation of year one traffic by 20-30 %. Even though over the long-term toll traffic may exceed forecasts and toll roads can generate surplus revenue, shortfalls in the ramp-up period are common. This uncertainty contributes to increased risks about the feasibility of toll roads, requirements for escrow accounts of up to 30 % of the amount borrowed, and thus high interest payments (and ultimately higher costs to the users) to compensate investors for higher risks. It can also skew public decision-making. Although traffic forecast models have become more sophisticated and a number of lessons learned have been incorporated, further improvements (especially concerning truck usage of toll roads) to the forecasting process are required. A better understanding of toll road usage, in particular trucker's behavioral response to tolling, is needed to inform existing assumptions and refine transportation models.

Project Director
Teresa Lemons, ADM

Project Advisors
Bubba Needham, AUS
Jack Dugas, SAT
Jose Hernandez, FIN
Lucio Vasquez, TTA
Mark Tomlinson, TTA

Research Supervisor
C Walton, CTR

The objectives of this research are to (a) assess traffic forecast risk through a comparison of the forecasted and actual usage of toll roads on a select number of international, U.S., and Texas toll roads, (b) monitor and analyze operations (including, forecasted and actual usage) on the Central Texas Turnpike roads in their first two years of operations, as well as changes in usage on related segments of the central Texas transportation system, (c) identify and assess those factors that influence toll road usage by different user categories (with specific emphasis on the trucking sector), (d) recommend measures and strategies to increase the reliability of traffic forecasts, and (e) recommend measures and strategies to increase the usage of toll roads by different user categories.

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$430,000	Center for Transportation Research	$145,000

0-6065 - Feasibility Study on Accelerating Utility Impacts Investigation and Coordination Leading to Practical Highway Design Refinements Using the Environmental Process

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

Two sources of delay during the project development process are utility adjustments and the environmental review and clearance process. There are several efforts underway at the Texas Department of Transportation (TxDOT) to optimize these processes, including recently finished and active research projects. Despite these efforts, the interaction between utility coordination/conflict elimination activities and the environmental process is one that has not received proper attention over the years. One of the reasons is that, although the collection of data regarding existing and abandoned utility installations is part of the environmental data gathering process, in practice, the collection of detailed underground utility-related data normally starts in the design phase, which typically occurs after the environmental process is complete. The purpose of the research is to determine whether it is feasible to (a) obtain better existing utility data during the schematic development phase as opposed to the design phase; and (b) increase the level of definition of design components such as horizontal alignment, vertical alignment, and drainage requirements during the schematic development phase. The research also develops strategies for integrating the utility coordination/conflict elimination process and the environmental process.

Project Director

Randy Anderson, ROW

Project Advisors

Brent Hillebrenner, DES
Jenise Walton, ENV
John Campbell, ROW

Research Supervisor

Cesar Quiroga, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$313,805	Texas Transportation Institute	$137,865
	West Texas A&M University	$21,360

0-6095 - Longer Combination Vehicles & Road Trains for Texas?

Start Date - 09/01/2008 ***End Date*** - 08/31/2010

Abstract

Transportation and logistics have been major contributors to U.S. economic growth, driven in part by productive modal systems. In the last two decades, planes have become larger and more fuel efficient, trains longer and heavier, container vessels substantially larger and more productive, but trucks have only benefited from marginal changes in trailer length and width on the federal highway system. The U.S. has the least productive trucks in the developed economies that form its competitive global market. This is now a drag on cost, made more severe by increases in fuel costs, and is prejudicing the U.S. competitive position.

This study will consider the impact that larger, productive trucks would have if permitted on Texas highways. The trucks evaluated in this proposal range from a heavier tridem semitrailer to a variety of combination trucks, including road trains, collectively termed long combination vehicles (LCVs). The research team in the first year will evaluate the extensive body of research undertaken on LCV operations and develop calibrated approaches to the determination of LCV productivity, bridge and pavement impacts, safety, operational considerations, and policy review determined from a series of Texas highway case studies. Furthermore, the team has the support of specialists familiar with Canadian, Australian, and Texas trucking who would complement the TxDOT technical advisors already selected for this study. The external Expert Panel would be informed of progress and meet in Austin at the end of the first year with their TxDOT advisory counterparts. Together they will review both the proposed methods and suggested case studies and act in a peer review capacity. The second year will consist of applying different LCV types to (a) a major interstate freight corridor, (b) an intrastate trade corridor, (c) TTC-35, and finally (d) a truck-only toll road. A broad-based evaluation method is envisioned, comprising traditional cost-benefit approaches strengthened by estimates of productivity, emissions, and safety.

Project Director

Duncan Stewart, RTI

Project Advisors

Don Lewis, GSD
Jack Heiss, TTA
Jefferey Tomkins, BRG
Joe Leidy, CST
Maria Burke, DES
Melisa Montemayor, LRD
Randy Anderson, ROW
Raymond (Ray) Hutchinson, MCD

Research Supervisor

C Walton, CTR

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$423,000	Center for Transportation Research	$133,036
	University of Texas at San Antonio	$64,964

0-6142 - Feasibility and Applications of RFID Technologies to Support Right-of-Way Functions

Start Date - 10/20/2008 ***End Date*** - 08/31/2009

Abstract

Radio frequency identification device (RFID) technology provides the capability to store a unique ID number and some basic attribute information, which can be retrieved wirelessly when the markers detect a radio signal from a remote reader. RFID technology is currently used in many applications including inventory management and highway toll tags. The use of RFID technology offers the potential for TxDOT to improve its right-of-way (ROW) functions and the manner in which it manages the assets located within the ROW. This research project is a feasibility study of how RFID technology can be used to support various TxDOT ROW functions. This one-year project will identify RFID technologies and the potential of those technologies to support ROW activities such as identifying utilities, outdoor advertising, infrastructure, and ROW markers. Activities include gathering information from a range of sources, assessing potential applications, conducting limited evaluations of RFID technologies to assess applicability for ROW functions, conducting a webinar to identify possibilities and obtain input, assessing institutional issues associated with RFID implementation, assessing economic factors related to implementation, and the developing recommendations. The research team includes researchers from the Texas Transportation Institute and Prairie View A&M University.

Project Director

Randy Anderson, ROW

Project Advisors

Dean Wilkerson, TSD
Don Hill, ENV
John Campbell, ROW
John Ewald, OGC
Ryan Bonner, WAC

Research Supervisor

Harvey (Gene) Hawkins, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$169,537	Prairie View A&M University	$62,660
	Texas Transportation Institute	$106,877

0-6147 - Bacteria Levels in Discharges from Road Right-of-Ways

Start Date - 09/01/2008 **End Date** - 08/31/2010

Abstract

Excessive bacteria concentrations are the most common cause of water quality impairments in Texas with almost 300 waterbodies identified by the Texas Commission on Environment Quality (TCEQ) as not meeting state standards. Total Maximum Daily Loads (TMDLs), which are designed to bring the waterbodies into compliance by reducing the bacteria discharge, must be adopted for each of these systems. TxDOT is often identified as being a contributor to these problems even though runoff from roads and bridges is only a very small fraction of the contributing watershed and has little in the way of natural bacteria sources. This research project is designed to provide TxDOT with the information to respond to regulatory requirements by evaluating the contribution of bacteria from TxDOT facilities to two systems in Central Texas: The Upper San Antonio River and its tributaries, and Gilleland Creek. These rivers were chosen for several reasons. Each of them already has a TMDL adopted by TCEQ that requires substantial reductions in bacteria discharge from all sources in their watersheds. In addition, these rivers have numerous highway crossings in a variety of settings from densely developed urban to rural, agricultural dominated land uses. This provides the opportunity to document bacteria discharges and the degree of impact on the receiving water quality in a way that the results can be extrapolated statewide and applied to other problem areas in the state such as Harris County. The project will begin with a literature review to compile information on the bacteria content of highway runoff. The review will also include an evaluation of the Best Management Practices (BMP) that are commonly used for treating stormwater runoff as well as those currently being marketed specifically to provide disinfection. The proposed site monitoring has three main components: an evaluation of the quality of runoff from TxDOT facilities, an assessment of receiving water quality upstream and downstream of the highway crossing, and a qualitative survey for birds and other sources of bacteria under and around bridges. The project will provide TxDOT with relevant and timely information that can be used to respond to TMDL requirements statewide. Without this study, TxDOT may be forced to spend substantial amounts of money to address a perceived, rather than real, problem. Consequently, TxDOT will be able to implement the results of this research immediately and realize potentially large cost savings.

Project Director
Stephen Ligon, ENV

Project Advisors
Emily Cuellar, ENV
Mario Mata, ENV

Research Supervisor
Michael Barrett, CTR

Total Project Budget	Research Universities	FY 2009 Budget
$377,698	Center for Transportation Research	$117,550
	University of Texas at San Antonio	$71,729

0-6194 - Quantifying the Purchasing Power of Public Transportation in Texas

Start Date - 09/01/2008 ***End Date*** - 08/31/2009

Abstract

Public transportation services are provided in Texas by many different entities, both public and private. Each of these entities buys goods and services on an individual basis. There are only a few examples of cooperative purchasing efforts, usually for the acquisition of vehicles. The multiplicity of public transportation providers and the lack of coordination have generated inefficiencies and wasted efforts and resources. The proposed research will identify how a cooperative purchasing program can leverage buying power to reduce the cost of equipment, goods, and services and reduce the time and expense for administration of procurement activities for public transportation providers. Research will also quantify the purchasing power of public transportation in Texas and document the economic impact on the local and state economy. Case study examples will illustrate opportunities to leverage buying power by a group of transit providers. The size and extent of the markets and the dollars savings possible or the other benefits gained will be documented. The research report will include best practices to effectively manage procurement and help public transporation providers to increase productivity and reduce or control costs.

Project Director
Karen Dunlap, PTN

Project Advisors
Darla Walton, BRY
Mary Hobson, FTW
Michelle Bloomer, NCTCOG

Research Supervisor
Linda Cherrington, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$120,308	Center for Multidisciplinary Research in Transportation	$38,298
	Texas Transportation Institute	$72,492
	University of Texas at Brownsville	$9,518

0-6199 - Estimated Impact of the 2010 Census on the PTN Funding Formula

Start Date - 09/01/2008 ***End Date*** - 02/28/2010

Abstract

Changes in the population and land area of urbanized areas in Texas will play a significant role in determining the allocation of public transportation funds to service providers in Texas after Census 2010. The purpose of this research project is to review demographic trends in order to anticipate changes in urbanized and non-urbanized areas in Texas and the resulting implications for transit funding. This collaborative effort between the Texas Transportation Institute (TTI), and the Institute for Demographic and Socioeconomic Research at the University of Texas at San Antonio will draw upon the complementary expertise of public transportation planners, demographers, and geographic information systems (GIS) professionals of the two research organizations. The research project will identify areas with potential to become over 200,000 in population and those nonurbanized areas that have potential to become urbanized (over 50,000 people) in 2010. The implications of these changes will be examined relative to the current Federal and State funding allocations. The research staff will provide a comprehensive assessment of these changes for the State as a whole and for individual transit service providers as well as recommendations for changes in current funding allocation formulas and suggestions for legislative action.

Project Director

Karen Dunlap, PTN

Project Advisors

Andrew Griffith, DES
Carole Mayo, WFS
Gary Williams, PTN
Linda Gonzalez, PTN
Maureen McCoy, CAMPO

Research Supervisor

Karl Eschbach, UTSA

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$134,623	Texas Transportation Institute	$43,717
	University of Texas at San Antonio	$40,622

0-6205 - Benchmarking and Improving Texas Rural Public Transportation Systems

Start Date - 09/01/2008 ***End Date*** - 08/31/2009

Abstract

Recognizing growing unmet needs for transportation services in rural America, SAFETEA-LU increased federal funding for rural transit. Texas demographic projections indicate that the state can expect rural transit needs continuing to increase into the future. It will become increasingly important to maximize service for every funding dollar. The research objective is to develop peer groupings of the 39 Texas rural transit districts and establish performance benchmarks for each. Analyses will focus on the efficiency and effectiveness indicators contained in the TxDOT funding allocation formula. Researcher will then conduct case studies of highly-performing agencies, highlighting transferable best practices. A special case study will specifically examine how Medical Transportation Services impact rural operators. This information will be documented in a guidance document that will help rural operators understand and improve their performance, increasing the return on federal and state rural transit investments.

Project Director
David Merritt, PAR

Project Advisors
Karen Dunlap, PTN
Kelly Kirkland, PTN
Matt Penney, LNGVIEWTRA
Tamara Cope, BWD

Research Supervisor
Jeffrey Arndt, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$116,722	Prairie View A&M University	$25,244
	Texas Transportation Institute	$91,478

0-6208 - Preserving Functionality / Asset Value of the State Highway System

Start Date - 09/01/2008 ***End Date*** - 02/28/2010

Abstract

This project will examine what losses to state highway functionality occur over time and what actions can be taken to preserve, recover, and enhance functionality over time. The key characteristic of functionality to be addressed will be operational capacity and efficiency. However, a state highway's function also derives from its right of way (including boundary conditions like access), infrastructure conditions, and safety, so those will also be considered. This project will examine experiences and results for highways within and outside Texas, both from existing information and through case studies of selected Texas highways. The research will seek to establish cause and effect relationships between various policies, actions, and practices and the resulting functionality over the life cycle of highways. The project will produce a research report, a guidebook of recommended practices, and workshops delivered to TxDOT districts.

Project Director

Blair Haynie, ABL

Project Advisors

Bob Appleton, BRY
Doug Woodall, TTA
Henry Wickes, TRF
Kenneth Petr, AMA
Maria Burke, DES
Melisa Montemayor, LRD
Peggy Thurin, TPP

Research Supervisor

Edwin Hard, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$194,323	Texas Southern University	$22,669
	Texas Transportation Institute	$138,866

0-6210 - Adding Tour-Based Modeling to TxDOT's Travel Modeling Framework

Start Date - 09/01/2008 **End Date** - 08/31/2009

Abstract

The Texas Department of Transportation (TxDOT), in conjunction with the metropolitan planning organizations (MPOs) under its purview, oversees the travel demand model development and implementation for most of the urban areas in Texas. In these urban areas, a package of computer programs labeled the "Texas Travel Demand Package" or the "Texas Package" is used as the decision making tool to forecast travel demand and support regional planning, project evaluation, and policy analysis efforts. The Texas Package currently adopts the widely used four-step trip-based urban travel demand modeling process, which was developed in the 1960s when the focus of transportation planning was to meet long-term mobility needs through the provision of additional transportation infrastructure supply. The trip-based model was intended to provide basic, aggregate-level, longterm travel demand forecasts for long-range regional transportation plans and evaluation of major infrastructure investments. Over the past three decades, however, the supply-oriented focus of transportation planning has expanded to include the objective of evaluating a range of travel demand management strategies and policy measures to address rapidly growing transportation problems, including traffic congestion and air quality concerns. The travel demand management emphasis, combined with federal regulations, has placed additional information demands on the capabilities of travel demand models. As a result, new approaches have been developed to model and forecast travel demand. The new approaches include the tour-based modeling approach, which employs tours instead of trips as the unit of analysis. The tour-based approach enhances the behavioral realism in modeling travel demand and the abilities of travel forecasting models in assessing transportation policies and evaluating alternative transportation investments. Hence, TxDOT is considering the implementation of tour-based modeling procedures within the Texas Package framework. As a first step of a potential advanced model implementation, this project aims to clearly evaluate the feasibility of, and understand the benefits of, a tour-based modeling process within the Texas Package framework. It will clearly document the steps to transition toward a tour-based framework, including an evaluation of data needs, software requirements and software enhancements, ease of implementation and application in the current Texas Package, and staffing and related resource needs.

Project Director
Janie Temple, TPP

Project Advisors
Greg Lancaster, TPP
Mark Hodges, TPP

Research Supervisor
Chandra Bhat, CTR

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$150,000	Center for Transportation Research	$90,000
	Texas Transportation Institute	$60,000

0-6225 - Protecting Waterways from Encroachment

Start Date - 09/01/2008 ***End Date*** - 08/31/2009

Abstract

The Gulf Intracoastal Waterway (GIWW) is a thoroughfare for materials and products essential to commerce in Texas. There is concern that, without proper planning, the essential travel conducted on the GIWW will be impeded through severe encroachment by various nontransportation related land uses. This encroachment can lead to effectively narrowing the waterway, causing safety hazards, and resulting in loss of property and life. This research project will explore how to best guide the Texas Department of Transportation (TxDOT) in evaluating shoreline development proposals along the GIWW. A guidebook will address various stakeholders such as developers, private property owners, municipalities, county government, port authorities, barge operators, shippers, the General Land Office (GLO), and the Army Corps of Engineers. Safety and navigation criteria are the primary focus of this project, with sensitivity to the economic issues. The project will gather safety information through interviews and archival data from various stakeholders. Further, the research team will use its navigation experience and industry contacts to identify "hot spot" safety hazards for current and potential development along the GIWW. Finally, the team will develop a template of standards on which TxDOT can rely to evaluate shoreline projects affecting navigation on the GIWW.

Project Director

Raul Cantu, TPP

Project Advisors

Dolan Dunn, USACE
Jesus (Jesse) Solis, TGLO
Raymond Butler, GICA
Scot Sullivan, TPP
Tammy Brooks, TGLO
Tony Williams, TGLO

Research Supervisor

Joan Mileski, TAMUG

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$156,153	Texas A&M University at Galveston	$110,710
	Texas Transportation Institute	$45,443

0-6235 - Sketch Planning Techniques to Assess Regional Air Quality Impacts of Congestion Mitigation Strategies

Start Date - 09/01/2008 **End Date** - 08/31/2010

Abstract

Mobile sources present air quality issues in a variety of congested regions around the state, where travel delays are rising and transportation systems are in need of improvement. Within this context, it is important to anticipate, quantify, and communicate the benefits and costs of new, congestion-abating transportation projects and policies. While additions to existing systems may facilitate new and longer trips, thereby increasing regional vehicle-miles traveled (VMT), such VMT tends to occur at preferred times of day, to more attractive destinations and/or at lower costs. The travel time and cost savings, as well as added choice benefits for personal and commercial travelers, can be sizable, along with crash reductions and other benefits. Procedures are needed to permit early and comprehensive evaluation of project proposals, facilitate project prioritization, and enhance communication with all stakeholders, as transportation planners pursue and promote new and beneficial transportation improvement plans. The proposed project will develop such a procedure by synthesizing, expanding, upgrading, and refining existing and emerging tools within a user-friendly, highly accessible Microsoft Access software platform. The resulting toolkit will accommodate both basic and more detailed inputs, pivoting off of existing datasets while facilitating, where present, the travel demand modeling capabilities that already exist in Texas' most congested nonattainment regions. Toolkit outputs will display all impacts of interest to the Project Monitoring Committee in both tabular and graphical formats (across the region of study), while highlighting any emission reductions from existing travelers and distinguishing these from emissions increases that emerge from latent demand. Within the existing vacuum of defensible sketch-level emissions impact procedures for largescale projects, the current project will produce a methodologically sound product for others to emulate. All forecasting tools and recommendations will be clearly defined in a User Guidebook, for distribution at case study workshops and for immediate use by Texas MPO and TxDOT modeling staff.

Project Director
Jackie Ploch, ENV

Project Advisors
Dan Lamers, NCTCOG
Janie Temple, TPP
Madhu Venugopal, NCTCOG
Mary McGarry-Barber, TCEQ

Research Supervisor
Kara Kockelman, CTR

Total Project Budget	Research Universities	FY 2009 Budget
$310,000	Center for Transportation Research	$150,000

0-6237 - Characterization of Exhaust Emissions from Heavy Duty Diesel Vehicles in the HGB Area

Start Date - 09/01/2008 ***End Date*** - 08/31/2010

Abstract

The relative contribution of heavy-duty diesel vehicles to mobile source emissions has grown significantly over the past decade. It is critical to address this component of the fleet, especially in nonattainment areas such as the Houston-Galveston-Brazoria (HGB) eight-county ozone nonattainment area. However, most emissions studies have not incorporated random sampling in their study designs, are mostly based on laboratory settings using chassis dynamometer testing, and are focused on gaseous pollutants, such as hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx), and do not include particulate matter (PM) and mobile source air toxics (MSATs). No study has been found that incorporates random sampling, real world testing, and also addresses PM and MSATs. This proposed project will address all these aspects and add one additional component that is often overlooked – the impact of high-emitting vehicles. This project will be directly beneficial to all districts of TxDOT, especially those that have responsibilities in nonattainment, near nonattainment and early action compact areas. The project will also be of great benefit to TxDOT divisions, such as Environmental (ENV) and Transportation Planning and Programming (TPP), which handle air quality issues such as mobile source emission reductions, policy formulation, plan implementation, National Environmental Policy Act (NEPA) reviews, and conformity determination. The findings of the study will also be of direct use to other agencies such as Metropolitan Planning Organizations (MPOs), the Texas Commission on Environmental Quality (TCEQ), and the U.S. Environmental Protection Agency (EPA).

Project Director

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Project Advisors

Charles Airiohuodion, HOU
Don Lewis, GSD
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Paul Tiley, TPP
Ruben Casso, EPA
Shelley Whitworth, HGAC

Research Supervisor

Josias Zietsman, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$424,401	Texas Southern University	$35,000
	Texas Transportation Institute	$154,567

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

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. 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. Other focal bird species that will be included, 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
Mike Shearer, ENV
Stirling Robertson, ENV
Valerie Collins, SAT

Research Supervisor

Michael Morrison, TAES

Total Project Budget	Research Universities	FY 2009 Budget
$1,150,496	Texas AgriLife Research	$409,709

0-6265 - Landside Freight Access to Airports - Challenges & Solutions

Start Date - 10/27/2008 ***End Date*** - 02/28/2010

Abstract

Texas' airports play a large role in the national and regional movement of goods by air. This includes goods moved within the state, across the country, and internationally to several continents. Most of this is accomplished at the largest of airports in Texas. However, as freight demand grows, a time will come when other airports will need to be utilized to accommodate additional demand.

Properly planned transportation infrastructure is critical in ensuring the vitality of an airport's freight operations. Time sensitive air freight requires high levels of operational efficiency which is generally optimized by taking steps to ensure both freight and passenger roadway access within the airport boundaries. Connections and design features of regional highways near the airports is no less important as it allows access to these important economic generators.

The objectives of this research are to identify the issues, barriers, physical bottlenecks (e.g., infrastructure needs), and solutions (including funding mechanisms) concerning landside access to airports in Texas and to propose a methodology for identifying and evaluating existing access performance from a freight perspective.

Project Director

Mark Young, FTW

Project Advisors

Josephine Jarrell, AVN
Lauren Garduno, ODA
Michelle Hannah, AVN
Paul Douglas, TPP

Research Supervisor

William Frawley, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$179,155	Texas Transportation Institute	$134,618

0-6268 - Acquisition, Uses, & Funding Options for Abandoned Rail Corridors

Start Date - 09/01/2008 ***End Date*** - 02/28/2010

Abstract

The use of existing and abandoned railroad rights of way has been a proven method of acquiring linear corridors for the construction of roadways since the formation of the Texas Highway Department. Either paralleling existing rail lines or re-using corridors first used by railroad companies exhibited tremendous wisdom since the railroads had dictated development patterns throughout the state in the half-century prior to the road building era. The long period of railroad system consolidation since the end of World War II has resulted in the loss of many abandoned rail corridors which could now be extremely valuable if put to use either as new transportation corridors (roadway, transit, etc.) or multiuse recreational trails (hiking, biking, skating, etc.). This project will evaluate the current Texas Administrative Code statutes governing TxDOT acquisition and use of abandoned rail corridors and look at potential funding options for purchase and preservation of these corridors by TxDOT or other public agencies. Public-private partnerships to achieve the goal of preserving the corridors for future transportation purposes and their interim or permanent use as recreational trails will also be explored. Identification of potential uses of existing abandonment corridors and suggested changes to existing statutes will also be completed.

Project Director

Mark Werner, TPP

Project Advisors

Angie Parker, OGC
Gilbert Wilson, TPP
Maria Burke, DES

Research Supervisor

Curtis Morgan, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$196,339	Center for Transportation Research	$56,443
	Texas Transportation Institute	$73,570

0-6297 - Freight Planning Factors Impacting Texas Commodity Flows

Start Date - 09/01/2008 ***End Date*** - 08/31/2010

Abstract

Efficient, reliable, and safe freight transportation is critical to the economic prosperity of any region. An efficient multimodal and intermodal transportation system reduces transportation and supply chain transaction costs and increases connectivity, reliability, and accessibility to local and global markets. An efficient freight transportation system, therefore, supports economic development, the expansion of international trade, increases national employment, growth in personal income and the Gross Domestic Product of a region, and improves the quality of life of its citizens. Intermodal and freight concerns have thus received increasing attention in the wake of globalization, increasing congestion, and changes in the logistics structure of shippers to facilitate just-in-time production. Both the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and the subsequent reauthorization of the Transportation Equity Act for the 21st century (TEA-21) have identified an understanding of the needs of the freight transportation sector as a critical component of transportation planning.

The objectives of this proposed research are to (a) improve the understanding of the size, scope, and type of commodities that are produced, consumed, and moved through different regions in Texas, (b) gain an insight into the business and transportation system factors that shippers and receivers consider when making shipping decisions, (c) identify and describe factors that impact the competitiveness of multimodal freight modes operating in Texas, (d) provide commodity data regarding origin and destination flows that will facilitate updates to various Texas freight models and studies, (e) identify and document significant multimodal freight system trends, needs, and issues in Texas, (f) recommend freight policies, strategies, performance measures, and infrastructure improvements that TxDOT can consider for implementation and funding, and (g) explore the interest, feasibility, and requirements for forming a Freight Advisory Committee in Texas.

Project Director

Orlando Jamandre, TPP

Project Advisors

Paul Tiley, TPP
Peggy Thurin, TPP
Jennifer Moczygemba, TPP

Research Supervisor

C Walton, CTR

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$325,000	Center for Transportation Research	$167,000

0-6325 - Integrating TWC Employment Data into TxDOT Modeling

Start Date - 09/01/2008 ***End Date*** - 08/31/2009

Abstract

The Transportation Planning and Programming Division (TPP) of the Texas Department of Transportation (TxDOT) maintains a cooperative agreement with the Texas Workforce Commission (TWC) to obtain employment data for use in developing and maintaining the travel demand models for the various urban areas across Texas. Beginning in 2002 the TWC began including longitude/latitude coordinates for employment locations in their data file. However, the usefulness of these coordinates has been limited because the underlying base geography used for geocoding the employment associated with the business locations is different from the underlying geography of StratMap used by TxDOT. The difference in the underlying geographies results in the inaccurate placement of employment within an area's traffic analysis zones (TAZ).

The objective of the research is to develop methods and guidelines for placing TWC employment within TAZs. The research will assess the magnitude of the error associated with using the TWC coordinates for placing employment using the StratMap geography and to explore methods to correct the associated error. Additionally, alternate methods for accurately locating the employment using employer addresses will be investigated. Guidelines for using the TWC data will be prepared.

Project Director

Greg Lancaster, TPP

Project Advisors

Paul Tiley, TPP

Research Supervisor

Patti Ellis, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$141,811	Texas Transportation Institute	$141,811

0-6395-CT - Modeling Revenue for Use in Developing Reasonable Expectations of Revenue for Long Range Plan Development

Start Date - 09/01/2008 **End Date** - 08/31/2009

Abstract

A task force of experienced TxDOT employees has examined the current financial forecasting methods of the Department and developed an improved and more understandable process. The resulting joint analysis using the combined knowledge (JACK) model is designed to estimate future revenues in Fund 006, diversions to non-TxDOT uses, and projections of expenditures in the 2009-2019 Unified Transportation Program (UTP). This research project will perform validation tests, refine the model components, and update the model if needed. In addition, communications materials will be developed to assist TxDOT in describing, explaining and illustrating the model to non-technical audiences.

Project Director

Jessica Castiglione, SAT

Project Advisors

Charmaine Richardson, RTI
Jenny Peterman, FIN
Robert (Bob) Brown, DAL
Stuart Hanzlik, FIN
Teresa Lemons, ADM

Research Supervisor

Robert Harrison, CTR

Total Project Budget	Research Universities	FY 2009 Budget
$119,000	Center for Transportation Research	$119,000

0-6395-TI - Modeling Revenue for Use in Developing Reasonable Expectations of Revenue for Long Range Plan Development

Start Date - 09/01/2008 ***End Date*** - 08/31/2009

Abstract

As a planning and programming aid, TxDOT's Joint Analysis using Combined Knowledge (JACK) model is designed to produce estimates of available revenue and expenditures for transportation improvements for future years. To assess its usefulness and viability as a planning and forecasting tool, this project will includes a review and potential recommendations for improvement and expansion of the existing JACK model. The project is divided into three phases including (1) assessing the accuracy and validity of the model and proposing fundamental improvements as necessary, (2) investigating potential improvements to an expanded, more comprehensive JACK model and (3) producing a report on the research findings and submitting an improved model. In addition to technical memoranda associated with specific research tasks and three interim Progress Reports, this proposal includes four specific deliverables: a Revised Jack Model, a report summarizing research methodology and findings, an Expanded Version of the Jack Model), and a User's Guide.

Project Director

Jessica Castiglione, SAT

Project Advisors

Charmaine Richardson, RTI
Jenny Peterman, FIN
Robert (Bob) Brown, DAL
Stuart Hanzlik, FIN
Teresa Lemons, ADM

Research Supervisor

David Ellis, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$92,340	Texas Transportation Institute	$92,340

0-6581-CT - TxDOT Administration Research

Start Date - 10/23/2008 **End Date** - 08/31/2009

Abstract

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

Research Supervisor

Khali Persad, CTR

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$50,000	Center for Transportation Research	$50,000

0-6581-TI - TxDOT Administration Research

Start Date - 10/10/2008 **End Date** - 08/31/2009

Abstract

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

Research Supervisor

Josias Zietsman, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$50,000	Texas Transportation Institute	$50,000

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RMC 4 – Active Projects

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0-4703 - Incorporating Safety into the Highway Design Process

Start Date - 09/01/2003 **End Date** - 08/31/2009

Abstract

There is a growing public demand for safer streets and highways. In response to this demand, state and national transportation agencies have developed safety programs that emphasize public education, accelerated highway renewal, community-sensitive street systems, and innovative technology to facilitate safe highway design. Highway safety concerns are also evident in Texas. Crashes in Texas continue to increase and currently exceed 300,000 per year. Nearly 4000 motorists die annually on Texas highways. A multi-year project is underway to develop and maintain a comprehensive, state-of-the-art assembly of resource documents, workshops, and reference materials dealing with the safety effects of geometrics. The successful incorporation of this information into the highway design process will require an extended commitment to research, synthesis, and training. The activities of this project will be coordinated with other ongoing safety research projects sponsored by the State of Texas and national transportation agencies. This project will ensure that the results of these state and national endeavors are well disseminated and implemented within TxDOT for the benefit of Texas motorists. A goal of this project is to reduce crashes on Texas highways by incorporating safety considerations at key steps in the highway design process. This goal will be achieved by providing Texas engineers with highway safety design guidance documents, safety awareness workshops, and a highway safety design clearinghouse.

Project Director

Elizabeth Hilton, DES

Project Advisors

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Meg Moore, TRF
Richard Harper, PAR
Robert Musselman, FHWA
Stan Hall, DAL
Wendy Simmons, TYL
A. Rory Meza, DES

Research Supervisor

James Bonneson, TTI

Total Project Budget	Research Universities	FY 2009 Budget
$998,577	Texas Transportation Institute	$147,111

0-5210 - Roadside Crash Testing Program for Design Guidance and Standard Detail Development

Start Date - 09/01/2004 ***End Date*** - 08/31/2010

Abstract

Roadside safety devices perform the important function of shielding errant motorists from roadside hazards such as non-traversable slopes and fixed objects. In order to maintain the desired level of safety for the motoring public, these safety appurtenances 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 the specific safety device with current vehicle testing criteria, and modify the device or develop a new device with enhanced performance and maintenance characteristics. Roadside safety issues will be identified and prioritized for investigation under this study in conjunction with TxDOT personnel. The selected safety problem will be evaluated through crash data analysis, computer simulation, 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 research report. Implementation may be in the form of new guidelines or procedures incorporated into appropriate design manuals and/or new or revised standard detail sheets.

Project Director

A. Rory Meza, DES

Project Advisors

Chris Hehr, DES
David Bartz, FHWA
Duane Browning, BMT
John Holt, BRG
Jon Ries, BRG

Research Supervisor

Roger Bligh, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$1,540,000	Texas Transportation Institute	$285,000

0-5235 - Determining Nighttime Driver Signing Needs

Start Date - 09/01/2005 ***End Date*** - 02/28/2009

Abstract

TxDOT has sponsored research in the past that supports effective use of retroreflective sheeting for traffic signs. However, constant changes such as vehicle design (size and headlamps) and driver aging creates a need to evaluate sheeting performance in terms of nighttime driver needs. This is especially needed with an increased number of different types of retroreflective sheetings becoming available. Instead of evaluating retroreflective sheeting materials as they enter the market, this project is intended to develop a nighttime driver needs specification for traffic signs. The intent is to eliminate the need to evaluate retroreflective sheeting materials as they are introduced to the market and provide users and industry with a performance-based specification that can be used to select and design the best available sheeting to meet the needs of nighttime drivers. This project is also intended to consider innovative signing materials such as electroluminescent or photoluminescent signing technologies. These materials will be considered in terms of factors such as costs, durability, and ability to meet the nighttime driver needs.

Project Director
Gary Tarter, TRF

Project Advisors
Charlie Wicker, TRF
Darren Hazlett, CST
Doug Skowronek, TRF

Research Supervisor
Paul Carlson, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$469,147	Texas Transportation Institute	$35,000

0-5548 - Development of Field Performance Evaluation Tools and Program for Pavement Marking Materials

Start Date - 09/01/2007 ***End Date*** - 08/31/2010

Abstract

Historically the prequalification or selection of pavement marking materials (PMMs) is mainly based on product specifications and lab testing, which do not correlate well with the field performance of the products. This project will develop field performance-based evaluation procedures for PMMs. Field decks are expected to be designed incorporating regular long lines together with transverse stripes for accelerated testing. Field decks will be installed at selected locations in the state considering area climate, roadway surface type, and traffic condition. Carefully selected PMM products will be installed and monitored for their field performance over time. Field test results will be used to correlate with initial specifications to develop new performance based specifications. At the end of the project, a field performance database that can record and query all relevant data, track individual jobs and products, graphically display performance changes over time, and predict future performance of PMMs will be developed for the use of the Texas Department of transportation (TxDOT).

Project Director

John Bassett, CST

Project Advisors

Frank Phillips, LBB
Howard Holland, BWD
Janet Manley, BMT
Michael Chacon, TRF
Larry Colclasure, WAC

Research Supervisor

Yunlong Zhang, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$316,742	Center for Multidisciplinary Research in Transportation	$11,797
	Texas Transportation Institute	$95,031

0-5856 - Safety and Economic Impacts of Converting Two-way Frontage Roads to One-way

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

When the opportunity arises, TxDOT is converting existing two-way frontage roads to one-way operation. Frequently the conversion projects occur at the urban fringe areas of rapidly growing communities. The motoring public is typically concerned about safety and mobility related to frontage road conversion, while business and property owners are concerned with economic impacts associated with access, business activity, and property values. This research will fill the need for updated and statistically valid information on the safety and economic impacts of frontage road conversion. To satisfy these needs, this research effort will satisfy three objectives: 1) develop accurate information that can be used to communicate the types of safety impacts that have been experienced and can be expected, 2) develop accurate information that can be used to communicate the types of economic impacts that have been experienced and can be expected, and 3) develop accident modification factors (AMFs) that roadway designers and decision-makers can use to guide frontage road conversion project planning. The research will produce technical documentation to address these objectives.

Project Director
Jonathan Bean, SAT

Project Advisors
Julia (Julie) Brown, SAT
Bianca Thorpe, SAT
Bob Appleton, BRY
Cathy Kratz, AUS
Chris Hehr, DES
Heath Bozeman, LBB
Stephen Gbur, BMT

Research Supervisor
William Eisele, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$324,720	Texas Transportation Institute	$155,320

0-5860 - Guidelines for Ramp Terminal Spacing for Freeways

Start Date - 09/01/2007 **End Date** - 08/31/2009

Abstract

The minimum acceptable distance between ramps is dependent upon the merge, diverge, and weaving operations that take place between ramps as well as distances required for signing. The Texas Roadway Design Manual includes a figure to show the minimum distances between ramps for various ramp configurations. Logically, the ramp spacing should be related to the design speed of the roadway, with more distance required when the design speed is higher. However, the actual design guidance available is not sensitive to the design speed of the roadway. This proposed research project will investigate the effects of speed and ramp spacing on the weaving areas between entrance and exit ramps. A key relationship to be defined by the research would be the relationship of freeway design speed, operating speed, and ramp spacing to provide unconstrained operation.

Project Director

Neil Welch, LBB

Project Advisors

Julia (Julie) Brown, SAT
Charles Koonce, TRF
Dwayne Halbardier, AUS
Jianming Ma, TRF
Tracy Jones, ABL

Research Supervisor

Kay Fitzpatrick, TTI

Total Project Budget	Research Universities	FY 2009 Budget
$259,378	Texas Transportation Institute	$130,298

0-5862 - Benefits of Wider Longitudinal Markings

Start Date - 09/01/2007 **End Date** - 08/31/2009

Abstract

The proposed research is designed to determine benefits of wider pavement markings. The research plan builds on those studies that have been completed or are on-going. In doing so, subjective evaluations and operational based studies are no longer needed. While crash studies provide an attractive and robust assessment technique, there is an on-going national study using multiple state DOT data to pursue this technique. If Texas crash records are made available during this study, there may be an opportunity to enhance an on-going national safety study. Visibility studies based on central vision have provided mixed results. Therefore, this study emphasizes visibility studies of wider markings based on peripheral vision, and the lane keeping benefits provided by peripheral vision. The results of this study will include recommendations that the Texas Department of Transportation (TxDOT) can use to set statewide policy for wider pavement markings.

Project Director

Brian Stanford, TRF

Project Advisors

Tom Beeman, DES
Angie Ortegon, SJT
Cynthia Flores, TRF

Research Supervisor

Paul Carlson, TTI

Total Project Budget	Research Universities	FY 2009 Budget
$295,680	Texas Transportation Institute	$143,040

0-5865 - Arterial Intelligent Transportation Systems - Infrastructure Elements and Traveler Information Requirements

Start Date - 09/01/2007 **End Date** - 08/31/2009

Abstract

Applying Intelligent Transportation Systems (ITS) to arterial systems allows TxDOT to collect more accurate network-wide data. It also allows TxDOT to increase transportation system efficiency by improving interplays between the freeway traffic management system and the arterial management system. In addition, under certain circumstances, TxDOT may use the arterial ITS devices to monitor critical transportation infrastructure elements and smooth emergency evacuation for security purposes. However, no guidelines are available to assist TxDOT staff in selecting the most beneficial arterial ITS elements and desirable ITS technologies. Likewise, no guidelines have been found to assist TxDOT staff in selecting appropriate performance measures and information dissemination modes. This research project will examine the arterial ITS elements, technologies, arterial performance measures, information dissemination technologies, and financial considerations for arterial ITS deployments. The results will provide new knowledge and practical guidance for the operation of 21" century ITS. This research will also help TxDOT better utilize existing ITS infrastructure elements and to make wise investments in future arterial ITS applications.

Project Director

Tony Parlamas, CRP

Project Advisors

Gabriel Garcia, CRP
Ismael Soto, CRP
Marc Jacobson, SANANTONIO
Robert Guydosh, AUS
Robert Wheeler, TRF

Research Supervisor

C. Michael Walton, CTR

Total Project Budget	Research Universities	FY 2009 Budget
$248,500	Center for Transportation Research	$125,000

0-5890 - Guidelines for the Use of Pavement Marking Symbols at Freeway Interchanges

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

Pavement marking technology has advanced to allow for the use of large multi-color symbols to be placed on the pavement as a means of providing drivers with another source of information from which they can make good driving decisions. This project will focus on the use of such pavement markings to provide the driver with lane guidance and warning information near freeway interchanges. More specifically, researchers will evaluate the design and application issues that are associated with the use of pavement marking symbols. A thorough review of the state-of-the-practice will help to identify candidate pavement marking symbol alternatives to be tested. This research project will employ three different methods of evaluating the identified alternatives. First, a closed course study will evaluate detection and recognition of different symbol designs. Second, a human factors survey will evaluate driver comprehension and preference for different designs and applications. Finally, a full field study in which candidate pavement marking symbol alternatives will be installed near freeway interchanges for real-world performance evaluation in terms of lane changes, erratic behavior, and driver comfort. At the end of this project, researchers will develop a set of design and application guidelines regarding the use of pavement marking symbols at freeway exits and interchanges.

Project Director

Omar Madrid, ELP

Project Advisors

David Valdez, TRF
John Hernandez, CRP
Ricardo (Rick) Castaneda, SAT
Roy Wright, ABL
Theresa Lopez, FTW
Stuart Corder, HOU

Research Supervisor

Brooke Ullman, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$307,075	Texas Transportation Institute	$161,675

0-5911 - Driver Workload and Visual Studies

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

Research is needed to identify driver workload and visual abilities at higher speeds. Most previous work has been done at speeds of 55 mph or less. There is interest to have a better understanding of driver's needs at 70 mph and above. The objectives of this project are to identify differences in driver workload at high speeds and to determine how operating speed affects time-to-contact estimates. Implementation of this research can occur through the use of guidelines developed on roadway design and traffic control device considerations. Examples of potential design and traffic control devices recommendations include lane and shoulder width needs, sign location due to higher driver workload on a horizontal curve or a grade, or use of variable speed limits. Implementation can also occur with the greater understanding of driver performance on high speed facilities.

Project Director

Ken Boehme, CST

Project Advisors

Cynthia Landez, DES
Josh Verastique, TRF
Martin Horst, CRP
Mark Tomlinson, TTA

Research Supervisor

Kay Fitzpatrick, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$325,595	Texas Transportation Institute	$167,475

0-5913 - Feasibility of Speed Harmonization and Peak Period Shoulder Use to Manage Urban Freeway Congestion

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

Speed harmonization and peak-period shoulder lane usage are advanced traffic management techniques widely implemented in Europe, and to some extent in the US. By making use of ITS to monitor and manage traffic in real time, they have led to safer traffic flow conditions, congestion and pollution reduction, throughput improvements, and an overall better driving experience. Despite previous success of speed harmonization and peak-period shoulder usage, the deployment of such new strategies in Texas cannot be successful without a comprehensive analysis of:

i. Methodological Challenges: Development of optimal control strategies and appropriate modeling tools, critical for deployment and benefit estimation

ii . Operational Challenges: Analysis of implementation issues, including safety considerations, infrastructure requirements, and cost estimation

iii. Institutional Challenges: Study of the legal enforcement framework, liability and inter-agency cooperation issues.

This research will develop a systematic framework for assessing the feasibility of speed harmonization and peak-period shoulder use implementation. A three-tiered approach, encompassing methodological, operational and institutional components, will be taken to generate a comprehensive and integrated decision-making framework. The insights from this study will provide the basis for a cost-benefit analysis, and for a traffic management plan, which can be utilized by TxDOT to effectively deploy speed harmonization and peak-period shoulder use.

Project Director

Imelda Barrett, AUS

Project Advisors

Flor Tamez, TRF
Mark Herber, AUS
Mark Olson, FHWA
Ricardo (Rick) Castaneda, SAT

Research Supervisor

S. Travis Waller, CTR

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$267,000	Center for Transportation Research	$121,803
	Texas A&M University – Kingsville	$13,197

0-5998 - Evaluation of Best Practices for Controlling Signal Systems During Oversaturated Conditions

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

Signalized intersections are often the source of urban traffic congestion, which may remain localized or quickly spread to adjacent signals or freeway off-ramps. The latter scenario often occurs on a daily basis in many cities, resulting in increased delays, fuels consumption, vehicular emissions, driver frustration, and accidents. Unfortunately, no standardized procedures, tools, or guidelines are available to practitioners to provide for proper characterization and effective mitigation of specific congestion problems in their systems. Thus, engineers in charge of maintaining traffic signals have no choice but to rely on technology and tools developed for undersaturated signals, combined with trial-and-error methods and expert judgment to solve their congestion problems. In most cases, the successes and failures of such efforts are not available for others to benefit from. The objective of this project is to develop guidelines for effectively combating congestion in traffic signal systems. This objective will be achieved through: (1) critical evaluations of technology and practice, (2) identifying ways to characterize congestion, (3) identifying effective tools, procedures/methods, implementation techniques, and policy issues, (4) refining initial guidelines using computer simulation, and (5) demonstration of guidelines at a minimum of two sites.

Project Director

Henry Wickes, TRF

Project Advisors

Al Kosik, TRF
Adam Chodkiewicz, TRF
David Danz, TRF
Derryl Skinnell, TRF
Don Baker, TRF
Gordon Harkey, BWD
Luis Villarreal, LRD
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Research Supervisor

Nadeem Chaudhary, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$264,920	Texas Transportation Institute	$134,920

0-6029 - Fully Adaptive Detection-Control System for Isolated Intersections

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

TxDOT has sponsored the use of intelligent signal control to improve intersection safety at traffic signals. The same intelligence can now be used to improve the efficiency of signal operations. The objective of this project is to improve the signal operations at intersections that use advance strategies like Detection-Control Systems (D-CS) by developing three modules. The first module will improve signal operation when there are no stop bar detectors on an approach by using the advance detectors. The second module will operate the traffic signal during detector(s) failures by using historical information. The final module will assign delays dynamically to left-turn and right-turn detectors to allow the turning vehicles to find gaps in major street movements and minimize gap outs. Researchers will develop these modules by conducting analytical and simulation studies. Simulation studies will include the use of hardware-in-the-loop (HITL) and cabinet in the loop (CITL) simulations. Extensive testing with hardware will also be conducted in a laboratory setting. Finally, the modules will be deployed at three signalized intersections and their performance evaluated. Successful completion of this project can result in signal controller vendors incorporating these modules into the controller software increasing the ease of future implementation.

Project Director

Kelli Williams, ODA

Project Advisors

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Adam Chodkiewicz, TRF
Don Baker, TRF
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Research Supervisor

Srinivasa Sunkari, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$261,000	Texas Transportation Institute	$134,000

0-6030 - Guidelines for Best Use of Video Detection for Stop Bar Presence Detection

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

TxDOT and other state DOT'S as well as cities nationwide are using video detection successfully at signalized intersections. However, operational issues with video imaging vehicle detection systems (VIVDS) products occur at some locations. The resulting issues are varied but have included: camera contrast loss resulting in max-recall operation, vehicles not being detected leading to excessive delay and red-light violations, and degraded detection accuracy during evening hours. This research will develop a formalized VIVDS test protocol and a set of performance measures that can be incorporated in future purchase orders and used to uniformly evaluate VIVDS products. It will also develop a VIVDS videotape library and will develop the conceptual plans for a field laboratory for future projects to deploy a range of VIVDS products at an operational signalized intersection. The research will evaluate alternative VIVDS stop bar detection designs and develop methods for enhancing the operation of VIVDS through adjustments in controller settings for day vs. night vs. transition periods, zone placement, and camera placement.

Project Director

Henry Wickes, TRF

Project Advisors

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Carlos Ibarra, ATL
Dan Maupin, HOU
David Danz, TRF
Derryl Skinnell, TRF
Al Kosik, TRF

Research Supervisor

Dan Middleton, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$240,000	Texas Transportation Institute	$115,000

0-6031 - Analysis of Roadway Departure Crashes on Two-Lane Rural Roads in Texas

Start Date - 09/01/2007 **End Date** - 08/31/2009

Abstract

Nearly 80% of the roadways that are operated and maintained by the Texas Department of Transportation (TxDOT) are two-lane highways located in rural areas. In 2004, more than 1,300 fatal collisions occurred on Texas highways, with about 60% of those happening on rural two-lane roads. The crash statistics have shown that about 40% of these crashes are attributed to single-vehicle crashes, which includes roadway departure crashes. The high crash rates and fatality rates occurring on rural two-lane highways results in a high cost to all Texas motorists in terms of both lives and dollars and have prompted TxDOT to begin a statewide review of roadway departure crashes.This study will provide TxDOT valuable information about contributing factors associated with roadway departure crashes on rural two-lane highways on a district by district basis. The study will include identifiable crash patterns and high risk locations as well as site and operational variables influencing roadway departure crashes. The study will also provide engineering countermeasures to reduce the number and injury related to this category of crashes. The countermeasures will be tailored by district or region, as governed by the contributing factors identified in the first part of this study. Workshop(s) will be conducted for interested districts to discuss the implementation of the engineering countermeasures.

Project Director

Juanita Daniels-West, TYL

Project Advisors

Angie Ortegon, SJT
Debra Vermillion, TRF
Herbert Bickley, LFK
Kelli Williams, ODA
Lance Simmons, ATL
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Research Supervisor

Dominique Lord, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$315,765	Texas Transportation Institute	$168,375

0-6071 - Development of Roadside Safety Devices for Very High Speed Roadways

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

The Texas Department of Transportation (TxDOT) is embarking on a multi-decade effort to expand the state's transportation system. This expansion includes the multiple, high-speed corridors of the Trans-Texas Corridor, as well as other facilities. TxDOT has expressed an interest in using very high design speeds (above 80 mph) for these facilities to promote faster and more efficient travel within the state. Currently, roadside hardware is tested at a speed of 62 mph (100 km/h). This impact speed was derived from crash data collected on roads with design speeds up to 70 mph. For economic reasons, many existing roadside safety features are optimized for the current design impact conditions and have little or no factor of safety for accommodating more severe impacts. Thus, designers do not have safety devices appropriate for use on facilities with very high design speeds. Under this research project, crashworthy roadside safety hardware suitable for use on very high speed highways will be developed. The impact performance of these devices will be evaluated through full-scale crash testing. It is anticipated that this testing will be conducted following the recommended design impact conditions for very high design speed facilities developed under research project 0-5544. The resulting devices will provide designers suitable options for protecting motorists traveling on very high speed roadways.

Project Director

Bobby Dye, DES

Project Advisors

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Edward Sewell, WFS
John Holt, BRG
Jon Ries, BRG
Michael McKissick, AUS

Research Supervisor

Roger Bligh, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$368,013	Texas Transportation Institute	$186,005

0-6103 - Evaluation of Longitudinal Channelizing Barricade Effectiveness

Start Date - 09/01/2008 ***End Date*** - 08/31/2010

Abstract

Work zones create unexpected conditions for motorists. In some cases, the complexity of the work zone can make it difficult for motorists to identify the correct travel path, which can result in motorist confusion and possibly intrusion into the work zone. Longitudinal channelizing barricades (more recently referred to as longitudinal channelizing devices (LCDs)) are crashworthy, lightweight, deformable devices that can be connected together to create a continuous line (i.e., no spacing between devices). Currently, LCDs may be used instead of a line of cones, drums, or barricades (whose spacing is dependent upon the posted speed). However, research has not been conducted to assess whether LCDs used in continuous line applications improve traffic safety and operations of work zones. Therefore, currently no guidance is provided regarding the work zone configurations and conditions where LCDs should be considered in lieu of these other devices.

The objectives of the proposed research are to:
- determine whether LCDs used in continuous line applications improve traffic safety and operations of work zones relative to the use of other types of channelizing devices (cones, drums, etc.). and
- develop guidance regarding the application of LCDs in work zones.

Project Director

Doug Skowronek, TRF

Project Advisors

Cynthia Landez, DES
Michael Jedlicka, BRY
Terry McCoy, AUS
Gary Tarter, TRF
Paul Clutts, FHWA
Tom Beeman, DES

Research Supervisor

Melisa Finley, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$304,540	Texas Transportation Institute	$149,120

0-6106 - Lane Assignment Traffic Control Devices on Frontage Roads and Conventional Roads at Interchanges

Start Date - 09/01/2008 ***End Date*** - 08/31/2010

Abstract

The "Intersection and Mandatory Movement Lane Control Signs" placed on diamond intersection approaches are critical to safe and efficient intersection operations. Ramp, frontage road, and cross street approaches to diamond interchanges often widen at the intersection to accommodate additional through or turn lanes. Currently there is inconsistency in conveying to drivers how they should align themselves upstream of a diamond intersection to maneuver for their desired turning movement as the intersection widens. These inconsistencies can result in drivers making incorrect lane selection which may result in late lane changes or illegal turns. The proper placement of signs and markings may be some distance back from the intersection, prior to where the roadway widens. Conveying lane assignments at sufficient distance so the motorist understands to make necessary lane changes is challenging using existing TMUTCD guidance. TxDOT project 0-4160 produced the Freeway Signing Handbook. This handbook contained a section on frontage road signing largely based on the application of MUTCD principals; but no research on the recommended practices was conducted. The draft Freeway Signing Handbook has not been adopted by TxDOT. The TMUTCD nor Federal MUTCD provide authoritative guidance on design and placement of lane assignment signs (or the use of signs in conjunction with lane assignment pavement markings).

Project Director

Mark Wooldridge, YKM

Project Advisors

Larry Colclasure, WAC
David Valdez, TRF
Gregg Granato, SAT
Jim Heacock, HOU
John Nguyen, DAL
Mark Olson, FHWA

Research Supervisor

Anthony Voight, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$284,455	Texas Transportation Institute	$141,800

0-6112 - Development of Guidelines for Triple Left and Dual Right-Turn Lanes

Start Date - 11/26/2008 **End Date** - 08/31/2010

Abstract

Triple left turn lanes and dual right-turn lanes are still considered as relatively new design alternatives that have been implemented in a very limited number of intersections in Texas. This project is intended to achieve two goals: (1) develop geometric design and installation guidelines for triple left-turn and dual right-turn lanes, and (2) evaluate the safety and operational performances of existing triple left-turn and dual right-turn lane sites in Texas. To this end, the research will (1) review existing design guidelines and practices regarding triple left-turn lanes and dual right-turn lanes around the country, (2) perform studies of existing triple left-turn and dual right-turn locations to document existing design issues and concerns, operational performance, and safety performance, (3) identify the important factors that affect the design, operation and safety of triple left-turn and dual right-turns, (4) develop geometric design criteria for triple left-turn and dual right-turn lanes, (5) develop installation criteria for determining when triple left-turn or dual right-turn lanes should be installed, and (6) develop guidance on the signal design for installation of triple left-turn or dual right-turn lanes.

Project Director

Roy Parikh, FTW

Project Advisors

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John Gianotti, SAT
Mark Mathis, CITY
Stuart Corder, HOU

Research Supervisor

Scott Cooner, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$289,998	Texas Southern University	$40,505
	Texas Transportation Institute	$94,494

0-6120 - An Evaluation of the Performance of High Impact Signs

Start Date - 10/30/2008 ***End Date*** - 08/31/2010

Abstract

There are approximately 15,000 Exit Gore signs installed on Texas highways. Because of their frequency and exposure to high-speed traffic, they remain one of the most commonly struck signs by errant vehicles. Thus, Exit Gore signs present a significant maintenance challenge for TxDOT; namely, the safety of personnel working in gore areas to replace these signs, and the resources (staff, equipment, and stock) that are necessary for continual maintenance. In addition, other roadside signs that are located near the travel lanes due to lack of available clear zone are also prime "high impact" candidates. The proposed research project will identify sites with safety problems related to high impact signs, diagnose the problems and recommend countermeasures using the Positive Guidance procedure. The countermeasures include alternative installation techniques and sign locations, and alternative signs/markings. The most promising countermeasures will be evaluated in the field.

Project Director

Ismael Soto, CRP

Project Advisors

Andrew Oberlander, DAL
Edgar Fino, ELP
Michael Jedlicka, BRY
Doug Skowronek, TRF

Research Supervisor

Geza Pesti, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$253,227	Texas Transportation Institute	$124,308

0-6127 - Bicycle and Pedestrian Friendly Crossings at Freeway Interchanges

Start Date - 09/01/2008 ***End Date*** - 08/31/2010

Abstract

Bicycle and pedestrian travels have played historic roles in transportation. Bicycling is widely accepted as with the energy efficiency, cost effectiveness, health benefits and environmental advantages. The reduction in motor vehicle trips creates additional capacity and reduces physical wear on roadways which both contribute to longer life and increased value of those assets. Given their relatively small size, maneuvering, and the vulnerability of their riders, bicycles and pedestrians often have difficulty mixing with modern modes of transportation. Traveling behaviors of bicyclists and pedestrians are quite different with motorists. The goal of this research is to identify a design guideline on how to provide safe and efficient movement of bicycles and pedestrians crossing freeway interchanges. To this end, the research entails the following specific objectives: (1) Identify behaviors of bicyclists and pedestrians when crossing freeway interchanges; (2) Identify facilities that are suitable for bicycle and pedestrian crossing at freeway interchanges; (3) Develop systematic guidelines for bicycle and pedestrian crossing at interchanges. By this proposal, travel behaviors of bicyclists and pedestrians crossing freeway interchanges will be carefully studied through field surveillances and synthesis of successful practices. The TSU Mobile Van with Autoscope, an effective tool for monitoring and collecting on-site, real time traffic data at any locations, will be possibly employed in field surveillance. Guidance on bicycle and pedestrian friendly crossing at interchange will be finally synthesized.

Project Director

Chad Bohne, BRY

Project Advisors

Bob Appleton, BRY
Maria Burke, DES
Teri Kaplan, HOU

Research Supervisor

Fengxiang Qiao, TSU

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$260,000	Texas Southern University	$100,000
	University of Texas at Arlington	$30,000

0-6135 - Super 2 Design for Higher Traffic Volumes

Start Date - 09/01/2008 ***End Date*** - 08/31/2010

Abstract

As traffic volumes increase statewide, the demand on the state's network of two-lane highways also increases. The increased volumes have an effect on congestion, air quality, and safety as traffic density increases, often approaching the limits of capacity for two-lane highways. High proportions of heavy vehicles compound the problem, contributing to a decrease in safety as impatient drivers attempt to pass slower vehicles in no-passing zones or pass trucks despite having diminished sight distance beyond such vehicles. Previous research (TxDOT Project 0-4064, "Design Criteria for Improved Two Lane Section (Super 2)") demonstrated that periodic passing lanes can improve operations on two-lane highways with low to moderate volumes; these "Super 2" highways can provide many of the benefits of a four-lane alignment at lower cost. The current Texas Roadway Design Manual contains these guidelines for highways with Average Daily Traffic (ADT) lower than 5000. This proposed project will expand on that research to develop design guidelines for length and spacing of passing lanes on two-lane highways with higher volumes. As in Project 0-4064, this project will consider the effects of volume and terrain on traffic flow; in addition, the effects of varying proportions of heavy vehicles will also be considered.

Project Director

Mark Wooldridge, YKM

Project Advisors

A. Rory Meza, DES
Chris Reed, CHS
David Harper, LBB
Roy Wright, ABL
Russel Lenz, ABL

Research Supervisor

Marcus Brewer, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$270,155	Texas Transportation Institute	$133,855

0-6143 - Standards for Mounting Traffic Control Signs and Devices on Concrete Traffic Barrier (CTB) in Construction Work Zones

Start Date - 09/01/2008 ***End Date*** - 08/31/2009

Abstract

Portable concrete traffic barriers (CTBs) have many uses on construction projects. A common use is to provide positive separation between opposing traffic streams on construction projects. One of the challenges in work zones is to provide signs that are visible to the traffic driving in the left lanes of a multi-lane construction work zone. Often, there is not enough room on the shoulder, or high speed traffic makes the support unstable. One solution would be to mount the signs on the center CTB. This would require a detachable system to attach such signs. The purpose of this project is to develop a crashworthy sign that is attached to the top of a portable concrete traffic barrier. The goal of this research will be to develop a sign mount connection that could be incorporated into the TxDOT standard specifications for signs used in construction work zones.

Project Director

Tracey Friggle, DAL

Project Advisors

Doug Skowronek, TRF
Kelly Selman, DAL
Stuart Corder, HOU
Robert Musselman, FHWA

Research Supervisor

William Williams, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$115,982	Texas Transportation Institute	$115,982

0-6163 - Improved Positive Protection Guidance for Work Zones

Start Date - 09/01/2008 **End Date** - 08/31/2010

Abstract

FHWA regulations (23 CFR 630.1102-1110) require states to establish explicit policies and procedures to guide when and where positive protection is to be used in work zones, as well as the type of protection that will be provided. Currently, TxDOT guidance regarding portable concrete barrier (the most common type of positive protection) use in work zones is rather limited. In addition, technologies such as steel barriers and low-profile concrete barriers which are more portable and thus less costly to install, move, and remove are now more readily available but guidance on their application is not available. In some work zones, alternatives to physical barriers that could reduce vehicle intrusion risk into the work zone (law enforcement, speed trailers, enhanced Portable Changeable Message Signs (PCMS) usage, etc.) may actually be more practical and cost effective for TxDOT to implement, but guidance on when and where to do this is also not available. In this project, researchers are conducting a variety of different analyses to assess the safety, cost, and other qualitative trade-offs of each of the above technologies and strategies for providing positive protection in work zones. These analyses will be used to develop improved guidance on when and where positive protection should be used as well as the type of positive protection technology that should be used for the specific roadway and work zone conditions that exist for a particular project.

Project Director

Ismael Soto, CRP

Project Advisors

Tom Beeman, DES
Bobby Dye, DES
Gary Tarter, TRF

Research Supervisor

Gerald Ullman, TTI

Total Project Budget	Research Universities	FY 2009 Budget
$298,576	Texas A&M University Kingsville	$32,678
	Texas Transportation Institute	$116,000

0-6167 - Assessment of Need and Feasibility of Truck-Mounted Changeable Message Signs (CMS) for Unscheduled Operations

Start Date - 09/01/2008 **End Date** - 08/31/2010

Abstract

Unscheduled operations are typically characterized by work that is present at any one location for a very short duration (such as debris removal, snow/ice removal, incident management, hurricane evacuation, etc.) and is therefore not recognized as a common condition for drivers. This project will focus on the use of truck-mounted changeable message signs (TMCMSs) as a possible means of providing increased information to motorists regarding conditions downstream of their current location. More specifically, researchers will evaluate the types of hazards and/or issues that could be addressed through the use of TMCMS and the symbol or text displays that would be appropriate for different scenarios. A thorough review of the state-of-the-practice will help to identify scenarios that could be considered in this evaluation. Additionally, the research project will employ both human factors motorist comprehension and field evaluation studies to evaluate the effects of the TMCMS information on the identified scenarios. At the end of the project, researchers will develop guidelines regarding the implementation of TMCMS during unscheduled operations.

Project Director

Christopher Freeman, AMA

Project Advisors

Bart Sherrill, CHS
Jianming Ma, TRF
Joe Prather, AMA
Frank Phillips, LBB

Research Supervisor

Dazhi Sun, TAMUK

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$209,090	Texas A&M University – Kingsville	$39,492
	Texas Transportation Institute	$60,032

0-6173 - Driver Understanding of Congestion-Based Pricing Messages

Start Date - 09/01/2008 ***End Date*** - 08/31/2010

Abstract

Changeable message signs (CMS), also called variable message signs (VMS) or dynamic message signs (DMS), are programmable traffic control devices that display messages composed of letters, symbols, or both. It is important to design and display CMS which are employed to convey pertinent, real-time, and remotely updated traffic information, including the dynamic pricing messages. Several toll roads/managed lanes in Texas will use dynamic pricing displays. In order to display the congestion-based pricing messages, several key research issues should be addressed, including: (1) what is the maximum number of lines of text per sign; (2) what is the drivers' comprehension to dynamic pricing messages; (3) how many destinations should be listed on each sign board; (4) is it necessary to list other dynamic information such as travel time simultaneously; and (5) will the dynamic pricing message add unsuitable workloads to motorists. Therefore, there is a strong need to synthesize the current relevant practices and research on pricing message design, and prepare guidelines for the use of CMS in dynamic congestion-based pricing messages. The goal of this study is to ascertain driver's understanding of congestion-based pricing messages. To this end, the research entails the following specific objectives: (1) evaluate drivers' psychological behaviors and workload in designing congestion-based pricing messages; (2) simulate and examine the driver's understanding of pricing messages using a driving simulator; and (3) develop guidelines for changeable message signs with regards to static and dynamic components of the sign, and to the number of signs and placement of signs.

Project Director

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Project Advisors

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Edgar Fino, ELP
Jianming Ma, TRF
Mark Olson, FHWA
Michael Chacon, TRF
Robert Wheeler, TRF
Stuart Corder, HOU

Research Supervisor

Fengxiang Qiao, TSU

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$328,641	Texas Southern University	$114,173
	Texas Transportation Institute	$55,964

0-6176 - Consistent Signal Timing Strategies at Rural Intersections with Wide Medians to Improve Efficiency and Safety

Start Date - 09/01/2008 ***End Date*** - 08/31/2009

Abstract

Wide median intersections are increasingly becoming more common in suburban and rural areas of Texas. These intersections alternatively can be viewed as two closely spaced intersections resulting from at-grade signalized intersections between minor streets and wide-median major highways. The design and operation of traffic signals depend on numerous factors including traffic volume patterns, median widths, approach speeds, and sight distances. TxDOT's current practices do not have any guidelines on how to operate these complicated intersections resulting in design inconsistency across the districts. In addition, these intersections are typically located in rural areas where a combination of insufficient design and high-speed traffic can further create an unsafe driving environment. Through this research project, the research team will conduct a review of current TxDOT practices, identify factors affecting signal timing solutions, and then develop recommendation guidelines for consistent timings at these locations. Some unique but useful controller features for operating these intersections will also be investigated. A traffic simulation will be used to evaluate and refine the recommendations from both operational and safety perspectives given prevailing characteristics of wide median intersections in Texas.

Project Director

Henry Wickes, TRF

Project Advisors

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Peter Eng, TYL
David Danz, TRF
Robert Guydosh, AUS
Maria Jasek, YKM
Dan Maupin, HOU
Derryl Skinnell, TRF

Research Supervisor

Srinivasa Sunkari, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$132,000	Texas Transportation Institute	$132,000

0-6177 - Portable Traffic Signal Monitoring and Evaluation Toolbox to Improve Signal Operations and Safety

Start Date - 09/01/2008 ***End Date*** - 08/31/2010

Abstract

Traffic signal operators are faced with the challenge of documenting signal operations. Typically operators program signal timings and do not have the resources to conduct a long-term monitoring of the new signal timing changes. Some of the settings may or may not be appropriate. Similarly operators frequently get complaints from motorists about detection operations especially video detection. However, the signal engineers and technicians are often unable to replicate the described problem. Signal operators need a tool to document traffic signal controller and detection operations in order to diagnose problems reported and develop appropriate solutions. This tool can be used as a maintenance device due to the scarcity of man power in most districts. This project will deliver a toolbox consisting of hardware and software that will interface with the TS-2 signal controller cabinets which TxDOT uses to operate traffic signals. The toolbox's hardware will be built from off-the-shelf components in a cost-effective manner. The toolbox comprises of a miniature field hardened computer, a simple and easy interface to connect to a TS-2 traffic cabinet, and software that will interface, log, and analyze the signal operation in the field and provide a report to the operators.

Project Director
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Project Advisors
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Larry Colclasure, TRF
Robert Guydosh, AUS
Gordon Harkey, BWD
Herbert Bickley, LFK
Don Baker, TRF
Adam Chodkiewicz, TRF

Research Supervisor
Srinivasa Sunkari, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$260,000	Texas Transportation Institute	$126,000

0-6262 - Signing Guidelines for Flooding Conditions and Warrants for Flooded Conditions Detection Systems

Start Date - 09/01/2008 **End Date** - 08/31/2010

Abstract

In Texas, approximately eight flood-related fatalities occur each year – the majority of these (78.6 percent) involve motorists that are trapped in their vehicles or washed away. In many cases, victims, not wanting to take a lengthy detour, ignored barricades and tried to drive across a flooded street or low-water crossing – literally driving themselves into harms way. It takes as little as two feet of water to float most cars. Several districts in Texas have developed different signing strategies for warning motorists of low water crossings. As part of this research, Texas Transportation Institute (TTI) will be developing guidelines and recommendations for creating signing uniformity for low water and flood-prone section of roadways. Signing guidelines will be created for following situations: 1) the beginning of a roadway section that has several low water crossings where water flows over the roadway in wet conditions, 2) at the actual low water crossing, and 3) for temporary road closures due to high water. TTI will also develop criteria for when to implement active water level detection and advance warning systems at low water crossings and flood-prone roadway sections.

Project Director

Angie Ortegon, SJT

Project Advisors

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Lewis Nowlin, SJT
Mike Coward, SAT
Mitch Murrell, TRF
Ricardo (Rick) Castaneda, SAT

Research Supervisor

Kevin Balke, TTI

Total Project Budget	Research Universities	FY 2009 Budget
$253,010	Texas Transportation Institute	$124,530

0-6267 - Benefits of Public Roadside Safety Rest Areas in Texas

Start Date - 09/01/2008 ***End Date*** - 08/31/2010

Abstract

Despite their popularity with the public, increased competition for public funding and concurrent increases in safety rest area costs, have brought into question the cost-effectiveness of publicly funded safety rest areas in Texas. To adequately respond to this question, a reliable and acceptable method for comparing safety rest area benefits with costs is required. While the costs associated with safety rest areas are typically well-defined, many of the benefits and disbenefits of rest areas may be difficult to quantify. The objective of this project is to develop such a benefit-cost analysis methodology for safety rest areas in Texas and to demonstrate its application in select corridors throughout the state. In addition, this project will consider novel safety rest area development approaches that could reduce the public cost burden borne by individual public agencies. The proposed research will characterize available data to support safety rest area benefit-cost analysis in Texas, assess existing benefit-cost methods identified through literature and state of the practice review, develop and apply a unique safety rest area benefit-cost analysis methodology for Texas, and explore alternate safety rest area development opportunities.

Project Director
Andy Keith, MNT

Project Advisors
Paul Campbell, MNT
Jim Hollis, TRF
Lynn Passmore, TRF

Research Supervisor
Jodi Carson, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$213,770	Texas Transportation Institute	$111,020

0-6363 - Improvements to Large and Small Roadside Sign Hardware and Design

Start Date - 09/01/2008 **End Date** - 08/31/2010

Abstract

Many of the design practices that TxDOT uses for large and small sign mountings were established many years ago. These mounting details may no longer be appropriate given changes in sign materials, fabrication methods, and installation practices. Further, the vehicle fleet and operating conditions on our highways have changed considerably, and there is a need to assess the compliance of some existing sign support systems with current vehicle testing criteria, and to evaluate new technologies that offer to enhance performance and maintenance. This two-year research project is designed to provide the Texas Department of Transportation (TxDOT) with a comprehensive review and update of mounting details and standards for large and small sign supports, and to provide a mechanism for TxDOT to quickly and effectively evaluate and address high priority needs related to sign support systems. The information provided through the project will be used to update standard Sign Mounting Detail (SMD) sheets, revise or set policies and standards, and evaluate new products and technologies. The issues to be researched under this project will be formulated on an annual basis, with the ability to modify priorities as needed.

Project Director

Doug Skowronek, TRF

Project Advisors

Armen Miskarov, BRG
Carlos Ibarra, ATL
Charlie Wicker, TRF
Christina Flores, CST
Karl Janak, CST
Larry Colclasure, WAC
Bryan Reed, LBB

Research Supervisor

Roger Bligh, TTI

Total Project Budget	Research Universities	FY 2009 Budget
$249,976	Texas Transportation Institute	$123,502

0-6384 - Evaluation and Development of Traffic Control Devices

Start Date - 09/01/2008 **End Date** - 08/31/2011

Abstract

This three-year research project is designed to provide the Texas Department of Transportation a mechanism creating a method to quickly and effectively evaluate high priority needs related to traffic control devices (TCD). The information provided through the project could be used to set policy and standards, and could be used to develop guidelines or handbooks. In addition, this information could be used to provide training, and to evaluate new products and technologies. The activities to be conducted in this project will be formulated on an annual basis, with the ability to modify priorities as needed.

Project Director

Michael Chacon, TRF

Project Advisors

Carlos Ibarra, ATL
Ismael Soto, CRP
John Gianotti, SAT
Ricardo (Rick) Castaneda, SAT
Roy Wright, ABL
Sylvester Onwas, HOU
Meg Moore, TRF

Research Supervisor

Paul Carlson, TTI

Total Project Budget	Research Universities	FY 2009 Budget
$468,355	Texas Transportation Institute	$150,775

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

Start Date - 09/01/2002 **End Date** - 08/31/2010

Abstract

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
Paul Virmani, FHWA

Research Supervisor
John Breen, CTR

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$1,035,144	Center for Transportation Research	$55,000

0-4889 - Sulfate Resistance of Concrete Exposed to External Sulfate Attack

Start Date - 09/01/2004 ***End Date*** - 08/31/2009

Abstract

Sulfate attack is a complex process that can result in either physical or chemical attack on concrete, and the sources of sulfates can either be internal to the concrete (e.g., DEF) or from external sources, such as groundwater, soils, and agricultural run-off. Texas is a state with relatively high sulfate concentrations (in soil and groundwater) and has long been aware of the potential for sulfate attack. Specifications have been followed over the years that have helped to protect the state from significant external sulfate attack. However, one concern is that the current and upcoming specifications dealing with sulfate attack do not allow for the use of Class C fly ash due to concerns over its poor sulfate resistance (when used by itself without another supplementary cementing material (SCM)). Research has shown that silica fume can be used in small doses to enable the use of Class C fly ash in sulfate-rich environments. Similar research is needed on Texas Class C fly ashes, especially those found in areas without an affordable Class F fly ash source. This project will develop test methods and specifications to provide for rapid implementation of the research results for sulfate-resistant concrete utilizing classic fly ash.

Project Director

Kevin Pruski, BRG

Project Advisors

Elizabeth (Lisa) Lukefahr, CST

Research Supervisor

Kevin Folliard, CTR

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$701,500	Center for Transportation Research	$150,000

0-5255 - Steel Fiber Replacement of Mild Steel in Prestressed Concrete Beams

Start Date - 09/01/2006 **End Date** - 08/31/2010

Abstract

In traditional prestressed concrete beams, longitudinal prestressed tendons serve to resist bending moment, and transverse mild steel bars (or stirrups) are used to carry shear forces. However, traditional prestressed I-beams exhibit brittle shear failure and early-age cracking, despite a high percentage of stirrups at the end zones. Moreover, producing and placing stirrups require costly labor and time. To overcome these difficulties, it is proposed to replace stirrups in prestressed concrete beams, partially or completely, with steel fibers. This replacement concept was shown to be feasible in a TxDOT project recently completed at the University of Houston (Dhonde et al. 2006). The replacement of stirrups by steel fibers in highway beams requires a set of shear design provisions and guidelines for Prestressed Fiber Concrete (PFC) beams. The development of rational shear provisions with wide applications must be guided by a mechanics based shear theory and must be validated by experimental tests on I-beams and box-beams. A rational shear theory, called Softened Membrane Model (SMM), has been developed at the University of Houston for reinforced concrete beams (Hsu and Zhu 2002). This theory satisfies Navier's three principles of mechanics of materials, namely, the stress equilibrium, strain compatibility and the stress-strain curves (constitutive laws) of materials. The researchers propose to expand the SMM model to PFC beams by establishing the constitutive laws of PFC elements.

Project Director
John Vogel, HOU

Project Advisors
Chi-Yen Fan, HOU
Dean Van Landuyt, BRG
Jason Tucker, CST
John Holt, BRG
Louis Triandafilou, FHWA
Matthew Connelly, HOU

Research Supervisor
Yi-Lung Mo, UH

In this project the proposed approach consists of three steps: (1) To test 10 full-size PFC panels, in order to establish the effect of fiber index and the level of prestress on the constitutive laws of fiber concrete and prestressing tendons. (2) To generalize the SMM shear theory for application to PFC beams. This can be achieved by feeding the new constitutive laws of fiber concrete and prestressing tendons into the theoretical model. (3) To evaluate the accuracy of the new shear theory for PFC beams by testing full-size I- and box-beams that fail in various shear modes.

Total Project Budget	Research Universities	FY 2009 Budget
$686,774	University of Houston	$155,973

0-5521 - Develop Statewide Regression Equations for Improved Flood Peak Estimation

Start Date - 10/12/2006 ***End Date*** - 08/31/2009

Abstract

The estimation of peak-stream flow frequency for ungaged streams is an important component of infrastructure design conducted by the Texas Department of Transportation (TxDOT). Peak-stream flow frequency represents the collective peak stream flow for recurrence intervals of 2, 5, 10, 25, 50, 100, 250, and 500 years. A popular technique for estimation of peak-stream flow frequency is based on the regional regression method. The regression equations are developed through the statistical relations between watershed characteristics and site-specific T-year peak stream flow values derived from U.S. Geological Survey stream flow-gaging stations. Watershed characteristics for the ungaged location are used with the T-year regional regression equation to estimate the T-year peak stream flow. A project is proposed to further refine the regional regression equations using state-of-the-practice techniques with the purpose of enhancing cost-effective risk-mitigated design of hydraulic structures by TxDOT. The resulting equations will complement existing techniques in use by TxDOT engineers.

Project Director

George (Rudy) Herrmann, SJT

Project Advisors

Amy Ronnfeldt, DES
David Zwernemann, AUS
John Terry, FTW

Research Supervisor

Ken Rainwater, TECHMRT

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$325,951	Center for Multidisciplinary Research in Transportation	$8,503
	United States Geological Survey	$20,000

0-5574 - Curved Plate Girder Design for Safe and Economical Construction

Start Date - 09/01/2006 **End Date** - 08/31/2009

Abstract

The design of bridge girders is often complicated by the many performance stages that must be evaluated, including erection, construction, and in-service. Horizontally curved girders are especially complex due to the wide range of support conditions and loading that an individual girder is subjected to at various stages during construction. Girder stability during erection and construction phases is often critical due to the variability in the bracing that is present at these crucial stages. Recent failures during construction on bridges in Illinois and Colorado have been blamed on inadequate installation of the bracing. The relatively slender flanges of the I-shaped girders left very little margin for error, which magnified the importance of the bracing. With increased material costs, many engineers are utilizing flange widths near the extreme limits permitted in the AASHTO specification. While these flanges may have sufficient strength and stiffness once the bridge is fully erected, their lateral flexibility can lead to problems during early stages of construction. Although the I-girder systems often have several cross-frames present in the finished bridge, during erection very little bracing is present, which makes the individual girders unwieldy and difficult to handle. The girder and bracing design is often carried out using approximate methods such as a V-load analysis or a grid analysis on the fully erected girder system. Many commercially available programs for bridge analysis are based upon grid analyses.

While these grid-analysis techniques can provide reasonable estimates of the bridge behavior once fully erected, the computer programs are generally unable to provide accurate analyses at many of the critical early construction stages. As a result, engineers need to anticipate some of the difficult steps during erection to ensure the girders have enough stiffness and strength to permit a safe construction sequence. Minimizing the number of cranes and shore towers for girder erection is important to reducing erection costs and increasing erection speed. Sizing the girders for the critical erection stages will lead to a faster, easier, and more economical construction stage with less interruption to traffic on existing roadways. TxDOT commonly employs preferred design practices with minimum flange widths as well as standardized shore tower requirements; however, research has not been conducted to support these basic guidelines.

The research outlined in this project will lead to clear guidelines for the proportioning of curved plate girder systems that can be safely and economically constructed. The research will consist of parametric finite element analyses supported with field measurements. The results of these investigations will produce clear guidelines for sizing and erecting curved plate girder systems.

Project Director
Amy Eskridge, BRG

Project Advisors
Charles Stone, SSE
Dingyi Yang, BRG
Jamie Farris, BRG
John Holt, BRG

Research Supervisor
Todd Helwig, CTR

Total Project Budget	Research Universities	FY 2009 Budget
$411,609	Center for Transportation Research	$129,452

0-5701 - Cross-frame and Diaphragm Layout and Connection Details

Start Date - 09/01/2007 **End Date** - 08/31/2010

Abstract

Cross-frames and diaphragms play an important role in the behavior of straight and curved steel bridge systems. These braces provide stability to straight girders during construction and serve as primary structural members in resisting torsion in curved bridges. Due to complexities in fabrication details and difficulties during erection and construction, these braces are often a large component of the cost of the overall bridge system. The costs associated with the braces can be increased further by maintenance issues during the service life of the bridge, as the cross-frame or diaphragm connections are often the most frequent locations of fatigue problems in steel bridges. Because of the many factors that affect the behavior of the braces, designers are often faced with difficult decisions regarding cross-frame and diaphragm detailing in steel bridges-particularly in bridges with skewed supports.

The research will consider both the stability and fatigue performance of the bracing connections, as well as practical issues related to fabrication and erection. While the bent plates are likely satisfactory for small skew angles, at large skew angles the brace forces cause large bending deformation of the plates, greatly reducing the stiffness of the brace. Large skew angles would require very thick bent connection plates to provide the required stiffness and strength. The limiting magnitude of the skew angle that economical bent plates can be used will be identified. The performance of cross-frames and diaphragms oriented along a staggered layout will also be evaluated. The use of staggered cross-frames can be useful: they permit the perpendicular stiffener orientation while also minimizing live load induced forces because they connect to adjacent girders at similar positions along the respective girder lengths.

Project Director
Yongqian Lin, HOU

Project Advisors
Lisa Novak, BRG
Michael Hyzak, BRG

Research Supervisor
Michael Engelhardt, CTR

The work will be accomplished with laboratory testing, parametric finite element analysis, as well as soliciting feedback from designers and fabricators so that the resulting connection satisfies both functional and practical criteria. The resulting recommendations will provide designers with practical detailing options and guidance relating to skewed diaphragm connections and configuration of torsional bracing systems.

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$538,407	Center for Transportation Research	$186,807

0-5706 - Impact of Overhang Construction on Girder Design

Start Date - 09/01/2006 **End Date** - 08/31/2009

Abstract

Economical constraints on the design of bridges usually necessitate the use of as few girders as possible across the bridge width. The girders are typically uniformly spaced transversely with the deck extending past the fascia girders, thereby resulting in an overhang. While designers commonly employ rules of thumb with regard to the geometry of the overhang, the actual girder behavior is not well understood due to the variability in the girder loading that the overhang exerts on the fascia girder. Construction of the overhang is accomplished using cantilever brackets that support the construction loads that include the weights of the formwork, freshly placed concrete, and the screed. The overhang brackets are connected to the top of the fascia girder and react against the side of these girders. Due to the eccentricity of the overhang, a torsional load is applied to the fascia girder. The forces from the overhang brackets can cause girder deformations that are not well understood in either concrete or steel bridge systems. In concrete girder systems, the overhangs often cause rotation in the fascia girders that are locked into the bridge system once the concrete bridge deck cures. In addition to locking this undesirable rotation into the girders, there are safety concerns with regard to the potential for dropping the formwork between the adjacent girders due to excessive twist of the fascia girder. In steel girder systems, the overhang brackets can cause problems with the local and global stability of the girders. In many instances the overhang brackets exert large concentrated forces on the webs of the steel girders. In deep girders or in the negative moment regions of continuous girders, the overhang brackets can exert large lateral forces on portions of the web in compression. The forces can distort the web, thereby leading to local instabilities or large web imperfections that get locked into the girders once the deck cures.

Project Director
Lewis Gamboa, BRG

Project Advisors
John Holt, BRG
Kelly Fan, HOU
Yuan Zhao, BRG

Research Supervisor
Todd Helwig, CTR

This project focuses on improving the understanding of bridge behavior as a result of the loading from overhangs. Critical scenarios for the layouts and geometries of the overhang brackets will be identified. The products of the research study include a design methodology for overhang design, as well as recommended details for construction bracing that can minimize undesirable deformations in both concrete and steel girder systems. The work will primarily be accomplished through a combination of field investigations and parametric finite element work.

Total Project Budget	Research Universities	FY 2009 Budget
$388,687	Center for Transportation Research	$127,075

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

Start Date - 09/01/2006 **End Date** - 08/31/2010

Abstract

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

John Vogel, HOU

Research Supervisor

David Trejo, TTI

Total Project Budget	Research Universities	FY 2009 Budget
$999,988	Texas Transportation Institute	$257,096

0-5823 - Hydraulic Performance Evaluation of Horizontal Inlet Type H

Start Date - 09/01/2006 ***End Date*** - 08/31/2009

Abstract

Type H Inlets are frequently used by the Texas Department of Transportation as median drains for divided highways. Two varieties of Type H inlets are used. One of them is the Horizontal Inlet (Type H) with grate top and the other is the Horizontal Inlet (Type H) with lid. These are illustrated in TxDOT construction details IL-H-G and IL-HL. Despite frequent use, engineers do not have adequate design information to mathematically describe the hydraulic performance of these structures. Typically, it has been assumed that IL-H-G and IL-H-L function essentially the same as roadway grates or curb inlets, but there is no basis for that assumption. However, the placements in which the Horizontal Inlets can be used deviate substantially from those of a roadway grate or curb inlets. The objective of this project is to evaluate the hydraulic performance of the Horizontal Inlets (Type H) through physical testing, and to synthesize the results of that testing into a series of algorithms for design use.

Project Director

Stan Hopfe, DES

Project Advisors

Amy Ronnfeldt, DES
Cynthia Nurmi, FHWA
David Zwernemann, AUS
Diane Venable, DES
George (Rudy) Herrmann, SJT
John Holt, BRG

Research Supervisor

Ken Rainwater, TECHMRT

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$494,601	Center for Multidisciplinary Research in Transportation	$138,820

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

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

Abstract

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.

This research project 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.

Project Director
Dean Van Landuyt, BRG

Project Advisors
Alissa Scott, BRY
Amy Eskridge, BRG
Graham Bettis, CST
John Holt, BRG
David Hohmann, BRG

Research Supervisor
Oguzhan Bayrak, CTR

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 implifications will promote the use of U-beams and box beams in more projects.

Total Project Budget	Research Universities	FY 2009 Budget
$995,691	Center for Transportation Research	$216,939

0-5834 - Study of Elastomeric Bearings for Superelevated U-Beam Bridges

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

Elastomeric bearings are currently used by the Texas Department of Transportation (TxDOT) to transfer load from the state's standard Texas U-beam section to the substructure. Designers usually refer to a set of TxDOT standard sheets to detail the bearings. The standard details for the bearings seem to work well when the U-beams are placed with little or no superelevation. However, when the beams are placed on a significant superelevation, the transverse thrust due to the dead weight of the beams can cause a transverse shear deformation at the time the beams are placed. This research proposal is designed to address two basic issues. First, are the transverse shear deformations, either alone or in combination with the normally expected thermally induced shear deformations, significant enough to be considered in design? Second, if the transverse shear deformations are significant, how should they be considered in design?

Project Director

John Holt, BRG

Project Advisors

Amy Eskridge, BRG
Dacio Marin, BRG
Jeff Cotham, BRG
Walter Fisher III, DAL
Keith Ramsey, BRG

Research Supervisor

Phillip Nash, TECHMRT

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$225,272	Center for Multidisciplinary Research in Transportation	$105,719

0-5849 - Evaluating Existing Culverts for Load Capacity Allowing for Soil Structure Interaction

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

When rights-of-way crossing existing culverts have to be raised and/or widened, the culverts have to be reanalyzed. Using current analysis methods (direct stiffness) and AASHTO loading protocols often results in these culverts being judged deficient, with a requirement for replacement or retrofit. The puzzling thing is that even very old box culverts very rarely fail in service, and that when they do show distress it's not in the same form as the current analysis methods would predict. This indicates that the direct-stiffness method is too conservative, and not representative of soil-structure interaction. It is not accurate enough in representing either the way the soil loads the structure, or the percentage of load that the soil itself absorbs. The proposed research suggests that the best way to approach this problem is to use finite element analysis to model the soil-structure system. Calibrate the analytical model by using heavy vehicles to apply lane loads to existing culverts, and measuring strain and deflection in the walls and slabs. Perform parametric analyses to calculate actual culvert structural loads over a range of culvert structures and geometries, and fill heights and characteristics. Develop rational load ratings for culverts by applying the reserve capacity determined through the parametric finite element studies to the demand calculated by direct stiffness .

Project Director

Manuel (Bernie) Carrasco, BRG

Project Advisors

Farren Basse, SAT
Mark McClelland, BRG
Mark Steves, BRG
Roger Lopez, SAT
Jon Kilgore, BRG

Research Supervisor

William (Bill) Lawson, TECHMRT

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$215,630	Center for Multidisciplinary Research in Transportation	$102,981

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

Start Date - 09/01/2007 ***End Date*** - 08/31/2011

Abstract

Recent TxDOT studies (0-1857,04069, 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 the proposed work is to develop guidelines for applying strut-and-tie models to large structural elements subject to varying conditions of premature concrete deterioration.

Project Director

Dingyi Yang, BRG

Project Advisors

Aldo Romero, SAT
Dean Van Landuyt, BRG
John Vogel, HOU
Yuan Zhao, BRG
Jon Kilgore, BRG

Research Supervisor

Joseph Bracci, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$849,808	Texas Transportation Institute	$199,268

0-6060 - Realtime Monitoring of Scour Events Using Remote Monitoring Technology

Start Date - 09/01/2007 ***End Date*** - 08/31/2010

Abstract

Bridge scour is the number one cause of bridge collapse. Improvements in prediction methods, scour countermeasures, and scour monitoring are needed. This project addresses fixed scour monitoring as a very useful approach to improving the safety of the traveling public while minimizing the expense. Fixed scour monitoring consists of placing instruments around the bridge monitoring the depth of the scour hole which may develop around bridge supports during high flow events. Warnings are sent to the authorities in time to shut the bridge in case of emergency. Scour monitors are still in development and there is a need to make them less expensive, easier to install, more robust, and to optimize the remote and wireless data collection and warning system.

Project Director

Marcus Galvan, BRG

Project Advisors

John Delphia, BRG
Nellie Shannon, SAT
Mark McClelland, BRG

Research Supervisor

Jean-Louis Briaud, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$375,733	Texas Transportation Institute	$129,918

0-6063 - Site Specific Wave Parameters for Texas Coastal Bridges

Start Date - 09/01/2007 ***End Date*** - 08/31/2009

Abstract

Several highway bridges along the Gulf Coast were damaged in recent hurricanes due to combined action of wave and storm surge. To prevent structural failure of coastal bridges, the wave force on bridge structures need to be determined. The objective of this research is to determine site-specific design wave parameters (i.e. wave height and wave period) which are needed in calculation of wave forces and evaluation of wave effects on bridge structures. The scope of this research include collection of historical wave and water level data along Texas coast, hindcast of wave climate along Texas coast for a seven year period (1999 to 2006), and determination of site-specific design wave parameters with long-term statistical analysis. Hindcast of water level including storm surge will be performed to provide input water level to wave hindcast. Both wave and water level surge hindcasts will be validated with observed wave and water level data. Site-specific wave parameters will be determined for specified probability of occurrence (e.g. 10% probability of exceedance in 50 years) or return period (e.g. once per 100 years). The results of this research will enable TxDOT to quickly implement the design methodology to be produced by an ongoing AASHTO/FHWA pooled fund study.

Project Director

Dacio Marin, BRG

Project Advisors

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Jon Holt, HOU
Mario Jorge, PHR

Research Supervisor

Jun Jin, TAMUG

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$237,555	Texas A&M University at Galveston	$68,224
	Texas Transportation Institute	$50,316

0-6070 - Use of the Rational and Modified Rational Methods for TxDOT Hydraulic Design

Start Date - 09/01/2007 ***End Date*** - 08/31/2010

Abstract

The rational method is a tool hydraulic engineers use to estimate design discharge for sizing a variety of drainage structures. The method are relatively simple: The peak discharge Q, is equal to the product of the drainage area A, the rainfall intensity I, and a runoff coefficient c. The last two terms, I and c, are dependent on analyst estimates of time-of-concentration and watershed conditions. Furthermore there is evidence that the runoff coefficient, c, is dependent on rainfall depth, thus the two terms are correlated and the simple model becomes quite nonlinear. The modified rational method is an extension of the rational method used to generate a runoff hydrograph for applications where the peak discharge is not sufficient to execute a design. The modified rational method uses the peak discharge produced by application of the rational method. A hydrograph is created by using the time of concentration for the time to peak discharge and using twice the time of concentration for the time base of runoff. The purpose of this project is to evaluate appropriate conditions for use of the rational and modified-rational methods for design on small watersheds, evaluate and refine, if necessary, current tabulated values of the runoff coefficient, and construct guidelines for TxDOT analysts for the selection of appropriate parameter values for Texas conditions.

Project Director

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Project Advisors

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Research Supervisor

Theodore Cleveland, TECHMRT

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$447,100	Lamar University	$40,000
	United States Geological Survey	$90,000
	University of Houston	$62,100

0-6094 - Mitigation Methods for Temporary Concrete Traffic Barrier Effects on Flood Water Flows

Start Date - 09/19/2008 **End Date** - 08/31/2010

Abstract

The requirement to use successfully crash tested concrete traffic barriers poses a concern with respect to hydraulic performance because the additional height and less open space may adversely impact the surrounding floodplain elevation. In the event of extreme flood, these barriers obstruct water flows and magnify the flooding by increasing the head water elevation. The issue of hydraulic performance of concrete traffic barrier came to limelight when a number of major arterial highways were shut down due to State wide flooding last year.

The primary objective of this project is to determine the hydraulic performance of standard and modified temporary concrete traffic barriers (TCTBs). The additional objectives include, evaluation of susceptibility to clogging, stability analysis in-terms of sliding and overturning, and develop a method to model of standard and modified TCTBs in HEC-RAS.

A combined experimental and analytical approach will be put together to achieve the objectives of the project. Two standard types and a modified TCTB will be evaluated. The fraction of open space of the two standard (F-shaped and single slope) TCTBs are much smaller than the modified TCTB. If the modified TCTBs are better in-terms of hydraulic performance and have adequate factor of safety for sliding and overturning, then the modified TCTB might be recommended as a choice for future to achieve its objectives without considerably hindering water flows during any flood event.

A parametric study will be conducted with HEC-RAS software for different geometric situations using parameters obtained from laboratory measurements. The total length of TCTB barricade, geometry and other properties of the flood plain, such as longitudinal slope, cross slope, elevation of the location where TCTB will be placed compared to that of other locations of the flood plain etc., will be varied for each type of the TCTB. The corresponding geometry and hydraulic efficiency parameters will be used as the input of the model to characterize the magnification of highway flooding due to installation of TCTB. This parametric study will also provide the information about the situations when the use of TCTB will be detrimental.

A concerted effort will be put forward by a well-rounded research team having expertise and experience in all required fields for the project. The collaboration between UTSA and UTAustin will provide the chance to take advantage of the experience of the UT researchers and the state-of-the-art research laboratory of UT-Austin.

Project Director

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Project Advisors

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Evan Roberts, PHR
Rob Fanning, HOU

Research Supervisor

Sazzad Shafique, UTSA

Total Project Budget	Research Universities	FY 2009 Budget
$199,172	Center for Transportation Research	$47,220
	University of Texas at San Antonio	$54,270

0-6100 - Development of a Precast Bridge Deck Overhang System

Start Date - 10/09/2007 **End Date** - 08/31/2009

Abstract

TxDOT personnel recently developed a precast, full-depth overhang system for bridges that has the potential to reduce cost, improve safety, improve constructability of bridges, and provide long-lasting bridge structures. However, several issues need to be investigated prior to implementation of this new system. This research proposes to evaluate the performance of the new, full-depth overhang system, evaluating the modes of failure and verifying the composite action of full-scale samples. Comparison will be made with conventional cast-in-place concrete overhang systems. In addition, materials necessary to connect the precast beams with the precast overhand and the precast beams with adjacent precast beams (placed longitudinally along the beam) will be investigated. A newly developed haunch form will be assessed for robustness and performance and alternative methods will be identified and evaluated. The research team will work with precast companies to evaluate and optimize the fabrication and constructability of the newly proposed system. Modifications to the current design will be proposed if necessary to increase the likelihood of implementing and capturing the potential significant benefits of this new system.

Project Director

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Project Advisors

John Holt, BRG
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Ralph Browne, FTW
Robert Cochrane, BRY
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Research Supervisor

David Trejo, TTI

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$405,010	Texas Transportation Institute	$130,010

0-6146 - Design of Short, Laterally Loaded Drilled Shafts in High-Plasticity Clay

Start Date - 10/10/2008 ***End Date*** - 08/31/2010

Abstract

An in-depth research investigation is proposed here to assess the possible causes of failures of drilled shafts or piers supporting cable median barriers in high plasticity clay environment and, consequently, develop new or revised methods for the design of drilled shafts with no failures for the same environment. The initial task of the research will involve a thorough documentation of available research on drilled shafts subjected to lateral and uplift loads. The middle tasks will focus on estimation of tensions mobilized in each cable, selection of a test site, construction of twelve different piers, and lateral load testing of the piers by simulating cable loads. Both numerical and analytical models will be used to predict the pier load test results. Once good calibration is achieved, these models will be used to predict lateral load capacities of piers of other dimensions. Uplift checks will also be addressed based on laboratory measured swell pressures. Design charts and guidelines will be developed to provide appropriate shaft dimensions for different soil conditions, tensions mobilized in the cable and for satisfying uplift considerations. Project deliverables will include reports summarizing research findings and design/construction guidelines of piers in high plasticity clay.

Project Director

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Project Advisors

Anthony Okafor, DAL
David Seago, DAL
Gary Moonshower, DAL
Jan Heady, DAL
Jimmey Bodiford, FTW
Marie Fisk, BRG
Walter Fisher III, DAL

Research Supervisor

Anand Puppala, UTA

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$237,446	University of Texas at Arlington	$126,032

0-6152 - Shear in High Strength Concrete Bridges

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

Abstract

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 proposed 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

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

Research Supervisor

Yi-Lung Mo, UH

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$999,961	University of Houston	$249,961

0-6306 - Shear Strengthening of Large Reinforced Concrete Elements Using Carbon Fiber Reinforced Polymer (CFRP) Sheets

Start Date - 09/01/2008 ***End Date*** - 08/31/2011

Abstract

The objective of the study is to demonstrate the feasibility of using CFRP for shear strengthening of large bridge girders or supporting elements. Although many tests have been done on small elements to show the efficiency of CFRP anchors and sheets, data are needed where large elements are to be strengthened to carry substantial shear forces. Also there has been little work done regarding the effect of creep of polymer materials and anchors under sustained or fatigue loads. A large amount of research has been conducted on the use of CFRP materials for structural strengthening. In most of these studies the forces are transferred from the concrete member into the CFRP through interface bond. As a result, it has been found that although the CRFP material has high tensile strength, only about 40 to 50% of that strength can be realized. With the use of CFRP anchors that result in development of stresses that will fracture the CFRP sheets, the application of these materials to strengthen damaged or inadequate reinforced concrete members becomes more feasible and economical. The ability to quickly apply the materials with a minimum of disruption to the use of a structure and with virtually no change in the geometry or weight of the element makes CFRP a viable and attractive method for strengthening existing elements.

Project Director
Dingyi Yang, BRG

Project Advisors
Carl Johnson, BWD
Keith Ramsey, BRG
Leon Flournoy, BRG
Nicholas Horiszny, HOU

Research Supervisor
James Jirsa, CTR

The scope of the proposed research includes the following tasks:

- Determine situations where TxDOT may consider the use of CFRP for shear strengthening.
- Establish the anchor requirements for use of CFRP sheets as shear reinforcement.
- Conduct tests to determine creep and fatigue characteristics of CFRP shear reinforcement.
- Determine the behavior of CFRP shear reinforcement on full-scale typical TxDOT elements.
- Develop design guidelines and material and construction specifications for the use of CFRP sheets as shear reinforcement.

Total Project Budget	*Research Universities*	*FY 2009 Budget*
$695,000	Center for Transportation Research	$220,000

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

Start Date - 09/01/2008 **End Date** - 08/31/2011

Abstract

In ASCE's 2003 Progress Report, our national infrastructure was given an overall of 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. This proposal describes a laboratory- and fieldbased research program aimed at developing 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.

Project Director

Kevin Pruski, BRG

Project Advisors

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Hector Garcia, FHWA
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Research Supervisor

Kevin Folliard, CTR

Total Project Budget	Research Universities	FY 2009 Budget
$498,500	Center for Transportation Research	$160,000

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

The project statement for this project was produced by combining two different project statements, one dealing with precast prestressed concrete deck panels and the other dealing with top mat reinforcement. The comprehensive work plan proposed here is intended to address both those issues and their interaction. The work will be carried out at two institutions. The work plan presented in the main body of this proposal envisages concurrent research on top mat reinforcement and on precast deck panels, to facilitate timely completion of the research. Deck Panel Research: The project statement indicates that 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. Our proposed 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. Our proposed 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. Our proposed 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

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Research Supervisor

Richard Klingner, CTR

Total Project Budget	Research Universities	FY 2009 Budget
$938,755	Center for Transportation Research	$171,656
	University of Texas at Arlington	$29,938

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

Start Date - 09/01/2008 **End Date** - 08/31/2011

Abstract

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 strategically MSE walls. The proposed research 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. 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

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Project Advisors

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Zhiming Si, CST

Research Supervisor

Soheil Nazarian, UTEP

Total Project Budget	Research Universities	FY 2009 Budget
$444,824	University of Texas at El Paso	$155,266

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

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

Abstract

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. 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 results of this initial look into the LRFD expressions are summarized in Figure 1. As seen in this figure 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.

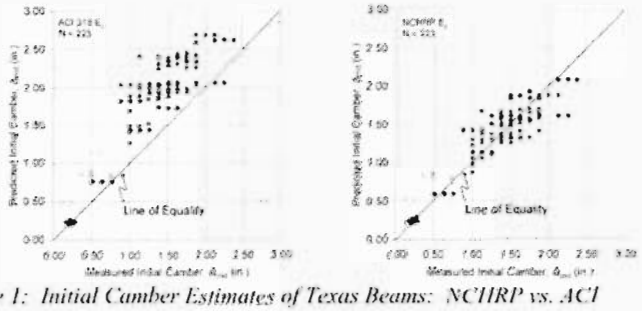

Figure 1: Initial Camber Estimates of Texas Beams: NCHRP vs. ACI

Losses due to elastic shortening can be estimated more accurately (rather than conservatively) by using the NCHRP expressions. While the PI of this proposal 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 proposal is tailored to answer those questions. In short, the work outlined in this proposal 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 as explained in the problem statement.

Project Director
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Research Supervisor
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Total Project Budget	Research Universities	FY 2009 Budget
$787,521	Center for Transportation Research	$220,407

0-6375 - Design of Cut-Type Retaining Walls in High Plasticity Soils

Start Date - 09/01/2008 **End Date** - 08/31/2010

Abstract

The current TxDOT design procedure for common retaining structures in cuts, such as soil nailing, tied-back, and drill shaft walls, is based on lateral pressures calculated from classical Rankine's or Coulomb's methods considering drained shear strength parameters and does not include any lateral pressure due to moisture change in expansive soils. In recently years, some of the TxDOT consultants raised the issue of considering additional lateral swelling pressure for designing retaining structures on expansive soils. The proposed lateral swelling pressures are as much as 10 to 20 times higher than the average lateral pressures that are considered in current procedures. In order to respond to the concerns of the TxDOT consultants and to reconfirm the current design procedure for the retaining walls that are common on cuts, a combined experimental, field study, and computer modeling approach will be put together to evaluate the design procedure in the context of field environment. A concerted effort will be put forward by a well-rounded research team having expertise and experience in the geotechnical and structural engineering areas. The project will begin with a literature review to compile relevant and timely information that can be used to evaluate the different field situations. Two field sites will be identified with the help of TxDOT personnel where retaining structures have been constructed on expansive soils. One of the sites will be a soil nailed or tied-back retaining wall and the other will be drilled shaft retaining wall. The reason for selecting these two types of walls is because of the different support conditions and design criteria usually used for designing them. Soil samples will be collected from the field sites and will be subjected to testing using state-of-the-art technology to characterize the soil to evaluate how the soil will perform in the context of field environment. The field sites will be instrumented with thermocouple psychrometer probes to collect the seasonal moisture content profiles. Data collected from field and laboratory testing will be used to simulate the retaining walls using a finite element model to study the stability analysis. The model will be verified using information collected from the literature review. Once the model is verified and calibrated, a parametric study will be conducted by varying different pertinent input parameters of soils and structures. Based on the sensitivity of each of the parameters, the conditions will be identified where the design of the walls needs special attention. The proposed project will provide TxDOT with relevant information and guidelines that can be used to design retaining structure in cuts in expansive soils with renewed confidence. Consequently, TxDOT will be able to implement the results of this research immediately and realize potentially large cost savings.

Project Director

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Research Supervisor

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Total Project Budget	Research Universities	FY 2009 Budget
$259,810	Texas Transportation Institute	$49,934
	University of Texas at San Antonio	$79,295

0-6382 - Establish Effective Lower Bounds of Watershed Slope for Traditional Hydrologic Methods

Start Date - 09/01/2008 **End Date** - 08/31/2011

Abstract

Traditional hydrologic methods such as the modi ed rational method, unit hydro-graphs, as well as modeling tools such as HEC-HMS, NRCS TR-20, EPA-SWMM, etc. rely either on an estimate of the time response characteristics of the watershed that is related to distances and slopes or directly upon slope. For example, kinematic wave routing assumes uniform flow hydraulics; thus the travel speeds are inversely related to localized slopes3. As slope approaches zero, relationships that contain slope in the denominator [nearly all] predict very small speeds and correspondingly large travel times. These large travel times can be quite unrealistic and alternate approaches are appropriate. The consequence of poor timing computations is likely to be under-sizing (as slope diminishes, estimated time increases, and estimated peak discharge decreases), but over-sizing using arbitrary timing values is also quite possible. Appropriately estimating characteristic times on low-slope watersheds will enhance confidence in predicting design discharges resulting in better decisions on structure size and corresponding cost, better use of money, and reduced risk of underestimation or of costly overestimation. The purpose of this project is to identify from literature, data, modeling and experiments, the dimensionless slope when alternate approaches should be considered, and to provide guidance on what approaches are appropriate in such low-slope situations.

Project Director

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Project Advisors

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Research Supervisor

Theodore Cleveland, TECHMRT

Total Project Budget	Research Universities	FY 2009 Budget
$464,622	Center for Multidisciplinary Research in Transportation	$78,506
	Texas Transportation Institute	$56,331
	United States Geological Survey	$70,000

0-6389 - Framework for Reliable and Comprehensive Bridge Management and Information System (BMIS)

Start Date - 10/31/2008 **End Date** - 08/31/2010

Abstract

There are over 50,000 bridges in the state of Texas. The Texas Department of Transportation (TxDOT) inspects most of these bridges. TxDOT uses several different systems that are not interlinked, to store different information on these bridges. Because these systems are not interconnected, information essential to the optimal management of these bridges is not readily available to TxDOT engineers and decision makers. Additionally, information on bridge-related maintenance expenditures is extremely limited to the most basic of categories, and links to SiteManager are effectively nonexistent with the current system.

An effective use of TxDOT resources would be to use the encompassing datasets currently available to better manage bridge maintenance rehabilitation and reconstruction. TxDOT lacks a blueprint for the development of a comprehensive, reliable Bridge Management Information System (BMIS). An effective BMIS system would serve the needs of the districts, those responsible for developing and monitoring statewide letting of bridge projects, and TxDOT management personnel. The objective of this project is to develop the frame work for a BMIS for TxDOT. This system should be user-friendly, accessible to a wide variety of users, and GIS enabled. An effective system must meet the needs of all users and provide information needed by all parties interested in bridge management.

Project Director

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Project Advisors

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Joe Riba, BRG

Research Supervisor

Andrew Wimsatt, TTI

Total Project Budget	Research Universities	FY 2009 Budget
$365,521	Texas Transportation Institute	$115,486
	University of Texas at San Antonio	$64,579

9-1526 - Investigation of the Fatigue Life of Steel Base Plate to Pole Connections for Traffic Structures

Start Date - 11/04/2005 **End Date** - 08/31/2009

Abstract

This pooled fund project will investigate improvements that can be made to the connections of the base or end plates to mast or mast arm of traffic structures to improve their fatigue life. Recent research on the fatigue life of traffic signal mast arm to pole socket welded connections found that the fatigue category of socket welds is E' or less and that the addition of stiffeners does not improve fatigue performance to the level predicted by the AASHTO Specifications and in some respects are detrimental. However, the research also found that small changes in various connection details, such as plate thickness, bolt pattern, and stiffener pattern, can improve the fatigue life of the connection. A combined experimental and analytical approach is underway to develop cost effective and practical connections designs with enhanced fatigue performance. The range of variables will be determined based upon a literature survey and the design standards used by the sponsoring states. The research will quantify the effect of these changes and provide design relationships between the arm and end plate geometry which will provide a systematic way that this knowledge can be incorporated into the design process and the AASHTO specifications for signal poles, high mast illumination poles, and other traffic structures.

Objectives

1.Develop a comprehensive list of connection details that affect the fatigue life of various commonly used connection details

2.Determine which changes to these details could feasibly and most cost effectively be used to increase the fatigue life of base plate to pole connections, with and without stiffeners

3.Determine a quantitative relationship between the changes in the details and their effect on the fatigue life of the connection

4.Develop a fatigue design guide that would show designers how they could quantitatively use the various recommended changes for use in there fatigue designs

5.Develop language to incorporate the above guide into the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals

Project Director

Tim Bradberry, BRG

Project Advisors

Jim Yang, BRG

Favid Hohmann, BRG

Research Supervisor

Karl Frank, CTR

Total Project Budget	Research Universities	FY 2009 Budget
$588,500	Center for Transportation Research	$145,000

9-4973 - Guidelines for Designing Bridge Piers and Abutments for Vehicle Collisions

Start Date - 03/26/2007 **End Date** - 08/31/2009

Abstract

This is a pooled fund research project. The AASHTO LRFD Bridge Design Specifications require that "abutments and piers located within a distance of 30.0 FT of the edge of the roadway, or within a distance of 50.0 FT to the centerline of a railway track, shall be designed for an equivalent static force of 400 KIP..." Supporting documentation for this design requirement, both its applicability and the magnitude of the design force, is not extensive. Further detailed guidance for the design engineer is not available.

Two issues need to be addressed:
1. What risks warrant application of this requirement? and,
2. Is the magnitude of design force (400 KIP) appropriate?

Scope of Work: This project will be conducted in two phases, as listed below. All Phase 1 work shall be completed, and recommendations for Phase 2 work (if any) approved by the project sponsors, prior to commencement of any Phase 2 research activities.

Project Phasing and Tasks:
Phase 1 will include the following tasks:
1a. Literature review,
1b. Computer simulations of vehicle/bridge column and abutment collisions,
1c. Accident survey and analysis study,
1d. Development of a risk analysis methodology for vehicle/bridge column and abutment collisions (analogous to AASHTO LRFD vessel impact requirements).
1e. Detailed justification and work plan for research (if any) to be conducted under Phase 2 of the project.
1f. Provide facilities and host a meeting to present Phase 1 results to project sponsors, including pooled fund project participants from other state DOTs.

Phase 2 may include the following tasks:
2a. Crash testing with a single unit truck to verify loading from Phase 1 literature survey and computer simulations.
2b. Crash testing of a 5-axle tractor trailer rig to verify loading from Phase 1 literature survey and computer simulations.

Project Director
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Project Advisors
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James Pohl, YKM
Nicholas Nemec, BRG
Alfredo Valles, FTW
Peter Chang, FHWA

Research Supervisor
Carl Buth, TTI

Total Project Budget	Research Universities	FY 2009 Budget
$423,470	Texas Transportation Institute	$315,042

9-5498 - Methods of Evaluating the Redundancy of Steel Bridges

Start Date - 09/01/2005 **End Date** - 08/31/2009

Abstract

Bridges that are classified as failure critical by AASHTO require more frequent inspections than other types of bridges, resulting in greater costs for their design and operation. These higher costs are justified if the use of such bridges does indeed pose a greater risk to the traveling public in comparison to other bridge types. However, several historical events involving the failure of main load-carrying members in steel bridges have demonstrated the ability of bridges to have significant reserve load carrying capability. For example, the girder failure of the I-79 Bridge at Neville Island in Pittsburgh in 1977 and the Hoan Bridge in Milwaukee in 2000 have shown that severe damage can occur without necessarily resulting in bridge collapse. Consequently, research is needed to characterize and define the different redundancies that can be safely incorporated into the evaluation of failure-critical bridges. With such information, it may be possible to modify inspection procedures and bridge classifications so that costs are dramatically reduced.

This project will develop guidelines for modeling a bridge's behavior after failure of a critical component. The research will include nonlinear structural modeling coupled with laboratory testing to validate analysis predictions. Modeling guidelines will be developed that can be used by TxDOT engineers and their consultants to evaluate the behavior of steel bridges with critical structural components.

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Total Project Budget	Research Universities	FY 2009 Budget
$948,088	Center for Transportation Research	$200,000

Project Index

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