Research Digest

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TxDOT Research Reports (Nov.2014-Jan.2015)

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Item 1

9-1529, Low-Cost Safety Solutions, Pavement Preservation, and Maintenance Practices for Rural Highways

TEXAS DEPARTMENT OF TRANSPORTATION (TXDOT). RESEARCH AND TECHNOLOGY IMPLEMENTATION OFFICE (RTI)

TTI 1529 PSR • 2014

"The objective of this project was to develop and demonstrate innovative low-cost solutions to improve safety at stop-controlled intersections. Preliminary directives from the project panel were to focus on treatments on the minor street approach and not necessarily on the major street approach, and to investigate solutions that are active in nature, i.e., have beacons come on when a vehicle arrives or when a vehicle is not slowing down. The focus of [Task 2] was to demonstrate the latest pavement preservation and maintenance treatments in a controlled environment, and then apply the best-performing products in demonstration projects."

(2 pages)

This report is available for free download (353 KB):

http://tti.tamu.edu/documents/9-1529-S.pdf

Item 2

Data Collected on TPAD Implementation Projects

UNIVERSITY OF TEXAS AT AUSTIN. CENTER FOR TRANSPORTATION RESEARCH (CTR)

CTR 6005-01-P3 • 2014

"TPAD testing was conducted by CTR personnel at the following locations during TxDOT Project 5-6005-01: Statewide Implementation of Total Pavement Acceptance Device (TPAD) (January 2013 through August 2014): (1) San Marcos Airport, (2) IH 10 in El Paso (two tests conducted at this site), (3) US 75 in Sherman, (4) IH 27 in Lubbock and Amarillo, (5) US 287 in Quanah, (6) US 287 in Childress, and (7) SH 288 in Houston. Pertinent data are provided in [this document]." --Introduction
(51 pages)

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This report is available for free download (5.5 MB):
http://library.ctr.utexas.edu/ctr-publications/5-6005-01-P3.pdf

Item 3

Conference/Workshop Presentation Materials

UNIVERSITY OF TEXAS AT AUSTIN. CENTER FOR TRANSPORTATION RESEARCH (CTR)

CTR 6005-01-P4 • 2014

"Project No. 5-6005-01: Statewide Implementation of Total Pavement Acceptance Device (TPAD) is coming to completion. During the operating period of the TPAD (January 1, 2013 through August 31, 2014), the research team gave several presentations and demonstrations concerning TPAD operations and data analyses. Most demonstrations were performed in the districts where TPAD implementation testing was conducted or at symposia at CTR and TTI. This product (P4) documents the project progress by conveying papers and PowerPoint presentations given at two major research conferences. The conference papers describe the TPAD components, functionality, and operation. The papers also discuss data analyses and results primarily associated with deflection and GPR profiles." --Introduction

([92] pages)

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This report is available for free download (3.3 MB):
http://library.ctr.utexas.edu/ctr-publications/5-6005-01-P4.pdf

Item 4

Project Level Performance Database for Rigid Pavements in Texas, II

TEXAS TECH UNIVERSITY. CENTER FOR MULTIDISCIPLINARY RESEARCH IN TRANSPORTATION (TECHMRT)

TechMRT 6274-2 • 2014

The primary objectives of this project included the collection of information on continuously reinforced concrete pavement (CRCP) behavior and performance in Texas to calibrate the mechanistic-empirical pavement design procedure for CRCP developed under TxDOT research study 0-5832, and the overall evaluation of rigid pavement performance in Texas, including special and experimental sections. To achieve the objectives, extensive field evaluations were conducted to identify the mechanisms of structural stress in CRCP and to investigate CRCP behavior at transverse cracks using falling weight deflectometer (FWD). Calibration of the distress prediction model in the new CRCP design procedure was made with a development of a transfer function. It was also observed that the most of the distresses in CRCP were due to the quality control issue of materials and construction. Jointed concrete pavement (CPCD) performance is satisfactory, except that most of the distresses were at transverse contraction joints, indicating construction quality issues. In addition, field evaluations were conducted on various experimental sections where the effects of design (steel percentages), materials (coarse aggregate type), and construction (placement season, early-entry saw cuts) variables on CRCP structural responses and performance were investigated. Furthermore, research efforts were made to examine the performance and behavior of a number of special test sections TxDOT has built over the years. The special PCC sections addressed in this project include post-tensioned concrete pavement (PTCP), precast PTCP, bonded (BCO) and unbonded (UBCO) concrete overlays, fast-track concrete pavement (FTCP), whitetopping sections, 100% recycled concrete aggregate (RCA) concrete pavement, and roller-compacted concrete (RCC) pavement sections. Lastly, this project developed an advanced and user-friendly database called the Texas Rigid Pavement Database (TxRPDB). This database is web-based, GIS-oriented, and application-integrated. This database includes all the information obtained in this project in an organized manner, with a query function.
(x, 298 pages)

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This report is available for free download (16.6 MB):
http://www.depts.ttu.edu/techmrtweb/Reports/Complete%20Reports/0-6274-2_Final.pdf

Item 5

Testing of Alternative Supporting Materials for Portable Roll-Up Signs Used for Maintenance Work Zones

TEXAS TECH UNIVERSITY. CENTER FOR MULTIDISCIPLINARY RESEARCH IN TRANSPORTATION (TECHMRT)

TechMRT 6639-1 • 2014

Portable roll-up signs are currently used by the Texas Department of Transportation (TxDOT) for identification of short-term maintenance/work zones and emergency operations. These signs have fiberglass frames to directly support diamond-shaped and rectangular flexible sign faces. It has been frequently reported that the fiberglass frames have failed due to bending caused by natural wind or gust generated by passing vehicles. The cost of these failures is more than the marginal cost of replacing the broken frame members. It includes the safety cost to workers and the traveling public. Research studies to date on sign structures have focused on permanent signs with rigid faces. However, there has been little formal and in-depth research on wind loading on roll-up signs with flexible facing materials. This research project was proposed to address three major issues: (1) understanding the nature of wind loading on portable roll-up signs, (2) identifying alternative materials for fiberglass frames, and (3) developing modified/new designs of portable roll-up signs. The work performed under this project revealed that the vertical frames failed due to progressive cracking at the fiber-matrix interfaces caused by torsion, instead of bending. Therefore, it was determined to increase the torsional stiffness of vertical frames by wrapping high-strength carbon fiber sheets around the existing fiberglass frames in a pre-determined direction to improve the resistance to wind loading. Prototype roll-up signs with the modified frame design were manufactured in the laboratory and were subjected to various tests including the full-scale vehicle impact tests per MASH impact performance criteria. The test results showed that the modified design showed better serviceability as well as higher resistance to torsion as compared to the original design. In addition, the prototype roll-up signs met MASH impact performance criteria. The outcome of the project can lead to a significant reduction of the cost for replacing failed roll-up signs, and more importantly, help improve the safety of workers and traveling public in maintenance/work zones.

(xii, 93, x, 88, [22] pages)

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This report is available for free download (17.6 MB):
http://www.depts.ttu.edu/techmrtweb/Reports/Complete%20Reports/0-6639_1_FINAL.pdf

Item 6

Data Collection and Population of the Database (The DSS and RDSSP)

TEXAS A&M UNIVERSITY. TEXAS TRANSPORTATION INSTITUTE (TTI)

TTI 6658-P5 • 2014

"This study was initiated to collect materials and pavement performance data on a minimum of 100 highway test sections around the state of Texas, incorporating both flexible pavements and overlays. Besides being used to calibrate and validate mechanistic-empirical (M-E) design models, the data collected will also serve as an ongoing reference data source and/or diagnostic tool for TxDOT engineers and other transportation professionals. Towards this goal, this product provides an itemized documentation of the data collection and population that is being conducted..." --p.1
(viii, 74 pages; 3.65 GB)

• Accompanying CD-ROM contains "Databases to accompany Product 0-6658-P5"

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This report is available for free download (10.2 MB):
http://tti.tamu.edu/documents/0-6658-P5.pdf

Item 7

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

TEXAS DEPARTMENT OF TRANSPORTATION (TXDOT). RESEARCH AND TECHNOLOGY IMPLEMENTATION OFFICE (RTI)

TTI 6683 PSR • 2014

"The Texas Department of Transportation (TxDOT) instituted the PMP [Pavement Management Plan] requirement for all 25 districts to help expend its limited resources and achieve its performance goals in a cost-effective manner and in response to legislative requirements (Rider 55 of TxDOT's appropriations bill). Each of TxDOT's 25 districts prepares a PMP that identifies candidate M&R projects for a 4-year planning period. TxDOT is responsible for the upkeep of approximately 194,000 lane-miles of roadway pavement. This research project seeks to support and enhance the PMP development process through a consistent methodology and computational tool. The methodology will help identify pavement M&R projects that yield the maximum performance benefits expected under different budget scenarios over a multi-year planning period."
(2 pages)

This report is available for free download (485 KB):
http://tti.tamu.edu/documents/0-6683-S.pdf

Item 8

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

TEXAS DEPARTMENT OF TRANSPORTATION (TXDOT). RESEARCH AND TECHNOLOGY IMPLEMENTATION OFFICE (RTI)

CTR 6717 PSR • [2015]

"In Texas, Class F fly ash is extensively used as a supplementary cementing material (SCM) because of its ability to control thermal cracking in mass concrete and to mitigate deleterious expansions in concrete from alkali-silica reaction (ASR) and sulfate attack. However, uncertainty in the supply of Class F fly ash due to impending environmental restrictions has made it imperative to find and test alternate sources of SCMs that can provide similar strength and durability benefits to concrete. This research characterized and evaluated the performance of eight natural pozzolans, available in Texas, to assess their potential as a Class F fly ash replacement in concrete." --Background
(2 pages)

This report is available for free download (356 KB):
http://library.ctr.utexas.edu/ctr-publications/psr/0-6717-s.pdf

Item 9

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

TEXAS DEPARTMENT OF TRANSPORTATION (TXDOT). RESEARCH AND TECHNOLOGY IMPLEMENTATION OFFICE (RTI)

CTR 6723 PSR • 2014

"The state of Texas has been plagued by various durability-related issues in recent years, including deterioration from alkali-silica reaction, delayed ettringite formation, corrosion of reinforcing steel, volume changes (plastic shrinkage, drying shrinkage, thermal effects, etc.), and spalling of continuously reinforced concrete pavements. These durability-related issues, coupled with other factors that contribute to reductions in service life (e.g., service loads and defects), have resulted in the need to repair concrete structures and to do so in a timely, efficient fashion, with minimal disruption to the traveling public. Thus, the need for rapid, cement-based repair materials... The focus of this project was to evaluate a range of repair materials across a range of properties (fresh, hardened, and durability) that affect the performance of horizontal repairs, such as on pavements and bridge decks."
(2 pages)

This report is available for free download:
http://library.ctr.utexas.edu/ctr-publications/psr/0-6723-s.pdf

Item 10

HMA Shear Resistance, Permanent Deformation, and Rutting Tests for Texas Mixes: Year-2 Report

TEXAS A&M UNIVERSITY. TEXAS TRANSPORTATION INSTITUTE (TTI)

TTI 6744-2 • 2014

Traditionally run at one test temperature (122°F), the Hamburg Wheel Tracking Test (HWTT) has a proven history of identifying hot-mix asphalt (HMA) mixes that are moisture susceptible and/or prone to rutting failures have occurred with HMA mixes that had passed the HWTT in the laboratory; mostly in high shear locations, in particular with slow moving (accelerating/decelerating) traffic at controlled intersections, stop-go sections, in areas of elevated temperatures, heavy/high traffic loading, and/or where lower PG asphalt-binder grades have been used. As a supplement to the HWTT, this two-year study is being undertaken to develop a simpler and less time consuming shear resistance and permanent deformation (PD)/rutting test that is also cost-effective, repeatable, and produces superior results in terms of correlation with field rutting performance. In particular, such a test should have the potential to discriminate HMA mixes for application in high shear stress areas (i.e., intersections) as well as being an indicator of the critical temperatures at which a given HMA mix, with a given PG asphalt-binder grade, becomes unstable and more prone to rutting and/or shear failure. In line with these objectives, this interim report documents the research work completed in Year-1 of the study, namely: a) data search and literature review; b) computational modeling and shear stress-strain analysis; c) comparative evaluation of the Asphalt Mixture Performance Tester (AMPT) and the Universal Testing Machine (UTM); d) comparative evaluation of the Flow Number (FN), Dynamic Modulus (DM), and Repeated Load Permanent Deformation (RLPD) tests relative to the HWTT test method.
(xv, 161 pages)

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This report is available for free download:
http://tti.tamu.edu/documents/0-6744-2.pdf

Item 11

Maximizing Mitigation Benefits-Making a Difference with Strategic Inter-Resource Agency Planning: Year Two Technical Report

TEXAS A&M UNIVERSITY. TEXAS TRANSPORTATION INSTITUTE (TTI)

TTI 6762-2 • 2014

The objective of this research project is to assess current mitigation policies and practices in comparison to resource agency objectives and to identify mitigation strategies and priorities that provide greater cost-benefit potential and implementation speed through strategic inter-resource agency planning. Mitigation for various actions associated with transportation development has been part of the process for decades. Although the science, practice, and technology may have advanced during this time, many of the processes and practices are rooted in traditional rules and regulations that require mitigation. The objective for this project is to assess mitigation policies and practices as a whole, looking at both the current and future of mitigation efforts in the transportation development process. This guide presents a summary of the Integrated Ecological Framework approach for mitigation in the transportation development process. (ix, 39, 21 pages)

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This report is available for free download:
http://tti.tamu.edu/documents/0-6762-2.pdf

Item 12

Accounting for Electric Vehicles in Air Quality Conformity: Final Report

TEXAS A&M UNIVERSITY. TEXAS TRANSPORTATION INSTITUTE (TTI)
TTI 6763-1 • 2014

Electric vehicles (EVs) obtain at least a part of the energy required for their propulsion from electricity. The market for EVs, including hybrid, plug-in hybrid, and battery electric vehicles continues to grow, as many new and affordable models have become available in recent years. The proliferation of EVs in the vehicle fleet has implications for energy use and emissions. The mobile source (vehicle exhaust) emissions component is of particular relevance to transportation agencies, especially those in nonattainment and attainment maintenance areas that need to meet transportation conformity requirements. This report presents a framework to incorporate EVs into mobile source emissions estimations. The framework uses the United States Environmental Protection Agency's Motor Vehicle Emissions Simulator (MOVES) model. It integrates EV driving characteristics, emissions rates, and market penetration information into a MOVES-based emissions inventory analysis. Vehicle activity data collection and drive schedule development, along with in-use emissions measurements, were conducted for a sample of EVs in Texas. Additionally, market penetration scenarios were developed using a consumer choice model. The collected data and market penetration scenarios were then used in the framework to conduct a pilot application for a large county in Texas. The pilot application demonstrated successful use of the framework and showed that including EVs in emissions analyses can potentially have an impact on the overall analysis results specifically for future years.
(xiv, 118 pages)

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This report is available for free download (3.7 MB):
http://tti.tamu.edu/documents/0-6763-1.pdf

Item 13

Assessment of the Effectiveness of Wrong Way Driving Countermeasures and Mitigation Methods

TEXAS A&M UNIVERSITY. TEXAS TRANSPORTATION INSTITUTE (TTI)

TTI 6769-1 • 2014

This report describes the methodology and results of tasks performed the effectiveness of wrong way driving countermeasures and mitigation methods. Researchers reviewed the state of the practice regarding wrong way driving in the United States and Texas. Based on Texas crash data from 2007 through 2011, the majority of wrong way driving crashes on controlled-access highways occur in major metropolitan areas at night between midnight and 5:00 a.m. Driving under the influence was the primary contributing factor. Therefore, researchers designed and conducted two closed-course studies to determine the effectiveness of select wrong way driving countermeasures on alcohol-impaired drivers. In addition, researchers obtained data from several Texas agencies that had installed wrong way driving countermeasures and/or mitigation methods on their road network. Using these datasets, researchers assessed the effectiveness of these strategies in actual operational environments. Researchers used the findings from these studies to develop recommendations regarding the implementation of wrong way driving countermeasures and mitigation methods. Researchers used the focus group discussion method to obtain motorists' opinions regarding the design manuals to gain insight into the design of wrong way driver warning messages that could be posted on dynamic message signs. Based on the findings, researchers developed two single-phase wrong way driver warning messages for dynamic message signs.
(xi, 160 pages)

This report is available for free download (4.7 MB):
http://tti.tamu.edu/documents/0-6769-1.pdf

Item 14

Skid-Mounted Support System for Temporary Guide Signs

TEXAS A&M UNIVERSITY. TEXAS TRANSPORTATION INSTITUTE (TTI)

TTI 6782-2 • 2014

A common issue during phased highway construction projects is the need to temporarily relocate large guide signs on the roadside or install new guide signs for temporary use. The conventional concrete foundations used for these signs are costly and time-consuming to install and remove after construction is completed. A freestanding, skid-mounted support system for temporary large guide signs was developed and successfully crash-tested in accordance with the Manual for Assessing Safety Hardware (MASH) guidelines. The design considered wind loads, ballast requirements, and impact performance. The skid-mounted design eliminates the need for below-ground footers, and permits rapid movement and relocation of the sign. The results of the research have been used to establish guidelines for both the direct embedded temporary wood support system (developed in the first year of the project) and the skid-mounted support system. The guidelines provide the designer with a means of selecting the appropriate number, size, and grade of support posts for a given sign panel size.
(viii, 129 pages)

This report is available for free download (33.6 MB):
http://tti.tamu.edu/documents/0-6782-2.pdf

Item 15

Work Plan for Establishing a Public-Private Consortium for Technology Development

UNIVERSITY OF TEXAS AT AUSTIN. CENTER FOR TRANSPORTATION RESEARCH (CTR)

CTR 6803-P3 • 2014

"The Texas Technology Task Force (TTTF) proposes that Texas launch a public-private consortium that will bring together technology industry leaders and experts, public professionals and representatives, nonprofit organizations, and research institutions in order to encourage the adoption of emerging technologies that will contribute to a safer, more efficient, seamless, and enjoyable transportation system... The proposed consortium is to be a public-private partnership established with the intent of researching, developing, and implementing new technologies that will be exploitable by Texas industry. Partnerships will likely be an association of the State, the technology industry, nonprofit organizations, and research institutions. A PPC will allow Texas industry to participate in leading-edge research, development, and testing, while maintaining a reasonable cost structure. Texas recognizes the importance that these consortia may play in developing next-generation transportation technologies and services that are developed by industry and supported by government and academia. It is hoped that this change will significant ly incentivize business-led innovation activities between industry, research institutions, and other innovative organizations. Consortia may be established to encourage and support the deployment of technologies, furthering the TTTF's goals."
(17 pages)

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This report is available for free download (165 KB):
http://library.ctr.utexas.edu/ctr-publications/0-6803-P3.pdf

Item 16

Work Plan for Establishing Test Platforms for New Transportation Systems

UNIVERSITY OF TEXAS AT AUSTIN. CENTER FOR TRANSPORTATION RESEARCH (CTR)

CTR 6803-P4 • 2014

"The Texas Technology Task Force (TTTF) reviewed the status and potential of autonomous vehicles (AV), connected vehicles (CV), electric vehicles (EV), and cloud computing (CC) and crowdsourcing technologies. The main objectives of TTTF is to make Texas the pioneering state in the research, development, and deployment of new transportation technologies, to take advantage of its long-standing role as an early adopter, and help to create a market for these new technologies. A cost-effective solution to achieve such goals is the establishment of test platforms, or testbeds. Testbeds can become major resources for accomplishing beta testing (multi-month, precommercial testing, etc.) and demonstrating technologies." --Background

(19 pages)

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This report is available for free download (346 KB):
http://library.ctr.utexas.edu/ctr-publications/0-6803-P4.pdf

Item 17

Safety and Economic Impact of Texas Travel Information Centers

UNIVERSITY OF TEXAS AT SAN ANTONIO (UTSA). DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

UTSA 6821-1 • 2014

The overall goal of this research was to develop a methodology and gather sufficient data to quantify the impact of Texas Travel Information Center staff and services on the safety of travelers on Texas roadways. Researchers used data and analytical tools that quantify the value of person-to-person contact with visitors by providing information on travel route, road condition, destination, weather, and disaster evacuation. Several tasks were performed under this study to provide a response to this legislative request.
(xi, 83 pages)

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This report is available for free download (3.1 MB):
http://ftp.dot.state.tx.us/pub/txdot-info/trv/travel-industry/safety-economic-impact-rpt.pdf