

Research Digest

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TxDOT Reports

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Item 1

Implementation of New Specification Requirements for Course Backfill Materials for Mechanically Stabilized Earth (MSE) Walls. Technical Memorandum 1, Specifications for Procuring an EIS System

UNIVERSITY OF TEXAS AT EL PASO (UTEP). CENTER FOR TRANSPORTATION INFRASTRUCTURE SYSTEMS

UTEP 5-6359-01 Tech Memo 1/P1 • 2015

This is the first Technical Memo update regarding TxDOT Implementation Project 5-6359-01. (2 leaves)

This report is available for free download:

http://library.ctr.utexas.edu/hostedPDFs/utep_5-6359-01-tm1_p1.pdf

Item 2

Spreadsheet with Swelling Curves for Clays in Texas (with Supplementary Materials)

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

CTR 6048-01-P1 • 2016

Spreadsheet and Training workshop slides for TxDOT Research Implementation 5-6048-01. "Spreadsheet with swelling curves for clays in Texas... Note: Key to Excel spreadsheet is included as a companion to the spreadsheet delivered in Excel format. Relevant properties of the tested soils are also included. Discussion of the centrifuge results, their use in PVR prediction, and characterization of tested soils will be included in the Technical Report (5-6048-01-1)."

(34 unnumbered pages)

CONTENTS

- Table 1: Key for P1 Summary Sheet of Centrifuge Test Results
- [Spreadsheet]
- Training Material: PVR Methodology

This report is available for free download (936 KB):

<http://library.ctr.utexas.edu/ctr-publications/5-6048-01-p1.pdf>

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Item 3

[Long-Term Performance of Drilled Shaft Retaining Walls]. Training Session materials

UNIVERSITY OF TEXAS AT AUSTIN. CENTER FOR TRANSPORTATION RESEARCH (CTR)
CTR 6603-P1 • 2016

Slides from a 2013 Training Workshop for Research Project 0-6603.

"The purpose of this research is to advance the understanding of the behavior of drilled shaft retaining walls installed through expansive clay." --Report 0-6603-2
(52 unnumbered pages)

This report is available for free download (1.3 MB):

<http://library.ctr.utexas.edu/ctr-publications/0-6603-p1.pdf>

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Item 4

Evaluate Methodology to Determine Localized Roughness

TEXAS A&M UNIVERSITY. TEXAS TRANSPORTATION INSTITUTE (TTI)
TTI 6610-2 • 2016

The Texas Department of Transportation implements a smoothness specification based on inertial profile measurements. This specification includes a localized roughness provision to locate defects on the final surface based on measured surface profiles. To identify defects, the existing methodology uses the deviations between the average of the left and right wheel path profiles, and its moving average as determined using a 25-ft base length. Stations where the deviations exceed 150 mils in magnitude are considered defect locations. While this methodology provides an objective approach for evaluating localized roughness based on profile data, some districts have introduced an additional step to determine the need for corrective work. Specifically, these districts have used a bump rating panel to select, from among the defects identified using the existing procedure, those bumps and dips that will require correction based on the panel's opinion of the severity of the defects from a ride quality point of view. Clearly, a standard methodology needs to be developed so that consistency in ride quality assurance testing can be maintained. Otherwise, differences in results of quality assurance tests between projects within a district and between districts can easily arise because of differences in road user perception of ride quality. Consequently, this project examined the existing methodology for evaluating localized roughness to develop recommendations for an improved methodology that engineers can use to objectively decide where corrective work is necessary so as to maintain consistency in quality assurance testing of pavement smoothness.

(x, 57 pages)

CONTENTS

- Chapter 1. Introduction
- Chapter 2. Bump Rating Panel Surveys
- Chapter 3. Analysis of Bump Survey Data
- Chapter 4. Recommendations for Evaluating Localized Roughness
- References

This report is available for free download (2.1 MB):

<http://tti.tamu.edu/documents/0-6610-2.pdf>

Research Digest

Item 5

Strengthening Existing Continuous Non-Composite Steel Girder Bridges Using Post-Installed Shear Connectors

UNIVERSITY OF TEXAS AT AUSTIN. CENTER FOR TRANSPORTATION RESEARCH (CTR)
CTR 6719-1 • 2016

This study investigated the use of post-installed shear connectors for strengthening existing non-composite continuous steel girder bridges. The existing bridges considered in this study have strength deficiencies in both the positive and the negative moment regions. The type of post-installed shear connector investigated in this study was an adhesive anchor, which is installed from underneath the bridge deck. The strengthening approach involves installing adhesive anchors to increase girder flexural capacity in positive moment regions, and allowing inelastic moment redistribution in negative moment regions. A variety of theoretical, computational, and experimental studies were completed as part of this investigation. The findings of this research indicate that strengthening non-composite continuous steel girder bridges with post-installed shear connectors and moment redistribution is a feasible and efficient method of extending the useful service life of a bridge. Increases of more than 60% in the load rating of bridges considered in this study were attained by strengthening to a composite ratio of only 30%. Design recommendations are provided in this report.

(xvi, 142 pages)

CONTENTS

- Chapter 1. Introduction
- Chapter 2. Background
- Chapter 3. Bridge Survey
- Chapter 4. Concept Studies
- Chapter 5. Fatigue Testing
- Chapter 6. Large-Scale Testing
- Chapter 7. Parametric Studies
- Chapter 8. Summary, Conclusions, and Design Recommendations
- References
- Appendix A. Partial-Composite Beam Theory
- Appendix B. Sample Strengthening Calculations

This report is available for free download (3.7 MB):

<http://library.ctr.utexas.edu/ctr-publications/0-6719-1.pdf>

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Item 6

Synthesis on Cost-Effectiveness of Extradosed Bridges: Technical Report

TEXAS STATE UNIVERSITY, SAN MARCOS

TSUSM 6729-1 • 2016

An extradosed bridge is a unique bridge type that utilizes both prestressed girder bridge and cable-stayed bridge concepts. Since the concept of an extradosed bridge is still relatively new, there is no clear definition and specification of the type of bridge. Also, due to the unique characteristics of an extradosed bridge, it is likely to initially cost more than a conventional girder bridge but less expensive compared to a cable-stayed bridge. This synthesis study identified and collected information on 120 extradosed bridges from Asia, Europe, North America, South America and Africa through a comprehensive literature review of over 350 technical papers, reports, and websites. Cost information on 58 extradosed bridges and bridge selection reasons for 47 extradosed bridges were collected and summarized. Over 100 individuals with experience in the design and/or construction of extradosed bridges were contacted. Telephone and email interviews of eight experts in extradosed bridges (three from Asia, three from Europe, and two from North America) were conducted. A statistical analysis was conducted to summarize general configurations, bridge selections, constructions, and costs of extradosed bridges. Four case studies regarding extradosed bridge selection were also included in the report. In addition, this study summarized the advantages and disadvantages of utilizing extradosed bridges, best practices, and existing methodologies. While there is a variety of advantages and disadvantages comparing extradosed bridges to girder bridges and cable-stayed bridges, the team identified aesthetic (signature bridge and landmark structure), underneath (navigation/vehicular) clearance and higher restriction, and construction and structure considerations were identified as top reasons for selecting extradosed bridges over other alternatives. A bridge selection process specifying considerations for determining how and when an extradosed bridge is cost-effective and in the best interest of the public was also recommended.

(xi, 179 pages)

CONTENTS

- Chapter 1. Introduction
- Chapter 2. General Aspects of Extradosed Bridges
- Chapter 3. Review of Extradosed Bridges
- Chapter 4. Cost of Extradosed Bridges Construction
- Chapter 5. Bridge Selection Procedures and Considerations
- Chapter 6. Conclusions and Recommendations
- Appendix A: List of References for Each Extradosed Bridges
- Appendix B: Summary of Extradosed Bridges
- Appendix C: Interview Questions and Records

This report is available for free download (6.6 MB):

<http://tti.tamu.edu/documents/0-6729-1.pdf>

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Item 7

New Laboratory Design Tools and Field Performance Monitoring Equipment for Permeable Friction Courses

TEXAS A&M UNIVERSITY. TEXAS TRANSPORTATION INSTITUTE (TTI)
TTI 6741-1 • 2016

"Permeable Friction Course (PFC) mixes have proven to be excellent mixes that exhibit a number of desirable characteristics: rut resistance, crack resistance, reduced wet weather splash spray, reduced tire noise, and increased visibility of pavement markers during heavy rain. The Texas Department of Transportation pays a premium price for these benefits, which are sometimes short-lived, and several districts have restricted their use because of premature raveling problems. This study was initiated to address these performance issues. It focused on the following three topics: [1] Developing new laboratory test protocols to be used at the design stage to potentially eliminate mixes with stripping susceptibility. [2] Monitoring the performance on sections constructed with new specifications with changes aimed at minimizing performance problems such as the new coarse graded asphalt rubber PFC. [3] Construct an automated splash spray monitoring system to measure how existing PFC pavements are performing, thereby helping to optimize future designs."
(xi, 63 pages)

CONTENTS

- Chapter 1. Introduction
- Chapter 2. Laboratory Evaluation of Key Performance Issues
- Chapter 3. Construction and Monitoring of PFC Test Sections
- Chapter 4. Field Measurements of Splash and Spray
- References

This report is available for free download (3.7 MB):

<http://tti.tamu.edu/documents/0-6741-1.pdf>

Item 8

Draft Test Protocols for PFC's in TxDOT Format

TEXAS A&M UNIVERSITY. TEXAS TRANSPORTATION INSTITUTE
(TTI)
TTI 6741-P1 • 2016

"To improve the quality of current PFC's it is important to introduce a moisture [susceptibility] test to be run during the mix design phase. No such test currently exists for PFC's in the current [specifications]. The following pages present a moisture conditioning test for PFC's, in the severe case samples fail during moisture conditioning."
(5 leaves)

This report is available for free download (348 KB):

<http://tti.tamu.edu/documents/0-6741-P1.pdf>

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Item 9

Extending Use of Steel-Laminated Elastomeric Bearings to Higher Demand Applications

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

CTR 6785-1 • 2016

Elastomeric bearings have historically been used on bridges with short to moderate spans. The resulting demand on the bearings is usually not very severe in terms of the necessary support reaction or the deformational requirements. The bearings have historically showed good behavior and as a result, there is a strong desire to use the bearings on higher demand applications with larger support reactions and more significant deformational requirements. Although longer span concrete bridges may be candidates for these higher demand applications, many steel girder systems such as tub girder systems are also good candidates for these applications. The necessary translational and rotational demands for these bridges are significant and the support reactions are much larger than bridges that have typically utilized elastomeric bearings. TxDOT has utilized the bearings on some steel tub girders and although many of these bearings have behaved well, isolated bearings have shown significant distress in a relatively short period of time. Although in recent years, TxDOT has successfully used elastomeric pads in steel bridge applications, no full size tests on the large bearings have been conducted to demonstrate the ability of the bearings to satisfy the long-term performance requirements. In the absence of these tests, it is not clear if manufactures have the ability to consistently produce bearings for high demand applications. The research outlined in this proposal consists of laboratory testing, field monitoring, and parametric computational modeling that will provide the supporting data so that elastomeric bearings can be confidently used in the wide range of bridge applications throughout the state of Texas. The use of elastomeric bearings in steel bridge applications will result in systems that are easier to fabricate, erect, and maintain while also improving the long-term bridge behavior.

(xvii, 166 pages)

CONTENTS

- Chapter 1. Introduction
- Chapter 2. Literature Review
- Chapter 3. Field Monitoring of steel Tub Girder Bridge With Elastomeric Bearings
- Chapter 4. Description of the Experimental Program
- Chapter 5. Results of the Experimental Program
- Chapter 6. Finite Element Analysis Modeling of Elastomeric Bridges
- Chapter 7. Parametric FE Study of Elastomer Layer
- Chapter 8. Investigation of Distressed Bearings
- Chapter 9. Conclusions
- Chapter 10. Design Methodology and Examples
- References

This report is available for free download (10.6 MB):

<http://library.ctr.utexas.edu/ctr-publications/0-6785-1.pdf>

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Item 10

Geosynthetic Reinforced Steep Slopes

TEXAS STATE UNIVERSITY, SAN MARCOS

TSUSM 6792-1 • 2016

Geosynthetics provide a means to mechanically stabilize earth structures by improving strength through tensile reinforcement. When incorporating these polymeric materials in the application of stabilizing steep slopes, geosynthetic reinforcement can accommodate budgetary restrictions and alleviate space constraints. TxDOT currently has limited use of geosynthetics in steep slope construction. Therefore, a synthesis study of geosynthetic reinforced steep slopes has been conducted to enhance the present understanding of this technology. The study summarized the benefits and limitations of utilizing geosynthetic reinforcement and investigated current design and construction methods in order to determine best practices. Additionally, the cost effectiveness of geosynthetic reinforced steep slopes was examined. Case studies were also identified and assessed to determine optimal soil conditions, geometry of the slope, design criteria, construction specifications, and performance measures. The synthesis study summarized best practices, existing methodologies, and recommendations for the use of geosynthetic reinforced steep slopes in Texas. (xi,171 pages)

CONTENTS

- Chapter I. Introduction
- Chapter II. Design Methods and Materials
- Chapter III. Construction Practices
- Chapter IV. Performance Measures and Cost Effectiveness
- Chapter V. Case Studies
- Chapter VI: Conclusions and Recommendations
- References
- Appendix A: Survey Questionnaire
- Appendix B: Summary Of Survey Questionnaire Results
- Appendix C: Interview Questionnaire
- Appendix D: Summary of Interview Questionnaire Results
- Appendix E: Design Examples
- Appendix F: Summary of Transportation Agency Specifications
- Appendix G: Specification Compliance and Construction Checklists
- Appendix H: Case Study Survey
- Appendix I: Summary of Published Case Study Information and Case Study Survey Results

This report is available for free download (8.6 MB):

<http://tti.tamu.edu/documents/0-6792-1.pdf>

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Item 11

Assessing the costs attributed to project delay during project pre-construction stages

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

TTI 6806-FY15 WR#3 • 2016

This project for the Texas Department of Transportation (TxDOT) developed a simple but sound methodology for estimating the cost of delaying most types of highway projects. Researchers considered the cost of delays during the pre-construction phases of project development: planning and scoping, preliminary engineering, final design, and letting. Researchers developed a simplified model that incorporates 16 user-controlled variables and produces estimates of the effect of project delay on personal and commercial travel and the cost to the general economy. While the methodology is simple, there is no rule of thumb because project delay costs depend on several variables, primarily location, traffic, construction costs, and travel speeds.

(x, 49 pages)

This report is available for free download (1.3 MB):

<http://tti.tamu.edu/documents/0-6806-FY15-WR3.pdf>

Item 12

An Economic Analysis of Four Options for Dealing with Low-Volume Roads in Energy-Impacted Areas of Texas

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

TTI 6806-TTI-1 • 2016

The Texas A&M Transportation Institute undertook an economic analysis to compare the costs of maintaining a typical Texas low-volume road in an energy-impacted area in its current state versus widening and maintaining the road; converting it to an improved, emulsified asphalt surface (IEAS); or rehabilitating the low-volume road for short-term oil/gas field traffic. For each option, three different cost scenarios were considered. For each cost scenario, the analysis shows that converting the road to an IEAS is the lowest-cost alternative among the four options considered.

(ix, 26 pages)

CONTENTS

- Introduction
- Life-Cycle Cost Estimates
- Conclusions
- References
- Appendix A. References for Pavement Activities
- Appendix B. Detailed Present Worth Cost Analyses

This report is available for free download (291 KB):

<http://tti.tamu.edu/documents/0-6806-TTI-1.pdf>

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Item 13

Highlights of the Texas Gulf Intracoastal Waterway Master Plan

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

TTI 6807-P1 • 2016

This product presents the highlights of the Texas Gulf Intracoastal Waterway Master Plan. It lists the most pressing maintenance issues, options for increased TxDOT participation in maintenance, funding needs, funding strategies, and recommendations.

(22 unnumbered pages)

This report is available for free download (1.2 MB):

<http://tti.tamu.edu/documents/0-6807-P1.pdf>

Item 14

Economic Impact to Barge Operators and Shippers of Closing the GIWW. White Paper

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

TTI 6807 White Paper • 2016

"This task analyzed the effect that the March 22, 2014, collision and oil spill in the Houston Ship Channel had on Gulf Intracoastal Waterway (GIWW) barge shipments. Because the incident is so recent, the scope of the analysis was somewhat constrained due to data availability. This task report discusses the following topics: [1] The events of March 22, 2014, and the following days. [2] The effect of the incident on barge traffic flows. [3] Transit delays for shipments already on the water and the cost of those delays. [4] Shipments that were postponed because of the channel closure. [5] Decontamination requirements. (18 pages)

CONTENTS

- Task Purpose
- Background—The Incident
- GIWW Traffic
- Postponed Shipments
- Decontamination
- Other Concerns

This report is available for free download (1.3 MB):

<http://tti.tamu.edu/documents/0-6807-WP.pdf>

Research Digest

Item 15

The Texas Freight Transportation System 2055

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

TTI 6809-P2 • 2016

Printout of a PowerPoint presentation describing Project 0-6809 which seeks to develop framework for Texas' freight transportation system in 2055.

(36 pages)

CONTENTS

- What are we doing?
- How are we doing it?
- What do we need?
- What are the major factors/trends?

This report is available for free download (1.8 MB):

<http://tti.tamu.edu/documents/0-6809-P2.pdf>

Item 16

Investigation of new vehicle detectors for high-speed signalized intersections

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

TTI 6828-1 • 2015

The objectives of this research were to: (1) Determine current TxDOT-specific needs for new vehicle detectors. (2) Identify the most promising detectors for both stop line and dilemma zone detection. (3) Develop guidelines on each new technology and establish recommended controller and detector settings to guide TxDOT on installation and use of each detector and combination of detectors.

(xii, 177 pages)

CONTENTS

- Executive Summary
- Chapter 1. Introduction
- Chapter 2. Literature Review
- Chapter 3. Field Data Collection -- Riverside
- Chapter 4. Field Data Collection -- Intersections
- Chapter 5. Data Collection Results
- Chapter 6. Guidelines for New Vehicle Detectors
- Appendix A. Pertinent Riverside Events
- Appendix B. Trafficware Pod Performance Characterization
- Appendix C. Raw Detector Data Summary
- Appendix D. Box Plot Data
- Appendix E. GPS Accuracy
- References

This report is available for free download (6.8 MB):

<http://tti.tamu.edu/documents/0-6828-1.pdf>

Research Digest

Item 17

Conceptual Design of a Connected Vehicle Wrong-Way Driving Detection and Management System

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

TTI 6867-1 • 2016

This report describes the tasks completed to develop a concept of operations, functional requirements, and high-level system design for a Connected Vehicle (CV) Wrong-Way Driving (WWD) Detection and Management System. This system was designed to detect wrong-way vehicles, notify the traffic management entities and law enforcement personnel, and alert affected travelers.

To accomplish the project goals, the research team reviewed the state of the practice regarding intelligent transportation systems and CV technologies being applied as WWD countermeasures and the WWD crash trends in Texas from 2010 to 2014. The research team also identified the user needs associated with the implementation of a CV WWD system and preliminary ways to connect with law enforcement. The research team conducted one-on-one surveys to assess motorist understanding of wrong-way driver warning messages that were designed to be displayed on dynamic message signs. The research team also investigated the use of roadside alert (RSA) messages to provide warning to CVs about approaching wrong-way drivers.

The research team recommended the development of a proof-of-concept test bed at an off-roadway location before implementing a model field deployment of the system on an actual roadway in Texas. The purpose of the test bed is to provide an offline location for the research team to test and fine-tune the system components and operations prior to installing them on the open roadway. A need also exists to conduct additional human factors studies to determine motorist needs, comprehension, and interpretations of RSA data elements in a WWD context. It is also important to understand how motorists will respond to the information contained in potential RSAs. The lessons learned from the deployment in the test bed environment would be used by the research team to determine the design considerations for a model field deployment of the system.

(xiii, 200 pages)

CONTENTS

- Chapter 1. Introduction
- Chapter 2. State of the Practice
- Chapter 3. Analysis of WWD Crashes in Texas
- Chapter 4. Needs Assessment
- Chapter 5. Concept of Operations
- Chapter 6. Functional Requirements
- Chapter 7. Emergency Service Provider Integration
- Chapter 8. High-Level System Design
- Chapter 9. Wrong-Way Driver Warning Messages
- Chapter 10. Summary and Recommendations For Future Research
- References
- Appendix: Functional Requirements

This report is available for free download (4.1 MB):

<http://tti.tamu.edu/documents/0-6867-1.pdf>