Research Digest

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TxDOT Research Publications (Jan.-Feb. 2013)

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Item 1

ConcreteWorks Implementation: Final Report

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

CTR 4563-01-1 • 2013

Under TxDOT Project 0-4563, researchers at The University of Texas at Austin developed an innovative software package known as ConcreteWorks, which gives laboratory technicians, engineers, inspectors, and contractors a tool that combines concrete design, analysis, and performance prediction to improve and guide TxDOT to better designs. Although ConcreteWorks has been very well received at the national and international levels, it has not yet been implemented into standard TxDOT practice. Through a combination of training and implementation support, the goal of this project will be to spur the implementation of ConcreteWorks within TxDOT.

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This report is available for free download (15.6 MB):

http://www.utexas.edu/research/ctr/pdf_reports/5_4563_01_1.pdf

http://library.ctr.utexas.edu/ctr-publications/5-4563-01-1/5-4563-01-1-cdrom.zip

Item 2

Performance and Cost Effectiveness of Permeable Friction Course (PFC) Pavements

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

TTI 5836-2 • 2013

In this project, the research team evaluated the performance of Permeable Friction Courses (PFC) over time and compared it against other types of wearing surface pavement layers. Several pavement sections including Asphalt Rubber (AR) PFCs, Performance Graded (PG) PFCs, and dense-graded Hot Mix Asphalt (HMA) were monitored over a four-year period. Non-destructive on-site measurements included noise, drainability, texture, friction, and skid. The change of these variables with time as well as the influence of traffic, binder/mixture type, aggregate classification, and climatic region was evaluated. Accident data were also gathered and analyzed on a more comprehensive number of pavement sections across Texas. All of this information was compiled in database format. In addition, when performance issues were identified, field cores were acquired for forensic evaluation. Results from the multiyear performance data analysis and previous research were used to produce guidelines and recommendations to improve the design, construction, and maintenance of PFCs.

Performance of PFCs over time was adequate. Therefore, the continued use of PFCs in Texas is encouraged. PFCs had lower overall noise levels when compared to dense-graded HMA, and AR-PFCs were quieter than PG-PFCs. With regard to drainability, the water flow values had a tendency to increase early in the life of the pavement and remain relatively constant afterward. PG-PFCs showed better drainability as compared to AR-PFCs. The amount of rainfall helped assure the continued drainability of PFCs, especially in warm climates. Texture for PFCs remained practically unchanged over time. Both AR- and PG-PFCs had superior texture and skid vs. dense-graded HMA pavements. With regard to friction and skid, sections with aggregates classified as SAC-B per the Surface Aggregate Classification (SAC) system had statistically significantly lower values as compared to those pavement employing either SAC-A or SAC-A/B aggregates. The accident data indicated that PFCs reduce the number of accidents, injuries, and fatalities on roads in Texas.

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This report is available for free download (30.3 MB):
http://tti.tamu.edu/documents/0-5836-2.pdf

Item 3

Structural Assessment of "D" Regions Affected by Premature Concrete Deterioration

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

TTI 5997-1 • 2012

The effects of ASR/DEF on the D-regions of structures are investigated by means of a dual experimental and analytical modeling program. Four near full scale specimens that represent cantilever and straddle pier bents, that are representative of typical bridges in Texas, are constructed, conditioned over time, and tested to failure. The undamaged first specimen serves as the control specimen, while the next two are tested after eight months and two years of field conditioning through the Texas heat along with supplemental water aimed at promoting ASR/DEF. The fourth remains to be tested within the next three years. In the two specimens subjected to deterioration, early formation of ASR gel is observed, and with time load-induced cracks along with other additional cracks are observed. These additional cracks are a result of the continued formation of ASR gel, which causes the concrete to swell, and in turn puts the reinforcing steel into a state of active prestress. It is observed that the failure mechanism in all the specimens is a brittle shear failure through the beam-column joint. Specimens with ASR/DEF deterioration show greater stiffness and strength, and slightly greater ductility. A Compatibility Strut-and Tie (C-STM) technique is developed as a suitable minimalist analysis technique to model the force-deformation behavior of reinforced concrete bridge piers with significant D-regions that may be deteriorated through ASR/DEF effects. The C-STM simulates the overall and the internal behavior of the structure very well. In spite of the disturbing appearances of the ASR/DEF damage arising from concrete swelling and cracking, the performance and strength of the specimens are not impaired. Damage that appears in the cover concrete region is offset by the mild level of confinement to the core concrete induced by the reinforcing steel.

This report is available for free download (37.1 MB):
http://tti.tamu.edu/documents/0-5997-1.pdf

Item 4

User's Manuals for Manufacturers' Components Integrated into the TPAD

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

CTR 6005-P5 • [2013]

Product information and user guides for various components of the TPAD (Total Pavement Acceptance Device).

This research product is available for free download (433 MB *** large file ***):
http://library.ctr.utexas.edu/ctr-publications/0-6005-P5.zip

Item 5

Recommendations for Achieving Adequate Surface Friction and Predicting Skid Values in Class P Concrete Containing Manufactured Fine Aggregates

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

CTR 6255-P4 • [2012], ©2011

This report summarizes findings and recommendations regarding the usage of manufactured fine aggregates in portland cement concrete pavement (PCCP). The supporting research included both field and laboratory testing of aggregates and concrete properties that relate to skid resistance. Results show good correlation between friction values obtained using a Dynamic Friction Tester (DFT) and the micro-Deval test for fine aggregates (ASTM D7428). After comparing skid trailer values with CTM and DFT values, a correlation between the skid trailer and the DFT was established. Recommendations on how to blend carbonate sands with low acid insoluble residues to achieve good friction are presented in chapter 1 of this document. In chapter 2, a model for estimating skid numbers on concrete pavements with a mortar surface finish is presented.

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This research product is available for free download (1.7 MB):
http://www.utexas.edu/research/ctr/pdf_reports/0_6255_p4.pdf

Item 6

A Project Evaluation Toolkit (PET) for Abstracted Networks: Final Report

UNIVERSITY OF TEXAS AT AUSTIN. CENTER FOR TRANSPORTATION RESEARCH (CTR)
CTR 6487-1 • 2013

This report summarizes research for TxDOT Project No. 0-6487, which enhanced and expanded the open-source Project Evaluation Toolkit (PET) to evaluate operational strategies for transport project (and policy) impact evaluation. Such strategies include advanced traveler information systems, speed harmonization, shoulder use, incident management, and ramp metering. PET is a user-friendly, comprehensive sketch-level project evaluation planning tool, anticipating changes in travel demand, traffic patterns, crashes, emissions, traveler welfare, reliability, project net present values, benefit-cost ratios, and other performance metrics. PET also tracks project financing measures for a number of project types, including capacity expansion projects, tolling, and managed lane facilities. Beyond operational strategies, this project increased PET's scope, usability, and accuracy in other ways. For example, new transit and fixed-cost features allow for deeper and more meaningful mode choice and network modeling, while a network visualization module dramatically facilitates user generation and editing of modeled networks. New features also allow users to bypass PET's built-in travel demand model (TDM) to evaluate external TDM outputs directly. Such features allow more sophisticated modelers the chance to apply PET to their own TDM outputs, for a much wider variety of outputs than traditionally available to transportation planners and engineers. As noted, outputs include emissions, crash counts, reliability, toll revenues, and benefit-cost ratios, among others. PET capabilities include budget allocation tolls, multi-criteria assessment (of multi-faceted projects, using decision envelopment analysis), and sensitivity analysis (to produce distributions of project performance metrics, recognizing that many/most inputs have some uncertainty associated with them). Alongside these scope-enhancing changes are updates to crash and emissions estimation procedures, reflecting the latest Highway Safety Manual and EPA emissions (MOVES) estimation routines. This project also developed a variety of professional supporting materials for PET users, including an extensive User's Guide, presentation materials (for rapid training of new users), and four urban roadway networks (for Dallas-Fort Worth, Austin, Houston, and San Antonio).

This report is available for free download (1.8 MB):
http://www.utexas.edu/research/ctr/pdf_reports/0_6487_1.pdf

Item 7

The OT Tex-248-F Updates and Some Video Demos

TEXAS A&M UNIVERSITY. TEXAS TRANSPORTATION INSTITUTE (TTI)
TTI 6607-P2 • 2012

This set of files includes "Test Procedure for the OVERLAY TEST, TxDOT Designation: Tex-248-F (Revised)" (Effective Date: January 2013), the 2012 "OT Calibration and Service Maintenance Manual" by Carlos P. Flores and Lubinda F. Walubita, PDFs of presentations from Project 0-6607, OT data analysis spreadsheet, and "Best Three Replicates out of Five" macro. It also includes 13 video clips that provide step-by-step testing instructions.

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- 1.00 The OT Tex-248-F Test Procedure
- 2.00 OT Calibration-Maintenance manual
- 3.00 PPT Presentations
- 4.00 Excel Sheets_MACROS
- 5.00 Videos DEMOS

This research product is available for free download (379 MB *** large file alert ***):
http://tti.tamu.edu/documents/0-6607-P2.zip

Item 8

The Economics of Transportation Systems: A Reference for Practitioners

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

CTR 6628-P1 • 2013

"Transportation planners and engineers often feel unfamiliar with economic principles, and some assume that economics does not apply to their job duties. In practice, most transportation professionals can regularly employ economic concepts and techniques for decision-making—and many do, albeit unconsciously. Due to a variety of time and data constraints, many transportation practitioners' decision-making processes are not formally documented and emerge via "engineering judgment." However casual in nature, the wisdom behind such judgment comes from past experiences and is rooted in economic considerations and consequences. In fact, many rules of thumb for transportation investment and policy arose from economic backgrounds... This Reference is designed to introduce transportation practitioners to the underlying economic realities of their profession. Ultimately, good engineering judgment, which is vital to defensible and optimal decision-making, relies in large part on good economic judgment." --Introduction

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This research product is available for free download (3.3 MB):
http://www.utexas.edu/research/ctr/pdf_reports/0_6628_P1.pdf

Item 9

Final Training Materials (with Instructor Notes in "notes" section of each PowerPoint slide)

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

CTR 6628-P2 • [2013]

This disc contains 3 PowerPoint presentation files from training webinars held in August 2012 on "The Economics of Transportation Systems."

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This research product is available for free download (9.4 MB):
http://library.ctr.utexas.edu/ctr-publications/0-6628-P2.zip

Item 10

Integrated Prioritization Method for Active and Passive Highway-Rail Crossings

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

UTSA 6642-1 • 2013

This two-year research project developed a prioritization system for highway-rail at-grade crossings that addressed the following major concerns: (1) warrants to identify low-volume, passive crossings with risk factors; (2) a broader priority index that considers more variables than the original index; (3) warranting thresholds that remain valid with changes in data; and (4) a prioritization methodology capable of properly prioritizing the warranted passive crossings over high-volumes active crossings. The prioritization system combines a revised priority index based on a newly developed crash prediction equation, warrants for active warning devices at passive crossings, and a passive crossing prioritization index based on Utility Theory principles. The warranting threshold are defined in terms of cumulative percentiles rather than fixed numbers to ensure reliability as data changes. The warrants and prioritization indices were integrated into a systematic prioritization methodology capable of a generating priority list that assigns top priorities to crossings with risk factors in spite of low volumes. The deliverables will facilitate highway-rail crossing management in Texas and ensure proper consideration of low-volume crossings when applying funding mechanisms such as Section 130 funds.

This report is available for free download (3.8 MB):
http://tti.tamu.edu/documents/0-6642-1.pdf

Item 11

Synthesis Study of Texas Signal Control Systems: Technical Report

TEXAS A&M UNIVERSITY KINGSVILLE (TAMUK)

TAMUK 6670-1 • 2013

In recent years, several versions of traffic control systems have been established across the United States and within the state of Texas. There is a growing need to identify the various versions of these systems that exist, including the system hardware components and communications. Such an effort will also help identify operational successes, deficiencies, cost effectiveness, and other attributes of the various traffic signal system components. The research objective was to develop a synthesis of traffic control system practices that can be utilized by various Texas Department of Transportation districts in pursuance of improved traffic signal operations and reduction in traffic signal system inefficiency and related costs. The study showed that while most operating agencies are utilizing newer and more technologically adaptive systems to control traffic, some agencies still have outdated traffic control systems. The lack of personnel and training to effectively use these advancements is one of the main reasons that the advanced systems are not fully being utilized. An average of 23 percent of all Texas agencies interviewed was equipped to transmit video from the field to their traffic management center. Increasing this percentage could facilitate the implementation of more advanced and effective traffic signal control, but would require the deployment of updated communications mediums. Inter-agency coordination was found to be lacking in most cases due to reasons such as non-uniform communications and controller equipment and communication between agency officials. Recommendations were made on how to achieve better inter-agency coordination and more effective use of signal systems across Texas.

This report is available for free download (871 KB):
http://tti.tamu.edu/documents/0-6670-1.pdf

Item 12

Workshop Presentation and Instructor's and Student's Guides

TEXAS STATE UNIVERSITY, SAN MARCOS

TSUSM 6677-P1 • 2013

This CD-ROM contains two versions of a PowerPoint presentation used in an August 2012 webinar about the Texas Department of Transportation's Research Project 0-6677, "Costs Associated with Conversion of Surfaced to Un-Surfaced Roads."

This research product is available for free download (2.6 MB):
http://tti.tamu.edu/documents/0-6677-P1.zip

Item 13

Examining Engineering Costs for Development of Highway Projects

TEXAS STATE UNIVERSITY, SAN MARCOS. DEPARTMENT OF ACCOUNTING

TSUSM 6730-1 • 2012

The Texas Department of Transportation (TxDOT) commissioned a research team at Texas State University-San Marcos Department of Accounting to analyze the cost of projects by determining the cost of a preliminary engineering hour necessary to develop highways projects. The current study determined the cost of engineering design on an hourly basis using comparable direct and indirect cost definitions and allocations as used by external consulting engineering firms. The analysis consisted of three tasks: Task 1: Determine average TxDOT cost per engineering hour. Task 2: Determine the typical cost of design engineering team members. Task 3: Determine the challenges of comparing costs to the private sector, which included analysis and comparison of the various overhead rates.

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This report is available for free download (769 KB):
http://tti.tamu.edu/documents/0-6730-1.pdf

Item 14

Winter Weather Management and Operations Curriculum Development and Instruction

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

TechMRT 9044-01-1 • [2013]

This project produced two training programs on the topic of winter weather roadway maintenance for the Texas Department of Transportation, one for management [Product P1] and one for operations personnel [Product P3]. The winter weather management training program consisted of curriculum development, instructional design, a pilot training course, and delivery of seven statewide training events. The winter weather operations training program consisted of curriculum development, instructional design, a pilot training course, and delivery of two 12-hour, instructor-led, "train the trainer" training events. The curriculum will be offered to TxDOT personnel by qualified trainers in future years.

This report is available for free download (1.2 MB):
http://www.depts.ttu.edu/techmrtweb/Reports/Complete%20Reports/5-9044-01-1_2.pdf

Item 15

Winter Weather Operations Training, MNT812. Student Manual -- REV: July 2012

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

TechMRT 9044-01-P3 Student • 2012

This student manual is for the 12-hour TxDOT training course MNT812 Winter Weather Operations Training and should be used in conjunction with the lecture presentations/videos. "The final learning objectives for the subject course are as follows: (1) List safety considerations associated with winter weather conditions, equipment, materials, and operational tasks. (2) Describe winter maintenance activities associated with pre-season preparation. (3) Explain how available road maintenance equipment is used to fight snow and ice. (4) Mount winter maintenance equipment including material spreaders and snow plows. (5) Conduct a "pre-trip" inspection on winter maintenance equipment. (6) Comprehend the importance of calibrating equipment in order to "hit the target rate" when applying snow and ice chemicals. (7) Identify the basic snow and ice control chemicals used in TxDOT. (8) Compare and contrast traction improvement, de-icing, and anti-icing as snow and ice treatment strategies. (9) Demonstrate basic knowledge of snow and ice removal techniques. (10) Identify post-storm clean-up activities associated with winter weather operations." -- Memo "Course Learning Objectives" dated July 28, 2012, from William D. Lawson, to TxDOT Research and Technology Implementation Office.

This research product is available for free download (49 MB):
http://library.ctr.utexas.edu/hostedPDFS/techmrt_5-9044-01-p3/9044-01-p3_student.pdf