



Research Digest

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Item 1

Identification of Compliance Testing Method for Curing Effectiveness

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

CTR 5106-2 • 2008

Curing has substantial effects on the long-term performance of Portland cement concrete (PCC) pavement. TxDOT requires two applications of curing compounds, with a maximum 180 sf/gal per each application. However, no compliance testing is conducted for curing and, from a practical standpoint, compliance with specification requirements are rarely verified. The purpose of this research was to identify simple testing procedures that can be implemented to verify the compliance with specification requirements on curing. To this end, various test methods that appear to have potential for compliance testing for curing were evaluated in the field. The test methods evaluated include penetration resistance, initial surface adsorption, surface temperature, reflectance, relative humidity, and dielectric constant. A factorial experiment was set up for field testing, and the test methods were evaluated in the field. Varying rate of curing compound applications as well as application time was included as variables in the factorial experiment. Advantages and limitations of each method were identified and discussed. Based on the findings, it is concluded that the methods evaluated are neither practical nor accurate enough to be included in TxDOT specifications as a compliance testing. Rather, it appears that evaluating curing compound application rates by measuring curing cart speed could present most feasible method for compliance testing.

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http://www.utexas.edu/research/ctr/pdf_reports/0_5106_2.pdf

Item 2

Electronic Vehicle Identification: Applications and Implementation Considerations

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

CTR 5217-1 • 2007

Electronic vehicle identification (EVI) is already an important component of electronic toll collection. Universal EVI would provide the opportunity for transportation agencies to introduce ITS features such as in-vehicle information systems. In this project three areas were researched: (1) Current and promising technologies for vehicle identification, especially those already being deployed for toll collection, (2) Incorporation of national and state standards, legislative initiatives, and public response into TxDOT planning, and (3) Costs, benefits and implementation requirements for EVI.

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Item 3

Assessment and Rehabilitation Methods for Longitudinal Cracks and Joint Separations in Concrete Pavement

UNIVERSITY OF TEXAS AT AUSTIN. CENTER FOR TRANSPORTATION RESEARCH (CTR)
CTR 5444-2 • 2008

Researchers surveyed DOTs in the U.S. and searched published literature for effective means of repairing and rehabilitating pavements with longitudinal cracking or longitudinal cracking. These methods included field assessment for determining the severity of the causes of the symptoms and procedures for addressing the issues discovered during the assessment. The methods were evaluated for ease of implementation, cost effectiveness, and durability implications. Results produced an understanding of several of the most popular methods and recommendations for TxDOT's intended implementation. Slot stitching generally proved to be the most effective method for restoring load transfer to joints. Cross stitching is effective for cracks that are still relatively narrow. Details and specifications are included for a section of US 75 near Sherman that exhibited slab faulting and joint separation.

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http://www.utexas.edu/research/ctr/pdf_reports/0_5444_2.pdf

Item 4

The Impacts of Port, Rail, and Border Drayage Activity in Texas

UNIVERSITY OF TEXAS AT AUSTIN. CENTER FOR TRANSPORTATION RESEARCH (CTR)
CTR 5684-1 • 2009

This report examines Texas dray operations of interest to TxDOT planners. Chapter 1 provides background to the study and summarizes an earlier study report. Chapter 2 reports on a large drayage driver survey conducted at the Union Pacific Englewood intermodal terminal in Houston. Chapter 3 moves the study to the southern border and estimates annual dray vehicle miles of travel (VMT) for those dray vehicles that crossed the border in a northbound direction at the McAllen/Pharr, Laredo, and El Paso gateways in 2007. Chapter 4 stays in Laredo but moves to the Union Pacific intermodal terminal where a driver survey was conducted on August 11 and 12, 2008, to gain insight into the origins and destinations of containers coming into and out of the terminal. Chapter 5 measures dray impacts created by the movement of containers from Port of Houston Authority (POHA) terminals on the Houston highway network. The level of service (LOS) on the network serving the port is determined, using different volumes of dray vehicles. It also reports output from the EPA DrayFLEET emissions and activity model developed by the Tioga Group. Chapter 6 identifies potential strategies to mitigate adverse impacts associated with dray operations. The strategies cover terminal operations, dray fleet technologies, reducing interactions with other highway users, and identifying opportunities to divert dray traffic to other modes. Finally, Chapter 7 presents the conclusions and recommendations of the study.

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Item 5

Phase 1 Report on the Development of Predictive Model for Bridge Deck Cracking and Strength Development

*UNIVERSITY OF TEXAS AT AUSTIN. CENTER FOR TRANSPORTATION RESEARCH (CTR)
CTR 6332-1 • 2009*

Early-age cracking, typically caused by drying shrinkage (and often coupled with autogenous and thermal shrinkage), can have several detrimental effects on long-term 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 field-based 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.

Full-text PDF of this report is available for free download from
http://www.utexas.edu/research/ctr/pdf_reports/0_6332_1.pdf

Item 6

In-Depth Analysis of the JACK Model

*UNIVERSITY OF TEXAS AT AUSTIN. CENTER FOR TRANSPORTATION RESEARCH (CTR)
CTR 6395-P3 • 2009*

Recently, as part of a comprehensive analysis of budget and funding options, a TxDOT special task force has examined the agency's current financial forecasting methods and has developed a model designed to estimate future State Highway Fund revenues and expenditures. The Joint Analysis using Combined Knowledge (JACK) model is capable of projecting future TxDOT revenues and expenditures. One part of the model includes estimation of revenue diversions.

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http://www.utexas.edu/research/ctr/pdf_reports/0_6395_P3.pdf



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Item 7

Subdivision of Texas Watersheds for Hydrologic Modeling

TEXAS TECH UNIVERSITY (TECHMRT)

TechMRT 5822-01-2 • 2009

The purpose of this report is to present a set of findings and examples for subdivision of watersheds for hydrologic modeling. Three approaches were used to examine the impact of watershed subdivision on modeled hydrologic response: (1) An equal-area approach, (2) an ad-hoc approach wherein subdivisions were created at locations based on engineering judgment, and (3) a distributed-modeling approach. The three methods were implemented by different individuals with varied hydrologic experience, using their professional judgment under the direction of project researchers. Technology included NRCS curve number method for runoff volume, a variety of runoff-transformation methods, and use of measured rainfall-runoff responses. In general, subdivision had little or no impact on runoff volume. Estimates of peak discharge from study watersheds showed modest improvement in accuracy, but none beyond about 5-7 subdivisions. Time to peak estimates tended to degrade with subdivision, most likely because hydrologic routing introduced additional parameters requiring estimates. The distributed-modeling approach was extremely difficult to apply. In general, subdivision of watersheds is beneficial primarily when flow rates at locations internal to the watershed are required. The improvement in implied accuracy does not generally justify the subdivision process.

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<http://www.techmrt.ttu.edu/Reports/Complete%20Reports/0-5822.pdf>

Item 8

Development of a Database for Surface Energy of Aggregates and Asphalt Binders

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

TTI 4524-01-1 • 2009

TxDOT project 0-4524 evaluated the influence of surface energy of aggregates and binders on the resistance of asphalt mixtures to moisture damage. The results from this research lead to the development of a three-tier approach to assess the moisture damage, resistance of asphalt mixtures. This approach is based on testing and evaluating the physical and/or mechanical properties of the constituent materials, the fine aggregate mixture, and full asphalt mixture. In the first tier, an energy-based parameter termed the energy ratio (ER) is calculated using the surface energy measurements. This parameter is used as a screening tool to select binders and aggregates that have good resistance to moisture damage. The second and third tiers rely on measuring the mechanical properties of the fine aggregate mixture and full asphalt mixture, respectively.

This report documents the results of an implementation project of the testing methods and analysis approaches of the 0-4524 project. This implementation project included (a) providing training on the developed experimental and analysis methods, (b) conducting measurements of the surface energy of binders, additives, and aggregates, and (c) developing a database of surface energy measurements. This database will be useful as a diagnostic tool for finding the cause of poor moisture damage resistance in mixes and to suggest remedies through modification with anti-strip agents, lime, polymers, other additives, or through a change of materials in extreme cases.

Full-text PDF of this report is available for free download from
<http://tti.tamu.edu/documents/5-4524-01-1.pdf>



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Item 9

Roadway Safety Design Workbook

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

TTI 4703-P2 • 2009

Highway safety is an ongoing concern to the Texas Department of Transportation (TxDOT). As part of its proactive commitment to improving highway safety, TxDOT is moving toward including quantitative safety analyses earlier in the project development process. The objectives of this research project are: (1) the development of safety design guidelines and evaluation tools to be used by TxDOT designers, and (2) the production of a plan for the incorporation of these guidelines and tools in the planning and design stages of the project development process. This document provides the best-available information describing the relationship between various highway geometric design components and crash frequency. It is intended to be used by engineers for the purpose of explicitly evaluating the potential safety trade-offs associated with various design alternatives. This document focuses on quantitative safety relationships for specific design components known to be correlated with crash frequency. It is intended for engineers responsible for the geometric design of streets and highways.

Full-text PDF of this report is available for free download from

<http://tti.tamu.edu/documents/0-4703-P2.pdf>

Item 10

Reference Guide for the Soil Compactor Analyzer

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

TTI 5135-P6 • 2009

The Soil Compactor Analyzer (SCA) attaches to the automatic tamper used for Test Methods Tex-113-E and 114-E and uses rapid sampling of the hammer displacement to measure impact velocity. With the known mass of the hammer and the determined velocity, energy can be determined.

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Item 11

Design and Performance Evaluation of Very Thin Overlays in Texas

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

TTI 5598-2 • 2009

Very thin overlays, 1-inch thick or less, were placed as surface layers on five major highways in Texas. These mixes were designed in the laboratory to have a balance of good rut resistance as measured by TxDOT's Hamburg Wheel Tracking test and good reflection cracking resistance as measured by TTI's Overlay Tester. These Crack Attenuating Mixes (CAM) were designed and constructed based on a new special specification SS 3109. In the design phase the optimal asphalt content was initially determined using the Superpave Gyratory Compactor selecting the asphalt content that achieved 98% density after 50 gyrations. This approach worked well with stiff binders and top quality granite aggregates. However design problems were encountered with the transition to softer binders and locally available materials. The researchers proposed an alternative design procedure where the performance tests are run first at a range of asphalt contents and a window defined where both rutting and crack resistance requirements are met. The CAM mixes designed have 100% passing the 3/8-inch sieve and binder contents ranging from 7 to 8.3% asphalt. Few construction problems were identified; these fine mixes are easy to compact and finish. However, on one project thermal segregation problems were identified that caused low density pockets and areas of raveling. Initial performance even over jointed concrete has been good, and skid resistance measurements looked very reasonable. The CAM mixes cost approximately 25% per ton more than the traditional mixes, but as they are placed as 1-inch thick mats rather than 2-inch thick, there is a clear economic advantage of using these high quality materials. TxDOT is in the process of updating SS 3109, and a statewide specification is scheduled for release in early 2009.

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<http://tti.tamu.edu/documents/0-5598-2.pdf>

Item 12

Mobile Retroreflectivity Best Practices Handbook

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

TTI 5656-P1 • 2009

This handbook documents best practices related to proper use of the mobile retroreflectometer, sampling of sites for data collection, and handling of mobile retroreflectivity data. The best practices described in this handbook are derived from the results of Texas Department of Transportation (TxDOT) Project 0-5656 and the author's observation in using the mobile retroreflectometer. The first part of the handbook provides information on sampling of pavement markings, periodic data quality checks, and data file naming conventions. The sampling procedure described here provides a systematic way of reducing the number of samples under a constrained budget. File naming conventions suggested in this handbook will be helpful in automating mobile retroreflectivity data handling and analysis. The second section of the handbook provides information on equipment required to calibrate the mobile retroreflectometer and collect the data. This handbook also describes the best practices for initial setup and calibration of the mobile retroreflectometer and calibration checks. Since several factors change as data are being collected, best practices for accounting for changes in variables, such as variations in vehicle speed and operating temperature, etc., are described. The final section pertains to best practices in data handling and suggested analysis of mobile data. This handbook elaborates on the consistency of data file headers and quality checking of data. A prototype of automation for data analysis is demonstrated that will prove handy in dealing with large amounts of mobile data.

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<http://tti.tamu.edu/documents/0-5656-P1.pdf>



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Item 13

Analysis and Integration of Spatial Data for Transportation Planning

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

TTI 5696-1 • 2009

Transportation planning requires substantial amounts of data and cooperation among transportation planning agencies. Advances in computer technology and the increasing availability of geographic information systems (GIS) are giving transportation planners the ability to develop and use data with a much higher degree of efficiency. However, as information systems advance, the need to provide effective data integration/exchange protocols and procedures to reduce redundancy and data collection costs is becoming more important. Many factors influence the effectiveness of data exchange and data integration efforts, such as data compatibility, data access, data quality, completeness, metadata, hardware, software, and staff expertise. This research resulted in a catalog of spatial data sources available to transportation planning agencies in Texas. The work included a synthesis of current transportation planning practices in Texas with a focus on spatial data integration and exchange issues, meetings with transportation planning and data stakeholders, the development of a map of data sources, the development of a preliminary logical data model of spatial data entities, and a compilation of metadata documents for a sample of data sources. Developing the catalog of categories and subcategories for transportation planning spatial data was an interactive process that involved several rounds of data entity categorization; analysis of the resulting structure for inconsistencies, gaps, and redundancies; and subsequent changes to the data entity categorization scheme. In the end, the three-level grouping structure resulted in 7 categories, 63 subcategories, and 589 spatial data entities. The research also resulted in a prototype web-based map and metadata viewer called Transportation Planning GIS (TPGIS) Data Viewer.

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<http://tti.tamu.edu/documents/0-5696-1.pdf>

Item 14

Synthesis Study on Transverse Variable Asphalt Application Rates for Seal Coats

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

TTI 5833-1 • 2009

This report documents a cooperative effort to collect, process, and make available information about successful methods of varying seal coat asphalt application rates across treated roadways to optimize aggregate retention and avoid wheel path flushing. This topic is of critical importance to maximizing value obtained from TxDOT's multi-million dollar preventive maintenance program. The primary source of the information was highly experienced TxDOT personnel. Researchers used a field interview process to capture knowledge that had been gained through years of roadway practice. Construction specifications and a field guidebook entitled Guide for Transversely Varying Asphalt Rates were developed. Captured field experience and knowledge was prepared for placement into TxDOT's knowledge management system and seal coat inspector training course.

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<http://tti.tamu.edu/documents/0-5833-1.pdf>



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Item 15

Characterization of In-Use Emissions from TxDOT's Non-Road Equipment Fleet Phase 1 Report

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

TTI 5955-1 • 2009

The objective of this document is to present the preliminary findings of the study characterizing in-use TxDOT non-road diesel equipment emissions. This document presents literature reviews of emissions reduction technologies and emissions control measures practiced by state of Texas and other states, discusses selection of TxDOT non-road equipment and emissions reduction technologies for emissions testing, and shows preliminary results of in-use emissions of TxDOT diesel equipment using portable emissions measurement systems (PEMS). Emissions measurements and data comparison and analysis tasks are still ongoing, so that a stage for any recommendation or conclusion has not been reached.

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<http://tti.tamu.edu/documents/0-5955-1.pdf>

Item 16

Prediction of Embankment Settlement Over Soft Soils

UNIVERSITY OF HOUSTON. CENTER FOR INNOVATIVE GROUTING MATERIALS AND TECHNOLOGY (UH / CIGMAT)

UH 5530-1 • 2009

The objective of this project was to review and verify the current design procedures used by TxDOT to estimate the total and rate of consolidation settlement in embankments constructed on soft soils.

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<http://tti.tamu.edu/documents/0-5530-1.pdf>

Item 17

Regression Equations for Estimation of Annual Peak-Streamflow Frequency for Undeveloped Watersheds in Texas Using an L-moment-Based, PRESS-Minimized, Residual-Adjusted Approach

TEXAS DEPARTMENT OF TRANSPORTATION (TXDOT)

USGS 5521-1 • 2009

Annual peak-streamflow frequency estimates are needed for flood-plain management; for objective assessment of flood risk; for cost-effective design of dams, levees, and other flood-control structures; and for design of roads, bridges, and culverts. Annual peak-streamflow frequency represents the peak streamflow for nine recurrence intervals of 2, 5, 10, 25, 50, 100, 200, 250, and 500 years. Common methods for estimation of peak-streamflow frequency for ungaged or unmonitored watersheds are regression equations for each recurrence interval developed for one or more regions; such regional equations are the subject of this report. The method is based on analysis of annual peak-streamflow data from U.S. Geological Survey streamflow-gaging stations (stations).

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<http://pubs.usgs.gov/sir/2009/5087/pdf/sir2009-5087.pdf>



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Item 18

Recommendations for Design, Construction, and Maintenance of Bridge Approach Slabs: Synthesis Report

UNIVERSITY OF TEXAS AT ARLINGTON (UTA)

UTA 6022-1 • 2009

Bridge approaches provide smooth and safe transition of vehicles from highway pavements to bridge structures. However, settlement of the bridge approach slab relative to bridge decks usually creates a bump in the roadway. The bump causes inconvenience to passengers and increases the cost of maintenance and repairing of the distressed approach slabs. Typically, the Texas Department of Transportation (TxDOT) spends millions of dollars annually to mitigate the bump problem across the state. The present research aims to better understand the mechanisms that cause the bump problem and to review currently used methods to mitigate this problem around the world, and to develop the methods that are appropriate for researching them in real field conditions. As a part of this research, a synthesis was prepared by conducting a comprehensive literature review of the past research on the subject and also by conducting a survey with all 25 districts to understand the local conditions that contribute to the bump problem in the bridges. The literature review also identified several technologies that were used to mitigate the problem. All these details along with district wide surveys are covered in this synthesis report.

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<http://tti.tamu.edu/documents/0-6022-1.pdf>

Item 19

Quantifying the Role of Coarse Aggregate Strength on Resistance to Load in HMA for Blended Aggregates

UNIVERSITY OF TEXAS AT EL PASO (UTEP)

UTEP 5268-3 • 2008

The performance of the new generation of HMA mixtures that rely more on a stone-to-stone contact is greatly influenced by the properties of the aggregate blends such as gradation and strength. As a result, aggregates have a significant and direct effect on the performance of asphalt pavements and it is important to maximize the quality of aggregates to ensure the proper performance of roadways.

The objective of this research is to evaluate the effect of stress concentrations at contact points of single-source and blended coarse aggregates. To achieve this objective, an extensive series of tests to characterize and to evaluate the performance of a number of aggregates were carried out. The laboratory activities were supplemented with micro-mechanical modeling to understand the internal behavior of the mixes. The aggregates were tested at different blends in four mixes.

A number of findings were made based on the aggregate quality, the blending ratios and the type of aggregate blended. Also, the results from Phase I and Phase II were supported both in the tests that are recommended to be included as part of the aggregate characterization and in showing the gap in ranking the aggregates based on current tests. It should be emphasized that these observations are preliminary since the database is rather small. As a result, it is proposed to expand the database with more aggregate sources.

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<http://ctis.utep.edu/publications/Reports/18TX-0-5268-3%20Research%20Report%20Final%20June%202009.pdf>