Research Digest

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Recent TxDOT Research Publications

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Item 1

Traffic Control Device Evaluation Program, FY 2016

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

TTI 1001-14-3 • 2017

This report presents findings on three different activities conducted in the Traffic Control Device Evaluation Program during the 2016 fiscal year. The first two activities are evaluations of full-matrix color light-emitting diode changeable message signs with 20 mm pixels. The first evaluation compared legibility and detection of roadway hazard objects for signs with and without sponsor acknowledgement logos on 1/3 of the sign. A closed-course evaluation was conducted day and night on a closed course with 30 drivers traveling 30 mph. Three sign types were evaluated: green background travel time signs with white letters, black background text signs with white letters, and blue background text signs with white letters. Sponsor logos had little or no effect on sign legibility or object detection distances. When an effect was significant, it was observed only for specific types of signs or placement locations. The second activity was a nighttime evaluation of legibility of these same signs comparing three different fonts: 16 inch letters (20 x 12 pixels), 18 inch (23 x 15 pixels), and a more condensed 18 inch letter (23 x 14 pixels). The study demonstrated drivers can read messages with 18 in. letters farther away than 16 in. letters. But when expressed as legibility index, all of the fonts tested hover around the minimum legibility index of 40 ft/in recommended in the TMUTCD. This suggests that there is room for improvement in the design of individual letters. The third activity provided an update to the worksheet used to determine signal preemption needs at railroad grade crossings. The updates provide default values in some frequently used fields, eliminated some fields rarely used, and minimized the decision making for those filling out the form.

(x, 87 pages)

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This report is available for free download (3.8 MB):
http://tti.tamu.edu/documents/9-1001-14-3.pdf

Item 2

MASH TL-4 Evaluation of the TxDOT Type C2P Bridge Rail

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

TTI 1002-15-2 • 2017

The objective of this research was to evaluate the impact performance of the Texas Department of Transportation (TxDOT) Type C2P Bridge Rail according to the safety-performance evaluation guidelines included in the American Association of State Highway and Transportation Officials Manual for Assessing Safety Hardware (MASH) for Test Level Four (TL-4). This report describes the TxDOT Type C2P Bridge Rail, documents the impact performance of the bridge rail system according to MASH TL-4 evaluation criteria for longitudinal barriers, and presents recommendations regarding implementation. MASH Tests 4-10 and 4-11 evaluate a barrier's ability to successfully contain and redirect passenger vehicles and evaluate occupant risk. MASH Test 4-12 evaluates the structural adequacy of the bridge rail. All three tests were performed on the TxDOT Type C2P Bridge Rail. For Test 4-12, the post welds were not properly fabricated according to the project design drawings. As a result, some post welds in the immediate impact area did rupture from the MASH Test 4-12 truck impact. These ruptured post welds did aggravate the stability of the single unit truck during the test. For subsequent tests, the posts were welded correctly as per the project drawings. The bridge rail posts, with the correct post welds, should only improve the performance of the single unit truck. The TxDOT Type C2P Bridge Rail performed acceptably for MASH TL-4.

(xi, 139 pages)

This report is available for free download (14.1 MB):

http://tti.tamu.edu/documents/9-1002-15-2.pdf

Item 3

Crash Testing and Evaluation of Multiple Mailbox Supports for Use with Locking Architectural Mailboxes

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

TTI 1002-15-7 • 2017

Some homeowners and businesses are becoming increasingly concerned about mail-identity theft. Consequently, there is a growing demand for the use of locking mailboxes for theft deterrence and vandal resistance. There are a number of mailbox products on the market that offer enhanced security for mail and small parcels. They typically feature an upper hopper for incoming mail, and a lower lockable compartment for mail retrieval. These lockable mailboxes are significantly larger and can be 4 to 5 times heavier than standard lightweight mailboxes, which are approximately 5 inches wide, 6 inches tall, and 19 inches long, and weigh less than 5 lb. Therefore, TxDOT requested evaluation of their crashworthiness before permitting their use on the state highway system. Under TxDOT Project 9-1002-12, crash tests were performed following Manual for Assessing Safety Hardware (MASH) guidelines and procedures to assess the impact performance of lockable, secure mailboxes in both single and multiple-mount configurations. Testing of the larger (15 inches tall, 11.5 inches wide, and 18 inches deep), heavier (approximately 23 lb) locking mailboxes on multiple-mount support posts resulted in failure due to vehicle windshield deformation and intrusion.

Under this project, crashworthiness of proposed designs for multiple-mailbox supports used with a combination of lockable and standard mailboxes was evaluated. This evaluation was performed to determine if TxDOT can permit their use on the state highway system. The crash tests were performed following the latest MASH guidelines and evaluation criteria. Two proposed designs were evaluated through full-scale crash testing: (1) 11-gauge (0.125-inch) steel tube multiple-mount support with 4-inch embedment. (2) 16-gauge (0.0625-inch) steel tube multiple-mount support with inclusion of ¼-inch-diameter wire rope and with 6-inch embedment.
(154 pages)

This report is available for free download (17.9 MB):
http://tti.tamu.edu/documents/9-1002-15-7.pdf

Item 4

MASH Evaluation of TxDOT High-Mounting-Height Temporary Work Zone Sign Support System

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

TTI 1002-15-8 • 2017

The objective of this research was to develop a nonproprietary, lightweight, crashworthy, temporary work-zone single sign support for use with an aluminum sign substrate. The device is intended to meet the evaluation criteria in American Association of State Highway and Transportation Officials Manual for Assessing Safety Hardware (MASH). In addition to crashworthiness, consideration was given to cost, functionality, and accommodating a high-mounting-height (7 ft). An aluminum sign substrate was also a design requirement stipulated by the Texas Department of Transportation. Texas A&M Transportation Institute researchers used perforated steel tubing for the frame of the new temporary single sign support system to accommodate the requests for a lightweight, durable, and easy to assemble structure. Slip joints were incorporated into the vertical support to help mitigate the severity of secondary contact between the sign substrate and roof of the impacting vehicle.

The proposed design options were full-scale crash tested with an 1100C and 2270P vehicles under required MASH TL-3 conditions. Two out of the three proposed new designs for temporary work zone sign supports functioned acceptably under the impacted MASH TL-3 conditions. A third design was judged to have potential for intrusion into the occupant compartment due to a tear in the roof of the 2270P vehicle during MASH Test 3-72 at 90 degrees.
(172 pages)

This report is available for free download (13.1 MB):
http://tti.tamu.edu/documents/9-1002-15-8.pdf

Item 5

Guidelines for TxDOT in Selecting Seal Coat Materials

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

TTI 6747-P1 • 2017

The aggregate in a seal coat provides resistance to the abrasion of moving wheel loads, transfers the wheel load to the underlying layers, provides a skid-resistant surface. Other factors that are related to the stone that affect the performance of a seal coat include nominal maximum size, gradation, shape, cleanliness, adhesion characteristics, strength and wearing characteristics. The primary decisions a designer must make when selecting aggregates for seal coat include aggregate size and gradation, aggregate type, aggregate quality, precoating requirements.
(viii, 19 pages)

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This report is available for free download (1 MB):
http://tti.tamu.edu/documents/0-6747-P1.pdf

Item 6

Framework for Development of TxDOT Construction Inspector Training Program

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

TTI 6806-TTI-3 • 2017

To meet the need for a larger number of inspectors and to improve the experience and knowledge level on inspectors, the Texas Department of Transportation (TxDOT) is reviewing construction inspector training needs and training programs that are available within TxDOT and from national organizations and other states. This project developed and delivered construction inspection training to personnel involved in inspection on TxDOT projects. This report reviews and summarizes hundreds of training programs available nationally. Researchers provided a listing of observations, recommendations, and a framework for a path forward immediately.
(952 pages)

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This report is available for free download (19.8 MB):
http://tti.tamu.edu/documents/0-6806-TTI-3.pdf

Item 7

The Benefits of Transportation Investment in Texas

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

TTI 6806-TTI-BS2 • 2017

This report highlights the benefits and return on investment of transportation funding in Texas. In total, over the next decade, Texans will invest $131 billion in statewide infrastructure with a total economic benefit of an estimated $373 billion
(22 pages)

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This report is available for free download (757 KB):
http://tti.tamu.edu/documents/0-6806-TTI-BS2.pdf

Item 8

Assessment of Innovative and Automated Freight Strategies and Technologies, Phase I Final Report

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

TTI 6837-1 • 2017

Many innovative freight delivery strategies and technologies have been proposed to address the future freight needs of Texas's growing population. Changes in both buying habits and a shift toward direct home package delivery threaten to dramatically change distribution patterns and increase the number of intercity and local delivery trucks on Texas Department of Transportation (TxDOT) roadways. Emerging freight delivery technologies such as automated freight vehicles and innovative operational freight strategies such as nighttime off-peak-hour deliveries to businesses are potential ways to better use existing infrastructure. Unfortunately, TxDOT and local transportation planners currently lack an established process to evaluate operational changes or technology applications needed to ensure continued, timely flow of commercial freight through the Texas transportation system. The primary objective of Phase I of this project was to establish a process to evaluate freight operational changes or technology applications to ensure continued, timely flow of commercial freight through the Texas transportation system. This phase identified over 50 currently proposed freight strategies and technologies and evaluated them to determine which should be further evaluated for implementation in future project phases.
(279 pages in various pagings)

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This report is available for free download (8.4 MB):
http://tti.tamu.edu/documents/0-6837-1.pdf

Item 9

Performance Planning for Rural Planning Organizations: Final Report

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

TTI 6852-1 • 2017

Recent federal rules place increased emphasis on performance-based management of the multimodal transportation system and require the use of performance based methods in state, metropolitan, and non-metropolitan transportation planning and programming. The Fixing America's Surface Transportation Act and the Moving Ahead for Progress in the 21st Century Act emphasizes seven areas including: safety, infrastructure condition, congestion reduction, system reliability, freight movement and economic vitality, environmental sustainability, and reduced project delivery. Establishing a common set of performance measures allows for the evaluation and comparison of different projects and transportation corridors for both current and future conditions, and translates data and statistics into a form that the public and decision makers can easily understand. This research developed a framework, performance measures, tools, and guidance to conduct performance-based transportation planning and programming in non-metropolitan areas of the state and support Rural Transportation Planning Organizations.
(144 pages)

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This report is available for free download (10.1 MB):
http://tti.tamu.edu/documents/0-6852-1.pdf

Item 10

Rural Performance Based Planning Guidebook

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

TTI 6852-P1 • 2017

"Establishing a common set of performance measures allows for the evaluation and comparison of different projects and transportation corridors for both current and future conditions, and translates data and statistics into a form that the public and decision makers can easily understand. The guidebook directs the reader through the framework for conducting a rural transportation system assessment based on individual goals and objectives and selected performance measures and weights. The planning tool developed as part of this project is intended for use with the guidebook for establishing and using rural performance-based transportation system assessment, monitoring, planning, and programming consistent with statewide plans and programs."
(40 pages)

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This report is available for free download (2.4 MB):
http://tti.tamu.edu/documents/0-6852-P1.pdf

Item 11

User Manual and Spreadsheet Tool for Implementing Performance Planning for Rural Planning Organizations

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

TTI 6852-P2 • 2017

"The performance-planning tool developed as part of this project is intended for use with the guidebook for establishing and using rural performance based transportation system assessment, monitoring, planning, and programming to support the rural planning organization (RPO), the Texas Department of Transportation's (TxDOT's) districts, and statewide long-range planning effort. The analyst is encouraged to read the following steps before using the tool." --PDF Introduction

"This tool enables TxDOT's Districts, RTPOs, individual counties, and TxDOT to support the rural performance based transportation system assessment, monitoring, planning, and programming at the individual county, RPO, TxDOT District, and statewide levels. This tool is intended for use with the guidebook for establishing and using rural performance based transportation system assessment, monitoring, planning and programming to support the RTPO, TxDOT's Districts, and statewide long-range planning effort. The analyst is encouraged to read the guidebook." --Excel file Introduction tab
(529 KB)

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- Technical Report 0-6852-P2: User Manual for Spreadsheet Tool and Implementing Performance Planning for Rural Planning Organizations / by John Overman [0-6852-P2_user-manual.pdf]
- TxDOT 0-6852 Rural Performance Based Planning Tool (DRAFT Version) / Developed by: Sushant Sharma and John Overman [Rural Transportation Performance Measurment Tool- v8.xlsm]

This report and tool are available for free download (529 KB):
http://tti.tamu.edu/documents/0-6852-P2.zip

Item 12

Guidelines for Deploying Weather Responsive Operations in TxDOT Traffic Signals

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

TTI 6861-1 • 2017

Inclement weather, such as rain, snow, fog, and ice, create special operational challenges for traffic management agencies. This project provided Texas Department of Transportation with technical guidance for improving safety and efficiency of signalized intersections during inclement weather. As part of this project, the research team examined available technologies for detecting adverse weather at signalized intersections and provided technical guidance on strategies for modifying traffic signal operations during various types of weather events. A realistic and practical architectural framework for collecting and disseminating weather information to improve signalized intersection operations was developed by the research team. The research team deployed the architecture at intersections in Dumas, Burleson, and Nassau Bay and conducted simulation and field studies to explore the benefits of providing weather responsive traffic signal operations. The research team also provided guidance for operating traffic signals and developing traffic signal timing plans for large scale evacuations, such as hurricane evacuations in coastal regions.
(178 pages)

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This report is available for free download (5.1 MB):
http://tti.tamu.edu/documents/0-6861-1.pdf

Item 13

Advancing Innovative High-Speed Remote-Sensing Highway Infrastructure Assessment Using Emerging Technologies: Technical Report

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

TTI 6869-1 • 2017

Asset management is a strategic approach to the optimal allocation of resources for the management, operation, maintenance, and preservation of transportation infrastructure. Asset management combines engineering and economic principles with sound business practices to support decision making at the strategic, network, and project levels. One of the key aspects of the development of asset management is data collection. The way in which transportation agencies collect, store, and analyze data has evolved along with advances in technology, such as mobile computing (e.g., laptops, tablets), sensing (e.g., laser and digital cameras), and spatial technologies (e.g., global positioning systems [GPS], geographic information systems [GIS], and spatially enabled database management systems). These technologies have enhanced the data collection and integration procedures necessary to support the comprehensive analyses and evaluation processes needed for asset management. Data collection is costly. In determining what data to collect, agencies must weigh these costs against the potential benefits from better data. Traditional pavement and bridge management approaches are data intensive, requiring extensive data collection activities of most or all pavement and bridge assets on an annual or biannual basis. These efforts can be justified given the cost of agencies' pavement and bridge programs. However, depending on the level of technology needed and the associated costs, it may be difficult to justify similarly extensive data collection efforts for safety and operation assets. While many of the technology innovations and improved data collection processes have been in the bridges and pavements area, there are emerging technologies in the safety and operations infrastructure areas that have yet to be applied to the transportation space. These technologies are driving the costs and efficiencies to the point that makes good sense in terms of the tradeoffs between fiscal responsibilities and advantages of having the data. Therefore, while this research covers all highway infrastructure areas, it includes an emphasis on technologies to assess safety and operations infrastructure. Ultimately, through the three-phased approach, the research strives to bundle the best technologies that maximize sensors and computing power in an effort to achieve the vision of one day having an all-in-one data collection system for infrastructure assessment.
(384 pages)

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This report is available for free download (33.6 MB):
http://tti.tamu.edu/documents/0-6869-1.pdf

Item 14

Tools for Port Authority Transportation Reinvestment Zones (TRZ) and TRZs for Multimodal Applications

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

TTI 6890-1 • 2017

In 2007, the Texas legislature created an innovative transportation funding mechanism called the transportation reinvestment zone (TRZ) that allows municipal and county governments to set aside local match contributions for the transportation projects most critical to their communities. TRZs are relatively new tools for infrastructure finance that allow governmental entities with taxing authority to set aside local match contributions for transportation projects and capture the land value increases that result from the transportation projects. In 2013, lawmakers made TRZs available to port authorities and navigation districts, the governmental entities that operate Texas ports. The main goal of this research project was to assist Texas Department of Transportation staff, Texas port authorities, and local government stakeholders in understanding port authority TRZs—how they work and how they might be of benefit to a port authority, its surrounding community, and the U.S. and Texas State Highway Systems. More specifically, this research aimed to: (a) document the processes for establishing Port Authority TRZs, (b) identify the TRZs that have been established to date, (c) develop a more systematic understanding of the types of projects that are TRZ eligible in the context of port authority TRZs and the interactions of TRZ funding in the context of port funding/finance and how that may vary across port types in Texas, (d) develop an understanding of land development in port jurisdictions, and (e) develop tools and guidance to facilitate the implementation process of port TRZs. The findings of this research are summarized in this report.
(94 pages)

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This report is available for free download (4.7 MB):
http://tti.tamu.edu/documents/0-6890-1.pdf

Item 15

Port Authority Transportation Reinvestment Zone. Executive Summary

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

TTI 6890-ES1 • 2017

"The transportation reinvestment zone (TRZ) is a relatively new tool for infrastructure finance that allows governmental entities with taxing authority to set aside funds for local match contributions for transportation projects and capture the land value increases that result from the transportation projects. In 2013, the Texas Legislature authorized port authorities and navigation districts to use TRZs. This research summarizes: The history of the TRZ. Its uses in port funding and financing since passage of the enabling legislation. The character of the existing port authority TRZs in Texas. Land development issues relevant to those TRZs."
(50 pages)

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This report is available for free download (924 KB):
http://tti.tamu.edu/documents/0-6890-ES1.pdf

Item 16

Port Authority Transportation Reinvestment Zone Development and Implementation Guidebook

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

TTI 6890-P1 • 2017

"This guidebook assists Texas Department of Transportation (TxDOT) staff, Texas port authorities, and local government stakeholders in understanding Port Authority TRZs—how they work and how they might be of benefit to a port authority, its surrounding community, and the U.S. and Texas State Highway Systems. More specifically, this guidebook provides the reader with the following TRZ basics: • A summary of the history of the TRZ since passage of the enabling legislation and key aspects of the Port Authority TRZ legal framework that affect their implementation. • The potential role of Port Authority TRZs in port funding and financing. • Step-by-step guidance for the identification, evaluation, and implementation of Port Authority TRZs. • A review of key factors influencing and driving Port Authority TRZ revenue. • A preliminary assessment of revenue potential of a Port Authority TRZ case study. (72 pages)

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This report is available for free download (2 MB):
http://tti.tamu.edu/documents/0-6890-P1.pdf

Item 17

Using Public Transportation to Facilitate Last Mile Package Delivery. Guidebook

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

TTI 6891-P2 • 2017

"This guidebook provides public transit agencies in rural Texas communities with the information necessary to implement a package delivery service in coordination with a private package delivery partner. Chapter 1 introduces the guidebook, describes its purpose, describes the opportunity to provide package delivery via rural transit, and documents findings from previous phases of research. Chapter 2 reviews the current package delivery industry and describes the needs that rural transit agencies might be able to fill by providing service Chapter 3 outlines the opportunities for service provision in more detail and highlights specific market segments for rural transit agencies to pursue Chapter 4 documents the challenges that may arise when implementing rural transit package delivery services. Chapter 5 provides examples of possible service models and documents current package delivery pricing models used by other entities."
(56 pages)

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This report is available for free download (2.8 MB):
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