

Research Digest

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Southwest Region University Transportation Center (SWUTC) Reports

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Item 1

Automating the Process for Locating No-Passing Zones Using Georeferencing Data

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TTI SWUTC/12/161102-1 • 2012

This research created a method of using global positioning system (GPS) coordinates to identify the location of no-passing zones in two-lane highways. Analytical algorithms were developed for analyzing the availability of sight distance along the alignments of two-lane highways. The main algorithm was incorporated into a computer model that uses GPS data as the input and produces a method for locating no-passing zones. The resulting automated system processes GPS coordinates and converts them into easting and northing values, smoothes GPS data, and evaluates roadway alignment for possible sight restrictions that indicate where no-passing zones should be located.

This report is available for free download (3 MB):

<http://swutc.tamu.edu/publications/technicalreports/161102-1.pdf>

Item 2

Calibration of HERS-ST for Estimating Traffic Impact on Pavement Deterioration in Texas

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

CTR SWUTC/12/169205-1 • 2012

The Highway Economic Requirements System-State Version (or the HERS-ST) is a software package which was developed by the Federal Highway Administration as a tool for evaluating the performance of state highway systems. HERS-ST has the capabilities of estimating highway system performance and system needs. It also has the capability of providing investment strategies required to attain a certain level of system performance. Some states such as Indiana, North Dakota, New Mexico and Oregon have been able to make extensive use of the software. New Mexico, for example has used the software to provide an assessment for the state's long term highway needs by running and evaluating various investment scenarios. The state of Indiana has used the software package in their Long Range Transportation Plan for assessing future system needs and budget planning. Texas has expressed interest in the HERS-ST software package, but it has been pointed out that the pavement deterioration model used by the HERS-ST software package to estimate pavement wear is inaccurate. This study focused on disaggregating the pavement deterioration model used by the HERS-ST to better understand its process with particular emphasis on traffic characteristics. This report presents a methodology that can be used to calibrate the model for state specific conditions.

This report is available for free download (1.1 MB):

<http://swutc.tamu.edu/publications/technicalreports/169205-1.pdf>

Item 3

A Comparison of Crashes and Fatalities in Texas by Age Group: Selected Cities in Texas

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TSU SWUTC/12/476660-00052-1 • 2012

In recent decades, great strides have been made to lower the number of accidents that occur on Texas roadways through graduated drivers licensing programs, messages against texting and driving, and discouraging drunk driving. Statistics show that young, novice drivers between 16 and 24 years old account for the highest rate of crashes, and senior drivers (65 and older) have the highest rate of fatalities when involved in a crash. In 2008, in Texas, 571 teens died in car crashes. From 2003 to 2008 over 2,751 seniors lost their lives in automobile accidents. Building on work done on a previous study of senior fatalities, this study will examine crash data from 2006 and 2009 from the cities of Houston, Sugar Land, and Pearland, Texas to determine if the number of crashes per age group is increasing or decreasing. This study will also determine if fatalities are increasing or decreasing between these two age groups.

This report is available for free download (2.6 MB):

<http://swutc.tamu.edu/publications/technicalreports/476660-00052-1.pdf>

Item 4

Comparisons Between Vehicular Emissions from Real-World In-Use Testing and EPA MOVES Estimation

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TTI SWUTC/12/476660-00021-1 • 2012

This research study developed a methodology to perform mandatory dynamometer vehicular emissions tests on real roads, performed on-road emissions tests, and compared the test results to the estimates using the current EPA emissions estimation model. Currently, mandatory vehicular exhaust emission tests are performed on chassis or engine dynamometers using the Federal Test Procedure (FTP)/Supplemental Federal Test Procedure (SFTP) drive schedules. Based on the developed real-world in-use emissions testing methodology with using a modified test vehicle, authors could follow the FTP/SFTP drive schedules while the vehicle was driven on real roads, and measure emissions during the in-use on-road FTP/SFTP emissions testing. Emissions from the vehicle during the testing were measured, analyzed, and compared to estimated emissions using the current EPA emissions estimation model, Motor Vehicle Emission Simulator (MOVES). The authors observed discrepancies between the measured data and the MOVES estimates, especially when associated with cold-start emissions. More detailed analysis results, along with the detailed test methodologies, are provided in this report.

This report is available for free download (2 MB):

<http://swutc.tamu.edu/publications/technicalreports/476660-00021-1.pdf>

Item 5

Evaluating Safety Performance and Developing Guidelines for the Use of Right Turn on Red (RTOR)

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TSU SWUTC/12/161242-1 • 2012

This research project investigates the safety performance of Right Turn on Red (RTOR) at intersections. Also, new design alternatives, such as dual right-turn lanes and guidelines incorporating the use of RTOR at intersections are evaluated. To this end, the following tasks were performed: (1) review literature on safety performance of RTOR, (2) review literature on driver behavior under RTOR operation, (3) synthesize best practices and existing guidelines on RTOR, (4) conduct field study to investigate driver behavior under RTOR operation at dual right-turn lanes, and (5) develop guidelines for the use of RTOR.

The results of this study showed that RTOR operations contributed to only a small portion of the total crashes at the intersections, and RTOR operations did not increase the crash rates after the implementation at the intersections. In this study, according to the existing guidelines and the field observation, a set of comprehensive guidelines were developed to support decision-making on the use of RTOR.

This report is available for free download (801 KB):

<http://swutc.tamu.edu/publications/technicalreports/161242-1.pdf>

Item 6

Evaluating the Impacts of the Panama Canal Expansion on Texas Gulf Ports

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

CTR SWUTC/13/476660-00062-1 • 2013

This report covers a four-year period after contractors started work on the third set of locks, which in 2015 will effectively double the size of the ship using the Panama Canal. Many of the impacts linked to the new locks remain unknown (like lock fees, demand, and shipper response) but it has been successfully promoted as an economic stimulus to a number of the larger Gulf and East Coast Atlantic ports. This in turn has generated a number of studies that reported during 2012. This report concentrates on three issues raised in these reports that fit the resources and focus of the original study—statewide planning. Chapter 2 gives a Texas Gulf perspective on the potential impacts of the new locks. Chapter 3 examines a major, yet unresolved, issue facing shippers and steamship companies – offering “direct” versus “hub and spoke” services to ports that may not have the status of true load centers or sufficiently deep access channels. Finally, Chapter 4 provides planning observations and recommendations, which could strengthen Texas statewide multimodal plans over the next 20 years.

This report is available for free download (1.5 MB):

<http://swutc.tamu.edu/publications/technicalreports/476660-00062-1.pdf>

Item 7

Examining the Design and Developmental Factors Associated with Crashes Involving Pedestrians, Cyclists, and Motorists in Urban Environments

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TTI SWUTC/12/161107-1 • 2012

Using a parcel-level database of crash incidence and urban form developed for the San Antonio-Bexar County metropolitan region, this study examined how urban form-related variables affect the incidence of crashes involving pedestrians, bicyclists, and motorists. Arterial thoroughfares, strip commercial uses, and big box stores--which include design features expressly intended to support automobile travel--were found to be associated with significant increases in crashes involving pedestrians, bicyclists, and motorists alike. Population density was found to be associated with increased crash incidence among pedestrians, although this is likely a function of increased crash exposure due to the higher levels of pedestrian activity occurring in higher-density environments. The presence of pedestrian-scaled commercial and retail uses, which is likewise associated with increased pedestrian travel, was nonetheless found to be associated with statistically significant reductions in the incidence of multiple-vehicle, fixed-object, and pedestrian crashes. Given that the developmental risk factors that affect pedestrians, cyclists, and motorists proved to be largely the same, this report outlines potential strategies for addressing urban crash incidence in a comprehensive, multimodal manner.

This report is available for free download (2.4 MB):

<http://swutc.tamu.edu/publications/technicalreports/161107-1.pdf>

Item 8

Feasibility of Solar Powered Traffic Signs in Houston: A Step toward Sustainable Control Devices

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TSU SWUTC/12/476660-00053-1 • 2012

With the economy fluctuating all the time, the federal and some city governments at times spend more money than they take in from taxes. It is important for these governments to find ways to reduce spending while still providing sufficient operations for their constituency. As the national focus turns to finding alternative energy rather than the reliance of fossil fuels, it is not hard to find ways in which the city can save money. One of these ways is taking advantage of the sun's energy to power our traffic signals as well as switching the traditional incandescent bulbs to LED. Since the city's origin, Houston, Texas has been a continuous success in population growth, land expansion, job opportunities, and a leader of industry. The city did not get to be where it is by not staying ahead of the curve. With its 2,450 signalized traffic intersections and a wide range in the number of signals at each one, the city has an opportunity to be a leader in large scale retrofitting in the United States. By retrofitting the signals to solar energy and switching to LED the city will see major energy and cost savings, as well as a significant decrease in maintenance cost and time due to the longer lifespan of the LEDs and solar panels.

This report is available for free download (682 KB):

<http://swutc.tamu.edu/publications/technicalreports/476660-00053-1.pdf>

Item 9

Free-Floating Carsharing Systems: Innovations in Membership Prediction, Mode Share, and Vehicle Allocation Optimization Methodologies

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

CTR SWUTC/12/476660-00079-1 • 2012

Free-floating carsharing systems are among the newest types of carsharing programs. They allow one-way rentals and have no set “homes” or docks for the carsharing vehicles; instead, users are permitted to drive the vehicles anywhere within the operating zone and leave the vehicle in a legal parking space. Compared to traditional carsharing operations, free-floating carsharing allows much greater spontaneity and flexibility for the user. However, it leads to additional operational challenges for the program. This report provides methodologies for some of these challenges facing both free-floating and traditional carsharing programs. First, it analyzes cities with carsharing to determine what characteristics increase the likelihood of the city supporting a successful carsharing program; high overall population, small household sizes, high transit use, and high levels of government employment all make the city a likely carsharing contender. Second, in terms of membership prediction, several modeling alternatives exist. All of the options find that the operating area is of key importance, with other factors (including household size, household densities, and proportion of the population between ages 20 and 39) of varying importance depending on the modeling technique. Third, carsharing trip frequencies and mode share are of value to both carsharing and metropolitan planning organizations, and this report provides innovative techniques to determine the number of trips taken and the share of total travel completed with carsharing (both free-floating and traditional). Fourth and finally, an original methodology for optimizing the vehicle allocation issue for free-floating carsharing organizations is provided. The methodology takes a user input for the total number of vehicles and returns the allocations across multiple demand periods that will maximize revenue, taking into account the cost of reallocating vehicles between demand periods.

This report is available for free download (2.4 MB):

<http://swutc.tamu.edu/publications/technicalreports/476660-00079-1.pdf>

Item 10

Moving the Concept of Megaregions into Transportation Planning: Workshop Proceedings

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TSU SWUTC/12/476660-00051-1 • 2012

An area of growing dialog among transportation professionals is about megaregions and the affect the concept may have on long range travel demand and the movement of goods and people throughout a state or region. Megaregion connotes that an individual urban area does not operate singly, but in concert with other urban and rural areas as a comprehensive unit providing and attracting goods and services for the world. As these complex mobility arrangements occur, planning entities are continuing to conduct more localized scaled activities for their independent urban and rural areas. Key questions should be asked about whether another planning layer should be added that examines the megaregions and investigates the interrelationships to determine if advantages or efficiencies might be available by considering operation of the complex whole as one unit. Clearly, such an assessment would not negate the smaller, local level planning activities, but may offer the potential to more competitively posture a megaregion in line with the other 40 or so world megaregions. This work convened a workshop addressing that planning concept. Workshop participants agreed that planning for the megaregions should be added to the elements included in long range plan development.

This report is available for free download (6.9 MB):

<http://swutc.tamu.edu/publications/technicalreports/476660-00051-1.pdf>

Item 11

Nanotechnology-Based System for Damage-Resistant Concrete Pavements

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TTI SWUTC/12/476660-00017-1 • 2012

The focus of this study was to explore the use of nanotechnology-based nanofilaments, such as carbon nanotubes (CNTs) and nanofibers (CNFs), as reinforcement for improving the mechanical properties of Portland cement paste and creating multifunctional and sensing concrete. Due to their ultra-high strength and very high aspect ratios, CNTs and CNFs have been excellent reinforcements for enhancing the physical and mechanical properties of polymer, metallic, and ceramic composites. Very little attention has been devoted to exploring the use of nanofilaments in the transportation industry, however. Therefore, this study aimed to bridge the gap between nanofilaments and transportation materials. This was achieved by testing the integration of CNTs and CNFs in ordinary Portland cement paste through state-of-the-art techniques. Different mixes in fixed proportions (e.g., water-to-cement ratio, air content, admixtures) along with varying concentrations of CNTs or CNFs were prepared. Different techniques commonly used for other materials (like polymers) were used in achieving uniform dispersion of nanofilaments in the cement paste matrix and strong nanofilament/cement bonding. Small-scale specimens were prepared for mechanical testing in order to measure the modified mechanical properties as a function of nanofilament concentration, type, and distribution. With 0.1% CNFs, the ultimate strain capacity increased by 142%, the flexural strength increased by 79%, and the fracture toughness increased by 242%. A scanning electron microscope was used to discern the difference between crack bridging and fiber pullout. Test results showed that the strength, ductility, and fracture toughness can be improved with the addition of low concentrations of either CNTs or CNFs.

This report is available for free download (4 MB):

<http://swutc.tamu.edu/publications/technicalreports/476660-00017-1.pdf>

Item 12

Quantification of the Effect of Maintenance Activities on Texas Road Network

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

CTR SWUTC/12/161125-1 • 2012

Pavement structures are designed for a finite life, usually referred to as performance period. This performance period is typically between 20 to 25 years for flexible pavements and between 25 and 40 years for rigid pavements. After this period, the pavement is predicted to reach a terminal level in terms of several preset criteria. This performance period can be reached by designing a structure that will withstand the effects of traffic and the environment through the design period or by planning a series of maintenance and rehabilitation activities that will keep the structure above the present terminal levels until the end of the design life is reached. The objective of this study is to gather data on pavement performance from FHWA's Long-Term Pavement Performance (LTPP) study. The sections will be selected such that they provide enough time-series information to obtain reliable pavement performance trends. Once the data are collected, the various pavement sections will be modeled using mechanistic-empirical principles and they performance will be predicted. The Mechanistic Empirical Pavement Design Guide (MEPDG) will be used for this purpose. In addition, empirical performance models will be developed to capture the performance (and in particular the differential performance) of the various sections. Once these two types of performance models are available, we will compare the effectiveness of the three types of sections.

This report is available for free download (1.1 MB):

<http://swutc.tamu.edu/publications/technicalreports/161125-1.pdf>

Item 13

Transit Agency Strategies that Encourage Mixed Use around Stations

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TSU SWUTC/12/476660-00054-1 • 2012

Transit-oriented development (TOD) is a mixed-use residential or commercial area designed to maximize access to public transportation that often incorporates features to encourage transit ridership. Varied interests must be represented to implement TOD. Developers present concepts and financial backing, governments create guidelines or zoning that facilitates TOD, community stakeholders voice desires about their neighborhoods and transit agencies implement the transit improvement that serves as the initial catalyst. This research focuses specifically on the role of the transit agency in encouraging development proximate to transit and investigates selected transit authorities within the United States to determine what strategies and steps they are taking to facilitate proximate desirable development around their stations.

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

<http://swutc.tamu.edu/publications/technicalreports/476660-00054-1.pdf>

Item 14

Transportation Security Institute: Recruiting Next Generation Professionals

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TSU SWUTC/12/161240-1 • 2012

The Center for Transportation Training and Research (CTTR), as part of Texas Southern University (TSU), served as host for the 2012 Transportation Security Institute (TSI) in Houston and surrounding area. The 2012 Houston TSI focuses on the mission and objectives of transportation security professionals and introduces a pre-selected group of high school students to the various career opportunities within the profession. TSI provides a curriculum framework that exposes high school students to the transportation security industry via hands-on technical activities, field trips to transportation facilities, lectures by transportation professionals, and on-site seminars. Furthermore, the primary goal of TSI is to introduce exemplary secondary school students to various career opportunities in transportation security. Secondly, industry professionals will reinforce the importance of mathematics, science, and technology skills in the twenty-first century. Lastly, students will observe how public/private partnerships work to strengthen the link between today's students and future transportation security professionals.

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

<http://swutc.tamu.edu/publications/technicalreports/161240-1.pdf>

Item 15

TTI's 2012 Urban Mobility Report: Powered by INRIX Traffic Data

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

TTI SWUTC/12/161202-1 • 2012

"The 2012 Urban Mobility Report builds on previous Urban Mobility Reports with an improved methodology and expanded coverage of the nation's urban congestion problem and solutions. The links below provide information on long-term congestion trends, the most recent congestion comparisons and a description of many congestion improvement strategies. All of the statistics have been recalculated with the new method to provide a consistent picture of the congestion challenge. As with previous methodology improvements, readers, writers and analysts are cautioned against using congestion data from the 2011 Report. All of the measures, plus a few more, have been updated and included in this report." --publ. website <http://mobility.tamu.edu/ums/>

This report is available for free download:

<http://mobility.tamu.edu/ums/report/>

Item 16

Using Real Time Traveler Demand Data to Optimize Commuter Rail Feeder Systems

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

CTR SWUTC/12/476660-00078-1 • 2012

This report focuses on real time optimization of the Commuter Rail Circulator Route Network Design Problem (CRCNDP). The route configuration of the circulator system – where to stop and the route among the stops – is determined on a real-time basis by employing adaptive Tabu Search to timely solve a Mixed Integer Program (MIP) problem with an objective to minimize total cost incurred to both transit users and transit operators. Numerical experiments are executed to find the threshold for the minimum fraction of travelers that would need to report their destinations via smart phone to guarantee the practical value of optimization based on real-time collected demand against a base case defined as the average performance of all possible routes. The adaptive Tabu Search Algorithm is also applied to three real-size networks abstracted from the Martin Luther King (MLK) station of the new MetroRail system in Austin, Texas.

This report is available for free download (1.6 MB):

<http://swutc.tamu.edu/publications/technicalreports/476660-00078-1.pdf>