Research Digest

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Southwest Region University Transportation Center (SWUTC)

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As of October 1, 2016, the SWUTC concluded its 28 years of operation and is no longer an active center. These are the last publications published through the center and received by the CTR Library.

Item 1

Compendium of Student Papers: 2015 Undergraduate Transportation Scholars Program

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TTI SWUTC/15/600451-00003-4 • 2016

This report is a compilation of research papers written by students participating in the 2015 Undergraduate Transportation Scholars Program. The 10-week summer program, now in its 25th year, provides undergraduate students in Civil Engineering the opportunity to learn about transportation engineering through participating in sponsored transportation research projects. The program design allows students to interact directly with a Texas A&M University faculty member or Texas A&M Transportation Institute researcher in developing a research proposal, conducting valid research, and documenting the research results through oral presentations and research papers.

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This report is available for free download (1.7 MB):
http://swutc.tamu.edu/publications/technicalreports/compendiums/600451-00003-4.pdf

Item 2

Compendium of Student Papers: 2016 Undergraduate Transportation Scholars Program

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TTI SWUTC/16/600451-00003-5 • 2016

This report is a compendium of research papers written by students participating in the 2016 Undergraduate Transportation Scholars Program. The 10-week summer program, now in its 26th year, provides undergraduate students in civil engineering the opportunity to learn about transportation engineering through participating in sponsored transportation research projects. The program design allows students to interact directly with a Texas A&M University faculty member or Texas A&M Transportation Institute researcher in developing a research proposal, conducting valid research, and documenting the research results through oral presentations and research papers.

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This report is available for free download (1.2 MB):
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Item 3

Integration of Heuristics and Statistics to Improve the Quality of Network-level Pavement Condition Data

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TTI SWUTC/16/600451-00052-1 • 2016

Transportation agencies use pavement management systems (PMSs) to make efficient decisions about allocating available resources to the maintenance, rehabilitation, and renewal of their roadway networks. One of the most costly parts of the PMS process is collecting pavement condition data. The efficiency and reliability of decisions made based on PMSs depend upon the quality of this data. Thus, transportation agencies need to ensure that dollars invested in this data are well spent, and pavement condition data has the level of quality necessary to meet PMS requirements. Therefore, assessing and improving the quality of pavement management data is a major challenge for both researchers and practitioners.

This study advances the quality assessment of network-level pavement condition data by answering the following questions: (a) How can we identify potential errors in pavement condition data used in PMSs? (b) How do multiple dimensions of error detection affect our ability to detect errors? (c) How does the accuracy of pavement condition data impact predictions of future road network performance? And (d) How do we measure multiple quality dimensions of pavement condition datasets? First, this research devises and implements a computational method to identify potential errors in pavement condition data, integrating conventional statistical methods and heuristics. Second, the effect of considering multiple dimensions of error detection in pavement condition data was investigated. These dimensions are based on data properties, including time series trends in pavement condition data, variability within uniform performance families, and the consistency between several performance indicators. Third, this research presents a quantitative assessment of the impact of data accuracy on the estimated remaining service life (RSL) of a roadway network as an overall measure of network health. Finally, it provides metrics for measuring data quality dimensions for pavement condition datasets.

The developed technique was validated using pavement condition field data for a road network in Texas.

This report is available for free download (4.1 MB):
http://swutc.tamu.edu/publications/technicalreports/600451-00052-1.pdf

Item 4

Modeling Deformation of Freezing Concrete: Towards the Identification of D-cracking Susceptible Aggregates and Construction of all Concrete LNG Tanks

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TTI SWUTC/16/600451-00053-1 • 2016

For many decades, degradation of concrete by freezing actions has been a primary interest of research for civil engineers. Past studies mostly relied on expensive and time-consuming experimental or semi-empirical investigations to identify the source of damage that is attributable to substandard aggregates, inadequate entrained air content, highly porous mortar or cement matrix, and use of deicing salts. Theoretical works developed in recent years do not incorporate all these factors in one single model. Very recently, concrete has gained widespread popularity as a cheap alternative to traditional material utilized for containing liquefied natural gas (LNG). Most studies documenting concrete behavior at cryogenic temperatures are obscure. Therefore, poroelastic theory, capable of incorporating aggregate and mortar properties, pore solution characteristics, air void spacing, and environmental exposure has been utilized to model damage triggering stresses and strain in concrete used for two purposes: 1) concrete pavement exposed to freezing and thawing cycles, and 2) concrete walled tanks containing LNG. The solid-liquid phase transformation equilibrium has been redeveloped to demonstrate the effect of pore solution speciation and disjoining pressure on the deformation of freezing concrete.

This report is available for free download (3.8 MB):
http://swutc.tamu.edu/publications/technicalreports/600451-00053-1.pdf

Item 5

Project Consistency Guidance. Part A, Project Consistency Guidebook: Maintaining Project Consistency throughout the Project Development Process

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TTI 0-6758 Part A • 2014

"Streamlined project delivery is a federally mandated goal that the Texas Department of Transportation (TxDOT) leadership supports. Federal and state transportation planning statutory and regulatory laws require transportation projects to be consistent with transportation plans and improvement programs before the Federal Highway Administration (FHWA) or the Federal Transit Authority (FTA) can take federal action on a project1 requiring one. Consequently, significant delays in project delivery can potentially occur, as the federal funding will be withheld for such projects and FHWA/FTA will not authorize their construction until the inconsistencies are fully addressed. Project consistency is required based on federal code 23 CFR 450 and Texas code 43 TAC 16... This document was developed for transportation professionals responsible for project development and has three basic goals: (1.) Define project consistency and identify the causes of project inconsistencies and the critical junctures in the project development process where project consistency should be reviewed. (2.) Identify resources and best practices that minimize project delays and financial risk, including the Project Consistency Checklist. (3.) Provide contact information for external entities and TxDOT offices of primary responsibility (OPRs) as well as communication guidelines for resolving project inconsistencies. To meet these goals, this guidebook is organized as follows: Chapter 2 will define project consistency and provide an overview of its elements. Chapter 3 will identify the causes of inconsistencies and outline the critical junctures in the planning and project development processes where project consistency should be reviewed. Chapter 4 will discuss project consistency management throughout the project development process to minimize delay and financial risk. In addition, this chapter will identify the tools helpful in this process." --page 1

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This report is available for free download (1.7 MB):
https://swutc.tamu.edu/publications/technicalreports/0-6758-1Guidebook.pdf

Item 6

Waterway System Maintenance Optimization

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER (SWUTC)

TTI SWUTC/16/600451-00039-1 • 2016

Coastal lines, harbors/ports, and inland waterways constitute the marine transportation system, a major component of the United States freight system, carrying a vast majority of foreign imports and exports and a significant amount of domestic freight. This system needs regular maintenance. US Army Corps of Engineers (USACE) is in charge of the waterway system maintenance. However, the limited maintenance budget needs to accommodate a large number of maintenance requests for dredging and dam repair, etc. The requests often exceed the budget available by much. A decision facing the USACE management is what projects to fund and how to select them. This research aims at providing the necessary models and tools to facilitate maintenance decisions at the USACE. The objective is to maximize the overall system improvement under annual limited budget. The underlying problem can be modeled as a knapsack problem with an additional constraint that increases the problem complexity. The additional constraints describe the benefit interdependency of different maintenance projects due to the waterways network effect.

This research tackles the maintenance problem at different levels. First, an integer selection model is developed to find the optimal set of dredging projects (waterway sediment removal operation) and some heuristics are developed to provide near-optimal solutions in computationally guaranteed polynomial time. Next, a model is developed to allow partial dredging. Partial dredging means partially conducting the requested dredging operation. The model is able to determine the percentage of the dredging depth to fund instead of a zero-one dredging decision for each project. Further, a stochastic problem is considered regarding to the probabilistic shoaling process. To solve the probabilistic problem, two methods are designed: an analytical model that takes account of probability in terms of expected values, and a stochastic optimization approach was developed based on Monte-Carlo simulation. Finally, the problem is modeled in a multi-modal context where the maintenance decisions are made simultaneously on dredging and lock/dam improvement. In this multimodal model, the effect of landside modes' capacity is considered comprehensively. All the developed methods are tested with real examples from US marine network and their performance is approved by comparison to real situation.

This report is available for free download (4.3 MB):
http://swutc.tamu.edu/publications/technicalreports/600451-00039-1.pdf