LTRC RESEARCH PROJECT CAPSULE

SEPTEMBER 2010

10-4P

TECHNOLOGY TRANSFER PROGRAM

JUST THE FACTS

Development of Cost-effective Pavement Treatment Selection and Treatment Performance Models

Start Date:
September 1, 2010

Duration:
34 months

End Date:
June 30, 2013

Funding:
State

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SPECIAL POINTS OF INTEREST:

- Problem Addressed
- Objectives of Research
- Methodology Used
- Implementation Potential

PROBLEM

Since the bulk of the highway systems in Louisiana have been constructed and completed, emphasis has shifted from design and construction to pavement preservation. Unfortunately, the engineering knowledge and the types of experience required to preserve the highway systems are much different than those required to originally design and construct them. Hence, the experience gained in the initial phase of construction, however important, cannot be solely used to preserve the systems.

In general, the term "system pavement preservation" includes preventive (or preservation) and corrective maintenance, rehabilitation, and reconstruction activities. Maintenance activities are typically applied at the initial stage of pavement deterioration. Rehabilitation activities, on the other hand, are applied at later stages. The cost-effectiveness of any pavement preservation program depends on the selection of the optimum time of intervention, project boundaries, and pavement fix type.

The Louisiana Department of Transportation and Development (LADOTD) manages approximately 18,000 roadway miles consisting of flexible pavements [asphaltic concrete (AC)], jointed concrete pavements (JCP), composite pavements (COM), and continuously reinforced concrete (CRC) pavements. The road network is deteriorating over time due to increasing traffic volume, axle loads, environmental factors, and aging. Timely rehabilitation and preservation of pavement systems are imperative to maximize their benefits in terms of drivers' comfort and safety and spending of tax payers' dollars. LADOTD has spent substantial financial resources on various rehabilitation and maintenance treatments to minimize the pavement distresses and to improve the pavement life. Such treatments include but are not limited to chip seal, crack seal, micro-surfacing, thin and thick overlays, rubblize and overlay, and structural overlays. Unfortunately, LADOTD has not conducted a full scale performance assessment and cost-effectiveness analysis of all the aforementioned treatments. A recent study completed by the Louisiana Transportation Research Center (LTRC) regarding the pavement management system (PMS) and performance modeling emphasized the importance of developing treatment performance and selection models. The proposed research addresses such needs by developing rigorous treatment performance and selection models that are specific to the mission and management strategies of LADOTD.

OBJECTIVES

The overall goal of this study is to develop pavement treatment performance models in support of the cost-effective selection of pavement treatment types, project boundaries, and time of treatment. The development of the proposed models will be based on historical pavement distress data available in LADOTD's mainframe and PMS database. The models will also be integrated into the LADOTD PMS, pavement preservation system, and pavement design system.

METHODOLOGY

To accomplish the objectives, the research study is divided into the following three phases:

Phase I—Review and Project Selection

Phase I of this study consists of the four tasks detailed below.

Task 1: Review of Literature and State-of-the-Practice: In this task, the research team will conduct a comprehensive examination and review of existing literature regarding the state-of-the-practice in the USA and abroad for the design, construction, and quality control of pavement structures.

Task 2: Review of LADOTD State-of-the-Practice: In this task, the research team will conduct a comprehensive survey of the state-of-the-practice of each district within LADOTD. The results of the survey will facilitate the advantages and shortcomings of each procedure used by the districts. Based on the survey results, a factorial grid will also be established incorporating various types of treatments and traffic conditions.

Task 3: Roadway Identification for Project Selection: The main objective of this task is to identify, with the help of PMS office, the project review committee (PRC), and district engineers, all roadways where different treatment projects were implemented. This objective will be accomplished by interviewing LADOTD engineers, searching the LADOTD mainframe database, searching the LADOTD PMS database, and searching the LADOTD pavement design and system preservation database.

Task 4: Project Selection: The main objective in this task is to examine the matrix developed in Tasks 2 and 3 to select candidate treatment projects to be included in the data analysis in Phase II of the study.

Task 5: Phase I Reporting: An interim report will be prepared by the research team and submitted to PRC for review. The report will summarize and disseminate both the findings of Phase I and the recommendations made by the research team. Based on the findings and recommendations, the PRC may modify the research plan of Phase II.

Phase II —Performance Modeling and Costs and Benefits of Treatments

The main objective of this phase is to conduct a data analysis for the development of pavement treatment performance models and cost-effective treatment selection models, respectively.

Task 6: Development of Pavement Treatment Performance Models: The pavement performance after treatment and the treatment life are functions of many variables including: the pavement conditions and its rate of deterioration before treatment, pavement age, causes of pavement distresses, construction methods, treatment types, pre-treatment actions, pavement types, classification, and traffic volume and loads. Statistical analyses will focus on developing practical and implementable regression relationships to predict pavement treatment life. Linear or non-linear regression analyses can be conducted to determine the regression models for treatment performance (actual distress value or distress index values) as functions of treatment age.

Task 7: Cost-effective Pavement Treatment Selection Models: The final selection of the optimum treatment for a given pavement section depends on the type, severity, and extent of the distress; the causes of the distresses; and on the cost and benefits of the treatment. In this task, the research team will collect and review information on the timing, selection, and performance of maintenance treatments of flexible, composite, and rigid pavements. The research team will evaluate the existing procedure adopted by LADOTD and upgrade the treatment selection model based on a logical step-by-step approach incorporating the aforementioned factors.

Task 8: Final Report: A final progress report will be prepared and provided to LTRC for review. The progress report will include all the research efforts, findings, problems encountered, guidelines, and recommendations for an efficient and cost-effective preservation of pavements in the state of Louisiana.

Phase III—Model Integration and Training

Phase III of this study consists of the following tasks:

Task 9: Model Integration: In this task, the research team will integrate all models developed in this study into the LADOTD PMS pavement preservation system. This implies that the software must be compatible with the LADOTD database and must be dynamic in nature to improve the prediction models as more PMS data become available. Furthermore, the life cycle cost data software will be designed to accommodate changing construction costs and pavement performance curves.

Task 10: Training: In this task, the research team will develop training materials to train the staff of LADOTD to use the models and the associated software. It is proposed that group training will be held for LTRC, PMS, pavement preservation, and the pavement design sections of LADOTD. The training will be conducted either at the LADOTD facility or at the University of Louisiana at Lafayette. All training will be hands on and based on real field data.

IMPLEMENTATION

The findings of the study will be based on the systemic research based approach and actual pavement performance data. The results will be directly implemented to improve the existing highway network in a cost-effective manner by using:

- New models for pavement treatment performance models for timely maintenance and rehabilitation.
- Updated cost-effective treatment selection models.

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