Summary of Final Report B352-09
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PROJECT PLANNING MODELS FOR FLORIDA'S BRIDGE MANAGEMENT SYSTEM

PROBLEM STATEMENT

The Florida Department of Transportation (FDOT) is implementing the AASHTOWare Pontis® Bridge Management System (BMS) as a decision support tool for planning and programming maintenance, repairs, rehabilitation, improvements, and replacement for more than 6,000 bridges on the state highway network. A BMS stores inventory and inspection data in a database, and uses engineering and economic models to predict the possible outcomes of policy and program decisions.

Previous FDOT research in the areas of user and agency costs identified the remaining analytical needs for implementation of the economic models of Pontis and has made significant progress in the development of these models. Following the success of these research efforts, further work was needed to investigate several additional modeling issues and to develop methods for applying the results of the earlier research in actual FDOT bridge management decision-making. Primarily, there is a need is to develop a project planning tool and to fill in other remaining gaps to make Pontis a valuable planning tool for FDOT bridge engineers. The project planning tool will require updated user cost models specific to Florida in terms of truck weight and height characteristics and in terms of moveable bridge openings on Florida roadways.

OBJECTIVES

The objectives of the study included the following:

- Develop truck height models for user cost modeling of bridges on Florida roadways.
- Develop truck weight models for user cost modeling of bridges on Florida roadways.
- Develop user cost models of moveable bridge openings on Florida roadways.
- Develop project planning models for implementation within the Florida's Bridge Management System, including software and a user's manual.

FINDINGS AND CONCLUSIONS

An extensive literature review was initially performed, including study and updating of pertinent previous research done by FDOT. Descriptive truck height and weight models were developed for user cost modeling of bridges on Florida highways. Using laser-based devices (a handheld range finder and installed vehicle scanners at FDOT weigh stations), truck height measurements were taken at nine sites on Florida roadways. The sites reflected variation in geographical location and roadway functional class. Truck weight data was collected simultaneously with the truck height data at three FDOT weigh stations (Interstate highways) by integrating the vehicle scanner into the weigh-in-motion (WIM) data collection system. Researchers also obtained from

FDOT historical WIM data on truck weight from additional eight sites. All eleven sites for truck weight data reflected geographical location diversity and functional class variation. The data were used to develop truck weight and height histograms and to generate curves, including piece-wise linear and nonlinear functions.

For Pontis implementation at both the network and the project levels, best-fitting linear and nonlinear functions were developed to estimate the probability of truck height or weight exceeding a specific value for three categories: interstate roadways, non-interstate roadways, and all roadways. User cost model input parameters were updated for vehicle operating costs and travel time cost. Bridge user cost models were formulated for both strengthening and raising improvements.

Researchers also developed a user cost model for moveable bridge openings, which quantifies the economic impact of bridge openings, specifically the lost time due to delay of motorists. Suitable data on bridge opening frequency and duration of opening for six moveable bridge sites on Florida highways was obtained. The locations were geographically spread and reflective of the variation in traffic and functional class of the roadways. On-site data were collected on automobile and vessel traffic, including vehicle queue length and vessel height distributions.

Researchers developed queue models (incorporating both vehicles and vessels) in which the vehicular delay was modeled as a bottleneck occurrence on the roadway, where the service flow rate of vehicles is reduced due to a blockade, which, in this case, would be the opening of the bridge. Decision making templates have been developed to correctly assign performance measures and priorities to moveable bridge replacement projects, including 20 year projections of vessel and vehicular traffic. Bridge replacement models considered higher moveable bridge options as well 65 ft. fixed bridges, with input data such as bridge geometrics, number of bridge openings, agency life cycle costs, and user delay costs. Also, the researcher has suggested modifications to the Pontis software that would be required to implement the user cost model at both the network and the project levels, for movable bridge openings, by considering vehicular and vessel delays and the load carrying capacity of existing bridges.

A project-level decision support software tool was developed. It incorporates Pontis network-level results along with all the products of the earlier research and provides FDOT bridge engineers with a clear picture of the economic health of a bridge and the economic implications of scoping and timing decisions for structure maintenance, repairs, rehabilitation, improvement, and replacement. A comprehensive user manual as well as the software is included with the study report.

The decision support tool is designed to be compatible with and to take advantage of the existing Pontis network-level models, but it is intended to be used as a part of project-level decision-making. Consequently, the Pontis economic definitions and life cycle cost model must be adapted to be most useful in the context of individual structures. Sub-models may be added to address certain project-level concerns and a display tool built to provide information for scoping and timing decisions.

BENEFITS

The developed decision support software, dubbed the Florida Project Level Analysis Tool, is highly graphical software that sheds light on the scoping and timing decisions inherent in bridge life cycle decision-making. This tool will aid in the implementation of several recent FDOT research efforts, such as *Development of User Cost Data for Florida's Bridge Management Systems* (WPI# 0510855) and *Development of Agency Maintenance Repair and Rehabilitation (MR&R) Cost Data for Florida's Bridge Management System* (BB879) (available online at http://www.dot.state.fl.us/research-center/Completed_Maintenance.htm).

The Project Level Analysis Tool will also be used by the Department's Bridge Maintenance Offices during their selection of bridge repair and replacement projects. The tool will facilitate the quick screening of many projects, and it will be useful in the selection of the most beneficial projects for further development. Consequently, it will improve the accuracy and the efficiency of the bridge repair and replacement work program. Because the tool developed in this project fills a significant gap in Pontis, other states have already expressed interest in implementing it.

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