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SUMMARY REPORT

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Calibrating Pavement Performance Prediction Models for Interstate and Primary Highway Systems in South Carolina

A study was performed to evaluate the prediction accuracy of pavement performance prediction models in South Carolina. The South Carolina Department of Transportation (SCDOT) maintains a designated Pavement Management Section to annually acquire, analyze and optimize data on pavement roughness and surface distress along its interstate and primary state highways. As part of the SCDOT Pavement Management System developed in 1989 by PMS Inc., now known as Stantec Consultants Inc., default prediction models were incorporated to forecast changes in pavement condition. In South Carolina, pavement condition is quantified by using the Pavement Distress Index (PDI), Present Serviceability Index (PSI) and the Pavement Quality Index (PQI), which is calculated from PDI and PSI.

There are 12 default curves for predicting PSI and 20 default curves for predicting PDI. PQI prediction curves are formulated by combining the predicted values of PSI and PDI in the PQI equation. From 1994 to 2000, the SCDOT acquired large volumes of high-quality performance data on interstate pavements that describe measured changes in PSI, PDI and PQI with time. These historical observations are used to evaluate several of the default pavement performance prediction models. This evaluation will allow the SCDOT Pavement Management Section to more efficiently manage highway pavements and predict pavement life expectancy more accurately and with more confidence.

As part of this study, a national survey was conducted to identify roughness- and distress-based pavement performance prediction models implemented successfully by other state Departments of Transportation and the District of Columbia. 29 of 51 agencies, including South Carolina, responded to this survey. More than 80% of the responding agencies collect their own pavement roughness and distress data. The remaining 20% contract these services to data collection vendors. More than 60% of responding agencies are using historical performance data to either develop or calibrate pavement performance prediction models. Nearly 50% of responding agencies use pavement performance indices to predict remaining life of pavement.

Pavement performance data on 28 interstate pavement sections in South Carolina were acquired for this study. Pavement performance indices (PSI, PDI and PQI) were calculated for each year from 1994 to 2000, except for 1998 when data was not collected by the SCDOT. Based on the rehabilitation history of these pavements, a total of seven PSI models, seven PDI models and eight PQI models were evaluated for prediction accuracy. Six of the seven default PSI models show an average percent deviation between 8% and 30%. Only the PSI-2 model, which is used for pavement sections undergoing rehabilitation activity ST1 (mill and replace 1-2 in.) and ST9 (overlay > 400 psy), has an average percent deviation less than 10%. Six of the seven default PDI models show an average percent deviation between 5% and 22%. Only the PDI-1 model has an average percent deviation less than 10%. The PDI-1 model is used for pavement sections undergoing rehabilitation activity ST1 (mill and replace 1-2 in.), ST5 (mill and replace 1-2 in. plus overlay 400 psy) and ST9 (overlay > 400 psy). The seventh models (PSI-7 and PDI-8) were developed specifically for concrete pavement undergoing minimum maintenance. Both have an average percent deviation more than 300% and should be discontinued.

Finally, the PQI-1 model is the only model with an average percent deviation less than 10%. This particular model is formulated by combining the two most accurate PSI and PDI models, PSI-2 and PDI-1. Using a best-fit procedure to minimize the error between observed and predicted values, it was determined that the PQI-1 model significantly improves prediction accuracy of most of the pavement sections in this study.

This research project was conducted at the University of South Carolina by Charles E. Pierce, Ph.D., Ronald L. Baus, Ph.D., and Dajun "Jerry" Wang.
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