



SPR RESEARCH PROGRAM

SECOND-STAGE PROBLEM STATEMENT

FY 2010

ODOT Research Unit
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I. PROBLEM NUMBER

PM-10-02

II. PROBLEM TITLE

Mechanistic Design Guide Calibration for Pavement Rehabilitation

III. RESEARCH PROBLEM STATEMENT

ODOT is currently in the process of implementing the new mechanistic-empirical pavement design guide (MEPDG) for new work pavement sections. Due to the substantial commitment of time and resources to accomplish this, ODOT is approaching this in a step-wise fashion.

Internally, ODOT has been evaluating the MEPDG for new work sections for both flexible and rigid interstate pavement sections. This work has principally involved using ODOT-specific design inputs for traffic and, to a lesser degree, inputs using generic materials properties (e.g., back-calculated subgrade moduli).

Work is also currently being conducted at Oregon State University to develop design inputs and evaluate the three principal pavement performance models (i.e., fatigue cracking, rutting, and thermal cracking models) that are integral to the design process of new work sections for hot mix asphalt concrete (HMAC) pavement structures. However, the vast majority of pavement work conducted by ODOT involves rehabilitation of existing pavements. Additional work is therefore needed to calibrate the design process for rehabilitation of existing pavement structures.

HMAC overlays are the preferred rehabilitation treatment for both flexible and rigid pavements in Oregon. However, like new work sections, overlays are susceptible to fatigue cracking, rutting, and thermal cracking. Hence, the research effort will need to include these forms of distress in the calibration process. In addition, cracks in the existing flexible pavements (or joints in existing rigid pavements) often initiate cracks in the overlay that propagate to the surface, a phenomenon referred to as reflective of reflection cracking. With this being a common problem in overlays placed in Oregon, this form of distress will also be included in the calibration process.

IV. RESEARCH OBJECTIVES

The objective of the research is to provide ODOT with pavement performance models for HMAC overlays that predict fatigue cracking, rutting, thermal cracking, and reflection cracking calibrated to Oregon conditions.

V. WORK TASKS, COST ESTIMATE AND DURATION

Task 1 – Literature Review: This will involve a review the documents developed under NCHRP Project 01-40B, *User Manual and Local Calibration Guide for the Mechanistic-Empirical Pavement Design Guide and Software* and published literature documenting other states' efforts toward calibration of the distress (performance) models utilized in the MEPDG.

Cost: \$10,000

Time: 1 month

Task 2 – Calibration Plan: Based largely on the findings from Task 1, this will involve developing a comprehensive plan for calibrating the performance models for Oregon conditions. It is anticipated that this will involve obtaining historical mix design, structural design, traffic, and climate information for rehabilitated pavements that currently exhibit distress in the form of fatigue cracking, rutting, thermal cracking, or reflection cracking. Pavement performance (distress) information from the ODOT Pavement Management System (PMS) will be used to initially screen potential in-service pavement sections for the calibration efforts. The accuracy of the calibration effort will largely depend on the accuracy of performance information. Hence, where possible and practical, detailed distress information will be obtained through field measurements during distress surveys of candidate pavement sections.

Using the information obtained from the historical records as inputs into the MEPDG software, predicted performance will be determined by the software for each of the rehabilitated pavement sections from which accurate distress information is obtained and compared with actual, in-service levels of distress. Assuming differences will exist between predicted and measured distress, the appropriate coefficients within the performance models will be adjusted so as to reduce any discrepancies to a satisfactory level. If significant discrepancies are not found, the effort will serve to validate the accuracy of the unmodified performance models.

Cost: \$10,000 **Time: 1 month**

Task 3 – Records Review: This will involve mining the ODOT PMS database to identify candidate projects, identifying projects for which requisite historical information (mix design, structural design, traffic, and climatic data) exists, identifying specific projects for further investigation, and obtaining and summarizing the historical information for these projects (to be used as the inputs for the MEPDG software runs under Task 5).

Cost: \$40,000 **Time: 6 months**

Task 4 – Condition Surveys: This will involve conducting detailed condition surveys, insomuch as possible and practical, to obtain detailed distress information for the specific projects identified in Task 3.

Cost: \$30,000 **Time: 4 months**

Task 5 – Model Calibration: This will involve executing the MEPDG software using the inputs obtained under Task 3 and comparing the output to the information obtained under Task 4. It will also involve adjusting the appropriate coefficients of the performance (distress) models so as to reduce discrepancies between measured (Task 4) and predicted distress to a satisfactory level. Additional software runs will be conducted to confirm the efficacy of the modified performance models.

Cost: \$30,000 **Time: 3 months**

Task 6 – Report: A final report will be developed to document the efforts undertaken to accomplish Tasks 1-5.

Cost: \$20,000 **Time: 3 months**

Task 7 - Research Administration

Cost: \$8,000

TOTAL PROJECT COST: \$148,000

TIME TO COMPLETION: 18 MONTHS

VI. IMPLEMENTATION

The results of this research effort (i.e., calibrated performance models for HMAC overlays) will be utilized by the pavement design engineer and pavement specialists in Pavement Services for the design of HMAC overlays for pavement rehabilitation projects.

VII. POTENTIAL BENEFITS

The new design procedure incorporated in the MEPDG software will allow states to design better performing and more cost effective pavements through the use of a procedure that is based more on the engineering properties of the materials and pavement structure and less on empirical relationships. Mechanistic-empirical design procedures allow designers to make better use of materials, evaluate and incorporate new materials in designs, and evaluate the impacts of heavier loads and new axle configurations on pavement performance. ODOT Pavement Services is currently in the process of implementing the new design procedure and this project will provide ODOT with performance models calibrated to Oregon conditions so that it can better reap the benefits of mechanistic pavement designs. This project is critical to the successful implementation of the mechanistic design procedures for HMAC rehabilitation efforts.

VIII. SUBMITTED BY

Stage 1 submitter and champion:

Submitter: Todd Scholz, Oregon State University

Champion: René Renteria, Pavement Design Engineer, ODOT Pavement Services

Stage 2 submitter:

Todd V. Scholz, Oregon State University