Title: Monitoring Seasonal Instrumentation & Modeling Climatic Effects on Pavements at the Ohio/SHRP Test Road
State Job Number: 14704
PID Number:
Research Agency: University of Toledo
Researcher(s): Andrew Heydinger
Technical Liaison(s): Aric Morse, Roger Green, Brad Young
Research Manager: Karen Pannell
Sponsor(s): Howard Wood, David Humphrey
Study Start Date: 5/18/1998
Study Completion Date: 11/1/2003
Study Duration: 66 Months
Study Cost: $219,920.00
Study Funding Type: 80 Federal / 20 State from ODOT SPR (2)

STATEMENT OF NEED:

Long-Term Pavement Performance (LTPP) Seasonal Monitoring Program (SMP) instrumentation was installed in pavement sections at the Ohio SHRP Test Road. The pavements are monitored for the seasonal variations of moisture, temperature and frost penetration. Data from the instrumentation is subjected to quality checks and prepared for uploading to the FHWA Information Management System (IMS). Findings from the testing are to be incorporated into future pavement design procedures. The data from the seasonal monitoring instrumentation and weather data need to be analyzed to determine the variations of climatic factors affecting pavement performance.

RESEARCH OBJECTIVES:

- Continue LTPP seasonal instrumentation data collection and equipment maintenance at the Ohio SHRP Test Road in Delaware County, Ohio.
- Perform quality assurance checks on the data and prepare data for the LTPP IMS.
- Analyze the data for seasonal variations of climatic conditions.
- Determine the soil-water characteristic curve and permeability function for the site subgrade soil at the site.
- Conduct calibration and sensitivity studies on pavement sections using the FHWA Enhanced Integrated Climatic Model (EICM).

RESEARCH TASKS:

Test sections with SMP instrumentation were visited 14 times each year to collect ONSITE and MOBILE data. Level C and D quality control checks were conducted on the data and upload files were prepared for the IMS. ONSITE, MOBILE, weather and depth to water table data were analyzed. Equations for the seasonal variations of air temperature, soil temperature and soil moisture were derived. An equation for the seasonal variation of soil
resilient modulus was proposed. Variations of the depth to the water table and the depth of frost penetration were investigated.

Modeling studies were completed using the EICM to predict the seasonal variations of various climatic factors. Soil-water characteristic and permeability tests were conducted on soil from the site. Calibrated models were developed using comparisons between predicted and observed values. The ability of the EICM to predict seasonal variations of climatic factors was evaluated.

**RESEARCH DELIVERABLES:**

- The final report will describe all research activities, findings, and conclusions.
- Seasonal instrumentation data was provided to LTPP IMS

**RESEARCH RECOMMENDATIONS:**

- There is a large amount of data available from the Seasonal Monitoring Program (SMP) testing. The SMP data can be used to evaluate the climatic effects on pavements. Researchers involved in the development of pavement design procedures or in the evaluation of mechanistic-empirical design procedures can utilize the data for their studies.
- Empirical equations were developed to predict seasonal variations in air temperature, subgrade soil temperature and soil moisture. Recommendations were made for determining the variation of subgrade soil resilient modulus. The approach used in this research is recommended for incorporation into pavement design.
- Mathematical models were developed for predicting seasonal variations in pavement sections at the Ohio SHRP Test Road using the Enhanced Integrated Climatic Model (EICM). Predictions from calibrated models were compared to observed values. Since the EICM is a part of the 2002 Mechanistic Pavement Design Guide, this research could be useful for pavement designers in Ohio.

**PROJECT PANEL COMMENTS:**
Data collected from environmental sensors, was collected, processed and forwarded to the Federal Highway Administration for storage in the national LTPP database.

The researcher performed an initial calibration of the EICM. Results of the EICM calibration were mixed.

**IMPLEMENTATION STEPS & TIME FRAME:**

1. Data has been collected, processed, and provided to the FHWA on a regular basis during the project.

2. Further investigation will be conducted under a fiscal year 2008 project titled “Guidelines for implementing NCHRP 1-37A M/E Design Procedures in Ohio”

**EXPECTED BENEFITS:**

The sheer magnitude of annual expenditures on pavements justifies the application of the best available design procedures to optimize the use of highway funds. Any improvements in this area will have significant and sizeable implications in reducing the cost of maintaining these pavements.
EXPECTED RISKS, OBSTACLES, & STRATEGIES TO OVERCOME THEM:

None

OTHER ODOT OFFICES AFFECTED BY THE CHANGE:

None

PROGRESS REPORTING & TIME FRAME:

N/A

TECHNOLOGY TRANSFER METHODS TO BE USED:

- The final report of this research will be available online at the ODOT website.
- The Final Report was also distributed to all other state departments of transportation in addition to national libraries and repositories.

IMPLEMENTATION COST & SOURCE OF FUNDING:

No funding needs are anticipated.

Approved By: (attached additional sheets if necessary)

Office Administrator(s):

Signature:  David Humphrey Office:  OPE Date:  12/07/2006

Division Deputy Director(s):

Signature:  Howard Wood Division:  Planning Date:  12/07/2006