

OHIO DEPARTMENT OF TRANSPORTATION
QUARTERLY RESEARCH REPORT

For Quarter Ending March 31, 2003
Date Submitted: June 9, 2003

Project: Truck/Pavement/Economic Modeling and In-Situ Field Test Data Analysis Applications

Research Agency: Ohio University

Principal Investigator(s): Dr. Shad Sargand and William Edwards

NCP No: _____

State Job No.: 14770(0)

Contract No.: 10212

Project Start Date: February 9, 2001 Contract Funds Approved: \$394,299

Project Completion Date: February 9, 2005 Spent To Date: \$251,741

64 % Funds Expended 55 % Work Done 52 % Time Expired

List the Technical Liaisons and other individuals who should receive copies of this report: Karen Pannell

SUMMARY OF PROGRESS FOR QUARTER:

On April 29 and 30, 2003, a National Pooled Fund Study Progress Meeting was held in Charlotte, North Carolina. Minutes from the Progress Meeting are summarized below.

Task A1 - Drainage

Factors to consider when selecting the base type are: 1) surface layer type, 2) permeability, 3) stiffness, and 4) constructability. Analysis of the environmental data collected on the Ohio/SHRP test road; the SR-2, US-33, and US-50 test roads; and the LTPP database is continuing. Data from the Ohio/SHRP test road is showing the subgrade immediately under the base is saturated or close to saturation regardless of base type due to capillary action.

Task A2 – PCC Pavements

The results of the curling and warping study recently completed at the APLF were presented. Two slabs were constructed, one with dowels, one without. The slabs contained LVDTs, strain gauges, thermocouples, and instrumented dowels. Slab curl and warping were measured from initial set with the instrumentation, dipstick, and a noncontact profiler. The APLF is being used to determine slab response to controlled temperature fluctuations. Results indicate there is always some “built-in” curl, even when the temperature gradient was positive, and dowel bars will restrain slab curl. Data collected at the New York I-490 test site will be used to validate results.

Based on the analysis of the Ohio test sections, factors which determine the desirable joint spacing are 1) warping and curling, 2) built in curl, 3) axle spacing and joint spacing interaction, 4) base stiffness, and 5) mechanical properties of the concrete.

Task A3 – Subgrade and Base Compaction

D. Shin Wu presented the results of an evaluation of the effect of base type on asphalt pavement performance using SPS-1 data from DataPave. The asphalt modulus values, as backcalculated with EVERCALC, decline with age. Rate of decline may be an indicator of performance. Dense graded aggregate bases greater than or equal to 200 mm in thickness will reduce deflection and variability. Permeable asphalt treated base by itself does not improve deflection measurements. The lean concrete base is a stiff layer and can be used on a weak subgrade.

Dr. Shin Wu presented the results of an evaluation of the effect of base type on concrete pavement performance using SPS-1 data from DataPave. Slabs constructed on lean concrete base performed almost as well.

Mr. Bill Edwards presented the results of the survey of state practices for subgrade acceptance and the analysis of FWD data collected on the subgrade and base during construction of SPS-1 and SPS-2 test sections. None of the states accept subgrade based on stiffness. Correlation between density and stiffness was low.

Task G2d – JSLAB2002

Mr. Bill Kenis provided an update of the JSLAB2002 work being completed by Galaxy. Work completed under Phase I includes 1) translate program from FORTRAN to Visual Basic 6.0, 2) added additional base types, 3) improved graphics capabilities for future needs, and 4) verified hundreds of examples to maximize reliability. Planned phase II work includes 1) add axle configuration library, 2) add capability to directly calculate the response time history at a specified location within the pavement under a moving axle, and 3) modify the ZSS model to correct boundary value problems.

Task G2d, PCC Models, TFHRC analysis:

Dr. Weijun Wang presented the results of the evaluation of the concrete models. Models to be evaluated included JSLAB2002, EverFe version 2.21, and UMPAD. To prepare and run a moving load, UMPAD required 3840 minutes, EverFe required 2144 minutes, and JSLAB required 124 minutes.

Problems encountered with UMPAD include 1) software only works on UNIX and 2) long run time.

Problems encountered with EverFe include 1) need to make multiple runs to simulate a moving load, 2) output is to screen, and 3) will not run with finer mesh.

Problems encountered with JSLAB 2002 include 1) need to make multiple runs to simulate a moving load, 2) output is to screen, and 3) only winkler foundation can be used for multiple slabs.

Task G2d, PCC Models, OU analysis:

Dr. Sargand presented the results of evaluation of PCC models at Ohio University. The Ohio University analysis focused on the trends of the models rather than the values since the values are a results of the material properties, trends are a result of the model.

The OU3D94, EverFE, and ISLAB2000 models were evaluated. OU was unable to get the JSLAB2002 model running.

All models followed the deflection, strain and pressure trends as the axles passed over the instrumentation. Only OU3D94 followed the stress reversal trend between axles. ISLAB2000 produced an unexplained response at he LVDT and pressure cell locations when the load was at the boundary, which indicates a bug in the program.

PCC Model Summary:

Following presentations by TFHRC and OU, the panel discussed the pros and cons of each model. The following table summarizes this discussion and the decision of the panel for each model.

Model	UMPAD	ISLAB2000	JSLAB2002	EverFE	OU3D94
Features	-Unix Based -long run time	-\$5000 license per computer -requires high end compute -has bugs -Winkler foundation only with multiple slabs	-all the features of ISLAB -public domain -more flexible than ISLAB -has bugs -Winkler foundation only with multiple slabs -more complex than EverFE -able to generate moving load trace with one run after phase II -runs on standard PC - results matched experimental data	-easy input -one subgrade -public domain -runs on standard PC -results matched experimental data -requires multiple runs to generate moving load trace -not complex	-no front end -results matched experimental data -public domain -Unix based -can analyze multiple slabs on multiple subgrades -able to generate moving load trace with one run -complex
Consider for development under SPR-2(203)?	no	no	yes	yes	yes

New York State Early Age Behavior of Concrete Study: Dr. Julian Bendaña presented an update of the slab curling study being conducted in New York. The shape of the slab immediately after placement (without a tied shoulder) was measured with LVDT's and the dipstick. Slab measurements were also obtained six weeks after placement of the slab (with a tied shoulder). FWD tests were also conducted during the six-week evaluation. The following conclusions were presented 1) Pavements placed during hot weather conditions can develop positive built-in gradients which can lead to significant deflections as early as the second day after placement, 2) These pavements with positive built-in gradients will most likely experience high tensile stresses on top and are likely to develop top down cracks under traffic loads, 3) Warping, caused by hot air temperatures and solar radiation during curing, can have a much greater influence on loss of support, 4) Even with the greatest positive gradients, the permanent loss of support due to warping can not be reversed, and 5) Because the driving lane was placed without the shoulder present, the outer edge of the slab experienced higher permanent deformation.

Task G2a, VESYS 5: Mr. Bill Kenis provided an update of work completed on VESYS 5. A Windows version of VESYS, VESYS 5sW, has been developed. VESYS 5sW possesses all features of VESYS 5 plus a shear rutting model has been incorporated into the pavement performance prediction.

Integrated KB Design Suite: Mr. Bill Kenis presented the concept and phases for the development of the KB design suite. The primary response model was improved to account for the influences from moving load (load continuously changes its position on a pavement) and material viscoelastic property. Final version of the suite will integrate the VESYS/JSLAB performance prediction models, EAROMAR, VSIM, vehicle stability analysis, bridges, and the integrated climatic models. All models will use a common database.

PROPOSED WORK FOR NEW QUARTER:

Future actions: Ohio University will send input data to TFHRC. TFHRC will run the data through the JSLAB2002 model. Output will be provided to Ohio University. Ohio University will plot the JSLAB2002, OU3D94, EverFE and experimental data. Plots will be sent to the panel prior to the next meeting.

NYDOT: Dr. Julian Bendaña presented a proposal for an unbonded concrete overlay experiment. Three rehabilitation techniques will be evaluated, 1) unbonded PCC overlay over rubblized concrete, 2) unbonded PCC overlay over break and seat concrete, and 3) unbonded PCC overlay over old PCC pavement. The goal is to determine the most cost effective technique for unbonded PCC overlays in the rehabilitation of existing pavements using measured responses, non-destructive testing and distress surveys from the instrumented sections. NYDOT will provide an additional \$100,000 for the task. Total estimated cost for the work is \$120,128. The panel agreed to fund the additional \$20,128 from the SPR-2(203) budget balance. A proposal will be distributed to the panel for approval after review of the budget by ODOT.

KBVESYS: Mr. Kenis requested additional funding to debug KBVESYS and validate the output using experimental data. A work plan with justification for the work will be developed and submitted to the panel for review.

The next meeting will be held in November in at the FHWA Turner Fairbanks Highway Research Center in McLean, Virginia. Senior level staff at TFHRC will be invited to address concerns about coordination of SPR-2(203) with the 200X design guide.

From June 16 – June 19, 2003 ORITE personnel and two students will travel to Rochester, NY to conduct testing and install instrumentation.

IMPLEMENTATION:

The final report will be provided in both .pdf and .doc format.

PROBLEMS (if any):

More time is required to obtain LTPP data than was originally anticipated.

EQUIPMENT PURCHASED (if any):

None.