| Title: Determination of Pavement Layer Stiffness on the Ohio SHRP Test Road Using Non-Destructive Testing Techniques |
| State Job Number: 14749 |
| PID Number: |
| Research Agency: Ohio University |
| Researcher(s): Shad Sargand |
| Technical Liaison(s): Roger Green, Brad Young |
| Research Manager: Karen Pannell |
| Sponsor(s): Howard Wood, David Humphrey |
| Study Start Date: 5/10/2000 |
| Study Completion Date: 5/10/2002 |
| Study Duration: 24 Months |
| Study Cost: $60,289.00 |
| Study Funding Type: 80 Federal / 20 State from ODOT SPR (2) |

**STATEMENT OF NEED:**
In 1994-96, the Ohio Department of Transportation (ODOT) constructed a 3.5 mile long test pavement on US 23 in Delaware County for the Strategic Highway Research Program. This project contained a total of 40 test sections of asphalt concrete and Portland cement concrete pavement in the SPS-1, SPS-2, SPS-8 and SPS-9 experiments of the Specific Pavement Studies program. These experiments were designed to assess the effectiveness of different base types and thicknesses, different pavement thicknesses and other design parameters on the structural performance of highway pavements.

**RESEARCH OBJECTIVES:**
To determine the relative contribution of each pavement layer toward the overall stiffness of the various test sections on the Ohio SHRP Test Road, as determined from nondestructive tests conducted during the construction of these sections. These tests included FWD test on all pavement layers as they were completed and approved by ODOT, and FWD and Dynaflect tests on the completed sections before they were opened to traffic.

**RESEARCH TASKS:**
1. Calculate normalized deflections for all FWD tests obtained during construction of the Ohio SHRP Test Road.
2. Calculate the resilient modulus of elasticity of the individual material layers at each FWD and Dynaflect test point.
3. Determine the structural equivalency of various materials and layer thicknesses used on Ohio SHRP Test Road.
4. Summarize all data obtained with environmental sensors mounted in the pavement structure at 18 sites.

**RESEARCH DELIVERABLES:**
- The final report will describe all research activities, findings, and conclusions.
RESEARCH RECOMMENDATIONS:

• Subgrade acceptance during construction should include some non-destructive testing to insure adequate stiffness and minimum variability.
• Subgrade modulus under in service pavements can be estimated in the field by dividing 4,500 by the normalized deflection at \( r = 60'' \)
• MODULUS 4.2 should be used in most cases to backcalculate layer moduli in AC and PCC pavements.

PROJECT PANEL COMMENTS:

Findings include:
• While nuclear density measurements indicated the subgrade was within specifications for moisture and density, and relatively uniform, FWD measurements and distress patterns observed later on the weaker sections suggested otherwise.
• The four weakest AC pavement sections failed in order of the average normalized deflections on the completed pavements with those having the highest deflection failing first.
• Elastic modulus of the subgrade can be estimated during construction by dividing 90.444 by the maximum normalize FWD deflection (Df1) in mils/kip.
• The theoretical FWD spreadability (SPR) for one layer systems is 29.7% with seven geophones spaced according to LTPP recommendations. SPR greater than 29.7% indicates a layer of stiffer top material, while SPR less than 29.7% indicates a weaker top layer.
• The placement of dense graded aggregate base on subgrade does not increase composite stiffness, but it does reduce the variability in stiffness.
• The relative stiffness of permeable asphalt treated base, asphalt treated base, permeable cement treated base, and lean concrete base in completed sections on US 23 were 1.04, 2.08, 3.42, and 10.96 respectively, compared to the subgrade.

IMPLEMENTATION STEPS & TIME FRAME:

• A research project entitled “Use of Dynamic Cone Penetrometer in Subgrade and Base Acceptance”, state job number 14817, was initiated on February 15, 2003, to develop a procedure for using the DCP as an acceptance criterion for subgrade and unbound base material. The project has a completion date of February 15, 2006.
• NCHRP has initiated project 21-09, “Intelligent Soils Compaction Systems” to determine the reliability of intelligent compaction systems and to develop recommended construction specifications. The project has a 30 month duration.
• A pooled fund, solicitation # 954, titled “Accelerated Implementation of Intelligent Compaction Technology for Embankment Subgrade Soils, Aggregate Base and Asphalt Pavement” will be initiated. The objective of the project is to develop QC/QA specifications for subgrade soils, aggregate base and asphalt pavement material. The project has a duration of 36 months. The results of the last projects will be evaluated for implementation in Ohio.

EXPECTED BENEFITS:

Reducing variability will allow ODOT to produce more consistent pavement performance and will allow increasingly effective planning and forecasting. An almost certain byproduct of this increased planning effectiveness will be a more efficient allocation of available funding.

EXPECTED RISKS, OBSTACLES, & STRATEGIES TO OVERCOME THEM:

None
OTHER ODOT OFFICES AFFECTED BY THE CHANGE:

None

PROGRESS REPORTING & TIME FRAME:

A progress and reporting time frame will be developed upon completion of the research project “Use of Dynamic Cone Penetrometer in Subgrade and Base Acceptance”, state job number 14817

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: 2/10/2006

Division Deputy Director(s):

Signature: Howard Wood Division: Planning Date: 2/14/2006