Structural improvements of flexible pavements using geosynthetics for base course reinforcement
Quarterly Progress Report

April 2005 – June 2005
Next report due: September 30, 2005

PURPOSE AND SCOPE:

This study will provide missing data required to help determine whether geosynthetic reinforcement is beneficial at conditions typically experienced in state highway construction. If the geogrid does provide benefit, the study will develop an AASHTO specification for geosynthetic reinforcement of the aggregate base course of flexible pavement structures. Furthermore, the results will be published in a format to conform with future modifications to the AASHTO Pavement Design Guide.

The objectives of this study are:

1.To determine whether and under what conditions geosynthetics (geogrids and geotextiles) increase the structural capacity of pavements typically constructed by state DOTs.
2.To determine whether and under what conditions geosynthetics increase the service life of pavements typically constructed by state DOTs.
3.To measure in-situ stress/strain response of the reinforced material for use in current or future pavement design processes.

ACCOMPLISHMENTS DURING THE QUARTER:

ERDC-CRREL:

Subgrade was sampled and specimens tested, and resilient modulus tests performed. The soil consistency precluded in-situ sampling, so the tests were performed on recompacted subgrade soil. The tests were conducted according to AASHTO T 307-99, following the Table 1 Testing Sequence for Subgrade Soil. The results of the tests are summarized in the following Table.

The construction of the test sections has been completed (including pavement) and the test sections have been marked.

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Critical details regarding modeling the geogrid and geogrid-base interaction have been resolved, and an 8-noded plane stress element has been implemented in the C++ finite-element code to represent the geogrid. This element is sandwiched between shear interface elements that allow imperfect bond and slip to occur between the geogrid and base layer. Further, the stress-smoothing routines have been modified to allow more accurate computation of stresses in each layer of the pavement system. Both of these modifications to the FE code have been tested by comparison with known solutions for simple mechanics problems.

In addition, mesh generation code has been developed in Matlab that allows the rapid production of locally refined meshes. Substantial effort was required to generate the geogrid elements, interface elements, boundary conditions, and loading. The code is nearly fully operational at this point, and will require relative modest revisions as the project progresses.

PROPOSED ACTIVITIES:

ERDC-CRREL:

Finish wiring instrumentation, and complete software programming for recording of all test data.

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Conduct a detailed literature review and further develop modeling strategies. One issue to be addressed is the inclusion of a realistic bond-slip relationship between the geogrid and base layer, for which there is some guidance in the literature. We will also simulate the construction sequence, which has a large effect on initial geogrid stresses.

UNRESOLVED OR NOTABLE ISSUES:

The heavy vehicle simulator is not running well, and we anticipate delays in the. This should not significantly impact the budget, but will impact anticipated completion date.

Respectfully submitted:

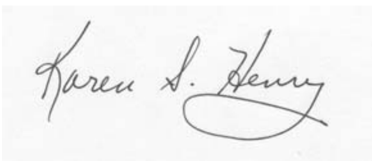

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Table of Resilient Modulus values for three compacted subgrade specimens.

Specimen	Water content	Dry density (Mg m^{-3}/ lb ft^{-3})	Confining Pressure (kPa)	Peak Cyclic Stress (kPa)	Resilient Modulus (GPa)
05-4	13.1	1.827/ 114.0	13.8	24.6	0.077
			13.8	37.3	0.072
			13.8	49.1	0.071
			13.8	61.6	0.073
			27.6	24.5	0.093
			27.6	36.9	0.088
			27.6	49.6	0.083
			27.6	61.4	0.082
			41.4	25.1	0.116
			41.4	49.5	0.097
			41.4	61.6	0.093
15-3	13.1	1.840/ 114.4	13.8	24.5	0.11
			13.8	37.0	0.086
			13.8	49.1	0.081
			13.8	61.6	0.081
			27.6	24.5	0.124
			27.6	36.5	0.105
			27.6	49.0	0.102
			27.6	61.7	0.094
			41.4	24.9	0.139
			41.4	36.9	0.117
			41.4	49.1	0.115
			41.4	61.9	0.110
15-2	13.0	1.840/ 114.4	13.8	24.4	0.138
			13.8	37.4	0.091
			13.8	49.5	0.084
			13.8	61.7	0.087
			27.6	24.5	0.103
			27.6	37.7	0.083
			27.6	49.6	0.085
			27.6	61.5	0.082
			41.4	24.3	0.006
			41.4	37.0	0.097
			41.4	49.7	0.092
			41.4	62.0	0.090