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

July – September 2006
Next report due: December 31, 2006

ACCOMPLISHMENTS DURING THE QUARTER:

ERDC-CRREL:

Heavy vehicle simulation trafficking of Test Sections 2 and 4 to failure was completed. Test sections 2 and 4 each had 4 inches of asphalt and 12 inches of base. Test Section 2 had no geogrid, and Test Section 4 contained a geogrid. Final deformations of each test section are shown in Figures 1 & 2. For Test Section 2, the loads applied by the HVS were 164,000 passes at 11 kips, then an increase in the wheel load to 16 kips until a total of 214,000 passes was reached. The total equivalent axle loads were determined according to Appendix D (Table D1) in the 1993 AASHTO Design Guide, assuming a pavement structural number of 4.0 and a terminal serviceability index of 2.0. The equivalency factor for the 11 kip and 16 kip wheel loads (22 kip and 32 kip axle loads) are 2.31 and 11.5, respectively. Hence, approximately 640,000 ESALs were applied to cause this test section to fail. The HVS was stopped at 250, 12064, 24000, 74000, 134000, 164000 passes, to take profilometer data and perform static load tests (while reading emus) with an 11 kip load.

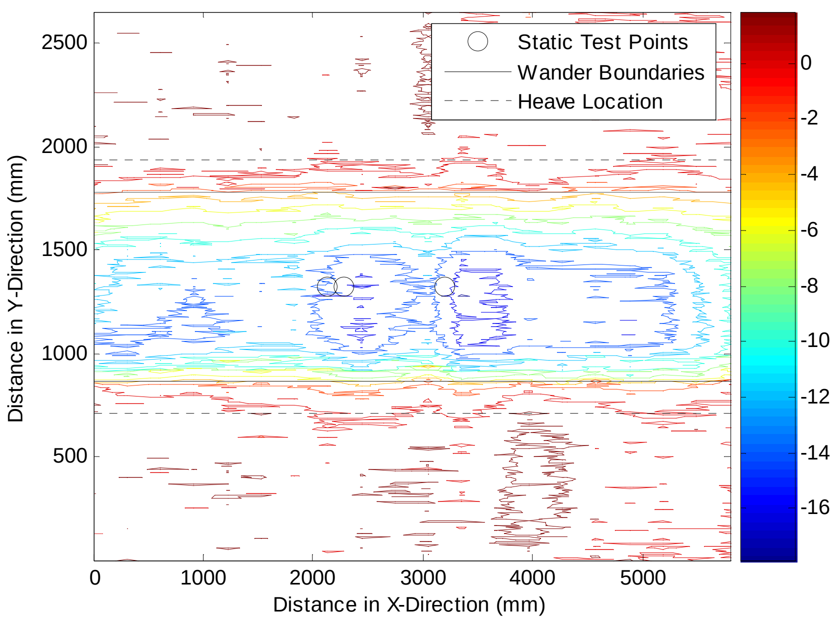


Figure 1. Relative elevation difference (mm) from 0 – 214,000 cycles in Test Section 2, contours at 2 mm intervals.

For Test Section 4, the loads applied by the HVS were 163,000 passes at 11 kips, then an increase in the wheel load to 16 kips until a total of 263,000 passes was reached. Failure occurred after a total of an estimated 1,050,000 ESALs (assuming a load equivalency of 2.31 for the 11 kip wheel load and 11.5 for the 16 kip wheel load). The HVS was stopped at 250, 12064, 24000, 74000, 134000, 163000 and 213,000 passes, to take profilometer data and perform static load tests (while reading emus). At 213,000 and 263,000 static load tests were performed with both 11 kip and 16 kip static loads.

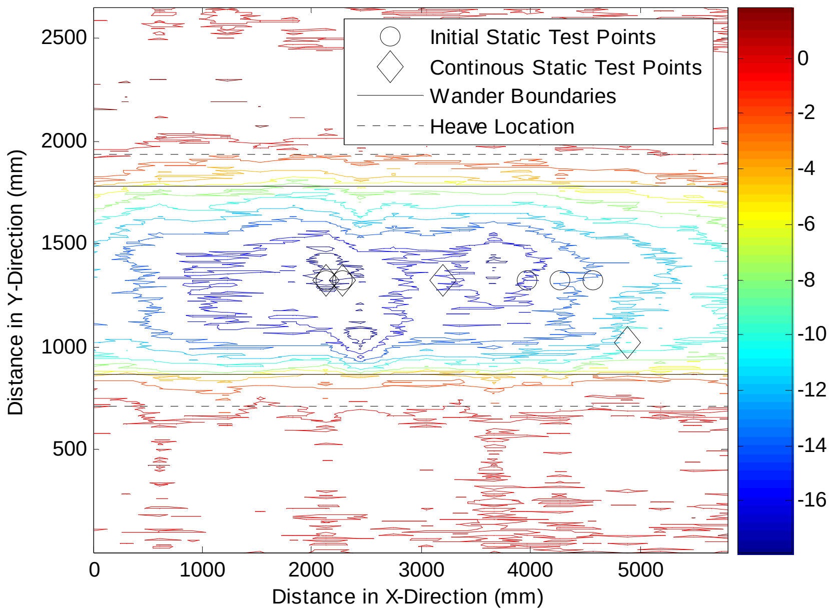


Figure 2. Relative elevation difference (mm) from 0 – 263,000 cycles in Test Section 4, contours at 2 mm intervals—note difference in scale from Figure 1.

Figure 3 shows rut depths vs. ESALs for the two test sections. The geogrid-reinforced test section performed better than the non-reinforced test section.

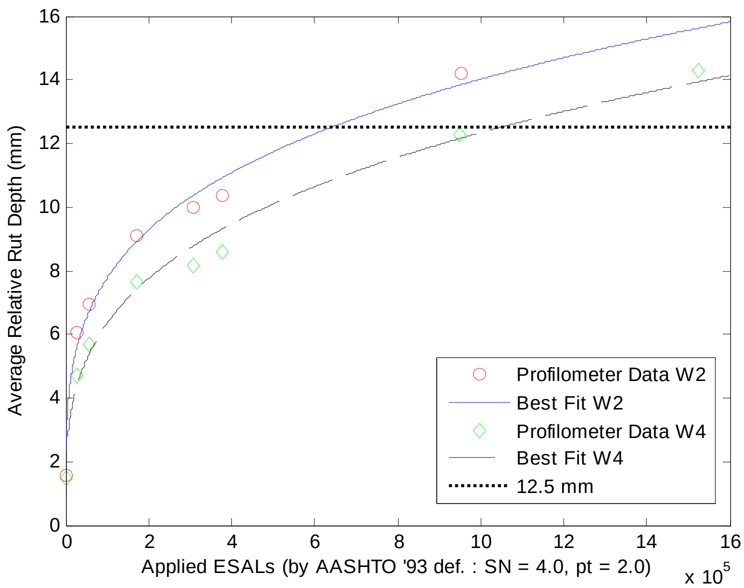


Figure 3. Rut depths vs. applied ESALs for Test Sections 2 and 4.

One strain gage on the grid was read and recorded during the static load tests for Test Section 4. Although other strain gages were installed on the geogrid, they were lost due to a technician error during wiring to the data logging system. This error is not expected to occur in the future.

We are sharing the HVS between two pooled-fund projects, and chose to test the two weakest test sections first because of the need to have testing completed by the end of July (in order to accommodate the other project). FWD tests were performed before and were planned to be performed immediately after loading, test section 2. Water contents of the test sections continue to be monitored.

UNIVERSITY OF MAINE:

The second long term laboratory geogrid creep test was completed. The creep model developed in ABAQUS, which was calibrated using only the results of the first creep test, was able to predict the response of the second creep test at a higher load.

All data from the two trafficked test sections has been reduced to a format suitable for finite element model calibration. The emu data from Test Section 2 was used to determine optimal layer moduli in the finite element model. The asphalt concrete modulus was significantly lower than the reported dynamic modulus due to the extended time period involved in applying the wheel load in the static load tests. Four cores were obtained from the failed test sections, and were tested in-house using a load rate representative of the static load tests. The resulting modulus was in general agreement with the modulus obtained through optimization.

PROPOSED ACTIVITIES:

ERDC-CRREL:

We must wait until the HVS is done being used on another pooled-fund project. This is anticipated to be 1 January 2007. In the meantime, we will:

1. Perform FWD analyses for all tests run to date, and provide to University of Maine.
2. Conduct team meeting with technical advisory committee in October.
3. Complete draft of construction report.

UNIVERSITY OF MAINE:

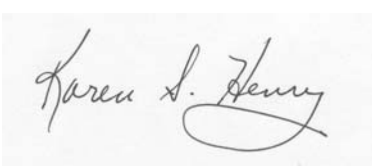
1. Compare optimized layer moduli to FWD analyses, adjusting the model if necessary.
2. Extend optimization to the geogrid section to calibrate reinforcement properties.
3. Prepare for full parametric study.

UNRESOLVED OR NOTABLE ISSUES:

The HVS continues to need more repairs and maintenance than one can imagine. This is a constant source of project delay and team frustration.

The teamwork across the two organizations performing the project (CRREL and Univ. of Maine) is quite well-coordinated, and communication is good among the two organizations.

Respectfully submitted:



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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.