Project Summary
Texas Department of Transportation

0-4829: Quantify the Benefits of Using Geosynthetics for Unbound Base Courses

Background

Base reinforcement results from the addition of a geosynthetic at the bottom or within a base course to increase the structural or load-carrying capacity of a pavement system. While there is clear evidence that geosynthetic reinforcements can lead to improved pavement performance, the identification and quantification of the parameters that contribute to such improvement has remained, at best, unclear. In addition, pavement structures deteriorate under the combined effects of traffic loading and environmental conditions such as moisture changes. The effect of moisture changes can be particularly detrimental in many locations of Texas, which are characterized by the presence of expansive clays. Consequently, this Texas Department of Transportation (TxDOT) research focused on the assessment of the geosynthetics' effect on the pavement structural section and resistance to environmental changes.

It is well documented that the use of geosynthetics for unbound base courses can lead to improved performance and reduced costs in pavement systems. However, appropriate selection of geosynthetics is compromised by the difficulty in associating their relevant properties with pavement performance. Accordingly, important objectives of this research included: 1) determining the properties of geosynthetics that contribute to enhance the performance of pavement systems, and 2) developing material specifications that incorporate the geosynthetic and soil properties that govern the pavement performance.

What the Researchers Did

Project 0-4829 involved a comprehensive scope of work, which included information survey, analytical, field monitoring, and experimental components. Each one of these components aimed at identifying the geosynthetic properties that govern their use as reinforcement for base courses.

The survey component involved collecting data on geosynthetic use and needs throughout Texas, and the analytical component aimed at identifying the sensitivity of the mechanical properties of soil and geosynthetics on the propagation of cracks through the pavement system.

The field monitoring component involved the construction of 32 test sections in the pavement of FM2 (Bryan District), reconstructed over expansive clays. The test sections included multiple reinforcement types and lime stabilization schemes.

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Post-construction evaluation was initiated as part of this project, which included condition survey, rolling dynamic deflectometer (RDD), falling weight deflectometer (FWD), monitoring by moisture sensors, elevation survey, and soil sampling.

The experimental component included evaluation of tests that have been proposed for quantification of the performance of reinforced pavements. It was concluded that the governing mechanisms of pavement performance should be characterized by tests that quantify the soil-geosynthetic interaction. More specifically, tests were identified to quantify the stiffness of the geosynthetic reinforcement under low strains and under the confinement of soil. Among those tests, a series of conventional, large-scale pullout tests were conducted. In addition, a new pullout test device was developed to allow characterization of the soil-geosynthetic interaction under low strain levels in an expeditious manner. Finally, integration of the field observations and laboratory test results was initiated for incorporation into a consistent design methodology and product specifications.

What They Found

The mechanisms that govern the performance of geosynthetic-reinforced pavements can be characterized by tests that quantify the interaction between soil and the geosynthetics, but under low strains. A newly developed testing device is particularly well suited for characterization of the stiffness of the geosynthetic reinforcement under the confinement of soil. Current material specifications for geosynthetic-reinforced pavements do not contemplate confined stiffness parameters.

Available field monitoring information from moisture sensors placed under the pavement indicates that subgrade moisture fluctuations have taken place in the vicinity of the road shoulders, but have not reached the pavement centerline. While monitoring of the recently constructed 32 field sections has not yet provided ultimate long-term performance information, continued monitoring is expected to provide information suitable to determine the threshold of confined geosynthetic stiffness that is suitable for TxDOT specifications.

What This Means

Available TxDOT specifications for geosynthetic-reinforced pavements identify index properties that are relevant for quality control purposes, but should be complemented with performance properties that are relevant for design. The additional performance properties should be obtained from quantification of the soil-geosynthetic interaction under low strains, and can be defined using newly developed equipment. Continued monitoring of the field sections recently constructed in Bryan District is expected to provide long-overdue correlation between laboratory test results and pavement field performance.

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