PROJECT SUMMARY REPORT

0-7002: Geosynthetic Reinforcement in Asphalt Overlays for Increased Roadway Structural Capacity

Background

Geosynthetic products, including geogrids, geotextiles, geocells, geonets, and geomembranes, can be used to improve roadway systems significantly through a wide range of functions, such as separation, filtration, stiffening, reinforcement, drainage, hydraulic/gas barriers, and protection. One of the several applications involving geosynthetics is their use to effectively retard the reflective cracking that occurs when new flexible pavement overlays are constructed over old paved roads with pre-existing cracks. Reflective cracking may be triggered by bending and/or shear stresses induced by repeated traffic loads, as well as by tensile stresses caused by thermal variations. Stress concentration in asphalt overlays may result from lateral movements induced by the flexing of paved roads located directly below the traffic load. Such stresses may end up causing a reflective crack that propagates through the new pavement overlay, making it susceptible to early failure facilitated by moisture intrusion. Geosynthetics have been used to mitigate the early development of reflective cracks through one or a combination of several functions, including reinforcement, separation (including stress relief), and barrier. Recent advances in the use of asphalt reinforcements include their use not only to mitigate the development of reflective cracks but also to increase the structural capacity of paved roads. The quantification of the increased structural capacity of geosynthetic-reinforced asphalt is the main objective of this study.

What the Researchers Did

This study included characterization, field and implementation components. These various components were associated with a comprehensive field instrumentation program during the rehabilitation of Texas State Highway (SH) 21. The subgrade soil within the project limits was determined to be an expansive clay with significant swell-shrink potential. Consequently, the environmental loading due to moisture fluctuations and the repeated traffic loading due to heavy truck traffic had resulted in the development of cracks and ruts along the wheel path, deteriorating the ride quality and road-user serviceability. The field project involved an initial field subsurface evaluation, a focused design and installation of an instrumentation system, and field monitoring during, immediately after, and post-construction to evaluate the performance of test sections under public traffic, controlled traffic, and environmental loads. The overall potential benefits of using various types of geogrids to reinforce hot-mix asphalt overlay, including a reduction of hot-mix overlay thickness, were assessed, with particular focus on the appropriate selection and installation of geogrids. In addition, a research component was completed to address critical questions regarding

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the suitability of milling, reusing, and recycling geosynthetic-reinforced asphalt layers in future road retrofitting operations. An appropriate selection and installation specification suitable for inclusion in a TxDOT manual for future projects was compiled, including the development of new and/or revisions to the existing installation guides. The special specifications adopted for the SH21 project (i.e., SS3062) based on lessons learned from the performance evaluations conducted in this project were revised.

What They Found

The results from the field monitoring program indicate that all the asphalt overlay sections reinforced with geosynthetic reinforcements performed better than the control section in terms of minimizing the tensile strains under controlled traffic loads, thereby improving the roadway structural capacity. Tensile strains decreased with increasing asphalt overlay thickness, irrespective of the presence or absence of geosynthetic reinforcements below the asphalt overlays. The lower the thickness of the asphalt layer, the greater the benefit from incorporating geosynthetic reinforcements. Tensile strains increased with increasing ambient air temperatures, irrespective of the presence or absence of geosynthetic reinforcements below the asphalt overlays. The higher the ambient air and asphalt temperature, the greater the benefit from incorporating geosynthetic reinforcements. Tensile strains increased with increasing time since construction (i.e., asphalt aging and degradation), irrespective of the presence or absence of geosynthetic reinforcements below the asphalt overlays. The longer the time since asphalt overlay construction, the greater the benefit from incorporating geosynthetic reinforcements. The reductions in tensile strains with the inclusion of geosynthetic reinforcements suggest an increase in the roadway structural capacity.

What This Means

A new application involving geosynthetics in asphaltic layers was quantified, which adds to the already well-established application involving geosynthetics as paving interlayers to mitigate problems associated with the reflection of preexisting cracks into new asphalt overlays. Specifically, geosynthetic reinforcements used as paving interlayers can also increase the structural capacity of the paved road, leading to significant cost benefits such as the reduction of the required thickness of the asphalt overlay.

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