Kansas Department of Transportation

TECHNICAL SUMMARY

Stabilization of Unpaved Shoulders on Moderate and Weak Subgrade Using Geosynthetics

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Introduction

Geosynthetics have been used to improve the performance of roadways, especially when weak subgrade soil exists. In this study, two types of geosynthetic products, geocell and geogrid, were investigated for their application for stabilization of unpaved shoulders on moderate and weak subgrade and for their effect on vegetation growth.

Project Description

A one-year-long outdoor field vegetation test for two primary target species (tall fescue grass and perennial ryegrass) was conducted on base courses with different combinations of aggregate and topsoil to investigate the possible effect of geocell and geogrid on shoulder vegetation. During the one-year test period, soil temperature and volumetric moisture content were monitored. Weather data, such as precipitation and air temperature, were obtained from the nearby weather station at the Lawrence airport. Vegetation growth was evaluated by grass leaf blade length, root length, and grass density. Vegetation biomass was obtained at the end of the test. The test results showed no obvious effect of geocell or geogrid on the vegetation in unpaved shoulders. The vegetation test also showed that the 50% aggregate and 50% topsoil mixture had vegetation growth similarly as the topsoil.

Based on the vegetation test, the 50% aggregate and 50% topsoil mixture was selected as a base course rather than the 65% aggregate and 35% topsoil mixture for cyclic plate loading tests. When geocell was used to reinforce unpaved shoulders, six large-scale plate loading tests were conducted on base courses reinforced by a single type of geocell on 5% California Bearing Ratio (CBR) subgrade (moderate subgrade) to investigate the benefits of geocell reinforcement on different base course and topsoil combinations. Eight similar plate loading tests were conducted on eight geogrid-reinforced base courses over 3% and 5% CBR subgrade, including 150-mm-thick aggregate with and without geogrid reinforcement and 150-mm-thick soil-aggregate mixture with and without geogrid reinforcement. Earth pressure cells were installed at the interface between subgrade and base course to monitor the vertical load distribution.

Project Results

The cyclic plate loading tests showed that the geocell and geogrid effectively reduced the accumulated permanent deformations as compared with the unreinforced sections. The geocell-reinforced soil-aggregate mixture slightly outperformed the unreinforced aggregate of the same thickness over a 5% CBR subgrade. The geogrid-reinforced soil-aggregate mixture performed significantly better than the unreinforced aggregate of the same thickness over 3% and 5% CBR subgrades. The plate loading tests also suggested that the topsoil cover resulted in large permanent deformations and rapid failure.

Aggregate bases are recommended for unpaved roads. A 50% soil and 50% aggregate mixture is recommended for vegetated unpaved shoulders. Topsoil should not be used as a cover if unpaved shoulders are subjected to traffic. Geogrid is recommended to improve aggregate bases if needed. Geocell is recommended to improve soil-aggregate mixture if needed.

Project Information

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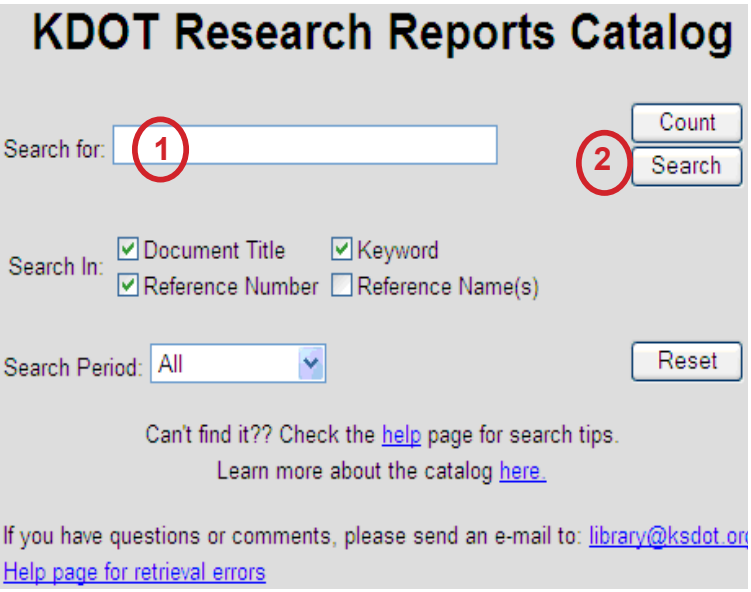

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