Montana Department of Transportation
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RESEARCH PROGRAMS

Implementation Report

LARGE-SCALE LABORATORY TESTING OF GEOSYNTHETICS IN ROADWAY APPLICATIONS

https://www.mdt.mt.gov/research/projects/geotech/lab_testing.shtml

PROJECT NO: 9564-602

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Introduction and Purpose

The Montana Department of Transportation (MDT) routinely uses woven and non-woven geotextiles as a construction expedient in situations where roadway subgrades are or may become wet, weak and unable to support construction traffic, and as a physical separator between the base course aggregate and the underlying subgrade to maintain the integrity of the base layer. MDT has previously supported research to investigate the use of geosynthetics (geogrids and geotextiles) for roadway reinforcement, where reinforcement provides structural value during the operational life of the roadway. Given the common use of geotextiles for stabilization and separation, MDT was interested in studying whether these same geotextiles provide a reinforcement function for typical Montana rural low-volume highway conditions. Documentation of a reinforcement benefit would allow roadways to be constructed with less base course aggregate and/or to realize an increased life of the paved roadway. These options are attractive for areas of the state where good quality base course aggregates are not readily available.

The reinforcement benefit of geotextiles commonly used by MDT for stabilization and separation was studied by the construction of a single test track in an indoor test facility. The test track contained two test sections with a reinforcement geotextile (woven and non-woven) while the third section was unreinforced. The test sections constructed had a nominal section of 3.4 inch of hot mix asphalt and 13.3 inch of base course aggregate on a clay subgrade with a constructed CBR of approximately 3.5. The test sections were trafficked by a full-scale accelerated pavement tester with approximately 1 million traffic passes applied.

The raw rutting results showed the unreinforced test section to perform better than the two sections with a geotextile. An analysis of the data showed that the three test sections performed similarly in terms of rutting performance for the conditions present in this study and summarized above. No reinforcement benefit was observed for these conditions and for the two geotextiles used.

The test sections were originally constructed by preparing the base course to a moisture content ranging from 6.4 to 8.2 %. HMA was placed on this first construction and traffic loading occurred thereafter. The test sections were seen to rut more rapidly than expected, which was due to too high of a moisture content of the base leading to lower stiffness values. Trafficking was stopped and the HMA layer and the base course layer were removed and reconstructed. The base course layer in the second construction was placed at a lower moisture content to correct the problem discovered in the first construction. The rate of rutting was much lower for the second construction

and illustrates the sensitivity of the base layer to moisture and shows the need to control moisture both during construction and during the service life of the pavement.

A secondary objective of the project was to update and further validate a geosynthetic reinforcement spreadsheet design model developed previously for MDT by the PI. For the conditions summarized above, the model predicted little reinforcement benefit. This model, however, showed moderate reinforcement benefit for weaker subgrade conditions (i.e. subgrade CBR of 2.5) that might be present in typical Montana roadways during seasonally wetter periods. This study did not quantify the separation benefit of the geotextiles, which are a recognized benefit applicable to most roadways in the state.

Implementation Summary

- The stabilization and separation functions and benefits of woven and non-woven geotextiles are well-recognized and applicable for Montana State roadways.
- For design subgrade CBR values of 3.5 and greater, the types of geotextile products used in this project offer little to no reinforcement benefit.
- Subsequent test section work following the completion of this project suggests that greater reinforcement benefit may be realized for real-world construction conditions where some rutting of the base course layer occurs during construction. MDT and MSU either independently or collaboratively may further research this topic and update design practices accordingly.
- Experienced gained during the first construction of the test sections when the base was prepared at too high of a moisture content and rutting occurred rapidly illustrates the sensitivity of the base layer's mechanical properties to moisture and the need to control this during construction and during the life of the pavement.
- The geosynthetic reinforcement spreadsheet design model previously developed for MDT predicts reasonably well the absence of reinforcement benefit of the geotextiles used in this study for the conditions present in the constructed test sections.
- The spreadsheet design model predicts a modest level of reinforcement benefit for a subgrade CBR of 2.5. This finding has application for roadways where seasonally wetter subgrade conditions are anticipated.
- The spreadsheet design model contains several parameters to define mechanical properties of geosynthetics. Two parameters are selected by check boxes such that parameter values correspond to one of two values. A third parameter lacks guidance for value selection. MDT and MSU either independently or collaboratively may further research the replacement of check boxes with value-input boxes and provide guidance for how values for all three parameters are selected.

Implementation Recommendations

Recommendation 1:

Woven and non-woven geotextiles should continue to be used in Montana roadways for the well-recognized benefits of stabilization and separation.

MDT Response:

MDT agrees with this recommendation. MDT will continue to recommend geotextiles under base course or where appropriate.

Recommendation 2:

For roadway designs involving a design subgrade CBR of 3.5 and greater, typical roadway designs for the State of Montana should not consider reducing the base course layer thickness in design for roads where a stabilization and/or separation geotextile has been used.

MDT Response:

MDT believes this statement is applicable to non-woven geotextiles.

Recommendation 3:

Current test section work subsequent to the completion of this project, where rutting of the base during construction occurred, should be considered to possibly revise the recommendations given in this report.

MDT Response:

MDT will continue to evaluate ongoing research related to geosynthetics.

Recommendation 4:

Base course materials for highway construction should be placed dry of optimum moisture content and should not be allowed to become wet during construction. Excessively wet base course layers during construction may lead to premature pavement failure.

MDT Response:

MDT will continue to follow current specification and will provide training to ensure proper application in the field.

Recommendation 5:

The geosynthetic reinforcement spreadsheet model previously developed for MDT should be used for future roadway construction projects in Montana to examine the potential for reinforcement benefit of currently used geotextiles and for the possible use of geogrids.

MDT Response:

MDT agrees with this recommendation. The geosynthetic reinforcement spreadsheet model will be made available on the project web page.

Recommendation 6:

The spreadsheet design model should be updated by replacing geosynthetic material property check boxes with value-input boxes and provide guidance for how values for three geosynthetic material properties are selected.

MDT Response:

MDT will evaluate future improvements following the standard research project process.