CONSTRUCTABILITY OF STABILIZED SUBGRADE LAYER UNDER HIGH GROUNDWATER TABLE

PROBLEM STATEMENT

In highway construction, loose embankment and subgrade soils must be compacted to increase their density. Compaction increases the strength characteristics of soils, and thus increases the bearing capacity of the pavement constructed above them. However, for a variety of reasons, road grades sometimes do not allow for much clearance between the pavement section and the groundwater table. When an adequate separation is not provided between the stabilized subgrade and the groundwater table, difficulties in compacting the stabilized subgrade often result. Research is needed to determine the minimum separation required between the bottom of the stabilized subgrade and the groundwater table so that construction can proceed without delay.

OBJECTIVES

This project addresses the constructability of pavement subgrade layers under various levels of high groundwater table in the underlying layer. The goal is to determine a minimum required clearance above the water table for the subgrade layers to achieve an adequate compaction as required by construction specifications. Researchers will evaluate whether the subgrade layers can be constructed according to construction specifications for different types of soil materials under varying groundwater table levels.

FINDINGS AND CONCLUSIONS

A full-scale laboratory experimental program and a field experimental program were conducted to evaluate the constructability of the subgrade layers. Two large test pits were set up in the laboratory to simulate the field conditions of compacting subgrade layers under various levels of high groundwater table. Two field test sites were also selected to evaluate the constructability problems under actual field compaction. An A-3 soil with 5% fines and an A-2-4 soil with 12% fines were selected for the embankment materials. The selected embankment materials were typical Florida soils and believed to be representative of the most commonly used pavement materials in Florida.

The findings and conclusions are summarized as follows:

Test Pit Constructability Study

- The A-3(5%) and A-2-4(12%) soils performed similarly as an embankment. Consequently, the conclusions drawn from this study on the A-3 (5%) embankment soils may be applied to the A-2-4 (12%) embankment soils. However, it should be noted that the comparison may not hold for A-2-4 soils with higher percent of fines.
- The A-2-4 (12%) soil and A-2-4(12%) mixed with 25% limerock had similar compaction and LBR results, and performed similarly as a stabilized subgrade layer.
- Due to lower stress levels achieved, the test-pit constructability results were used to show trends and should be validated by field compaction tests.

Field Constructability Study

- The in-situ moisture content of subgrade soil was critical to successful compaction and to achieve the specified density (unit weight).
- The static compaction technique was more effective for compacting A-3 and A-2-4 subgrade layers under high groundwater conditions.
- For both A-3 and A-2-4 embankment soils, the A-3 and A-2-4 subgrade soils could be constructed according to specifications by either static or dynamic compaction when the groundwater level was at least 18 inches or deeper below the subgrade-embankment interface. When the groundwater level was raised to 12 inches below the interface, adequate compaction could only be achieved using the static compaction.
- In case of a drawdown condition in the field, the groundwater level should be lowered to a level of at least 24 inches below the interface to facilitate an adequate compaction of subgrade layers.
- When the groundwater level was raised to six inches below the subgrade-embankment interface, the top six inches of compacted subgrade soils showed greater dry density than the bottom six inches of subgrade soils due to capillary effects and pumping caused by compaction. Under this groundwater condition, the field test results showed that adequate compaction could not be obtained by either static or dynamic compaction efforts.

It appeared that the minimum required groundwater level clearance below the subgrade-embankment interface was approximately 18 to 24 inches or deeper in order to achieve an adequate compaction of subgrade layers according to construction specifications. In the case of a drawdown condition, the minimum required groundwater level clearance below the interface was approximately 24 inches or deeper for achieving an adequate compaction of the overlying subgrade layer. However, the pavement materials were limited to A-3 silty sands and A-2-4 silty soils with lower percent of fines for the subgrade and embankment layers in the field study. Additional field verification tests should be required for other types of Florida pavement materials.

BENEFITS

One of the potential benefits of this study is the usefulness of the results for updating statewide guidelines to ensure that design base clearances that will not affect construction. The findings of this study could also be used to evaluate critical groundwater clearance levels under different conditions (e.g., less than 18 inches below the subgrade-embankment interface when the static compaction is required for achieving adequate compaction).

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