The Ohio Department of Transportation
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Executive Summary Report

Evaluation of Guidelines for Subgrade Treatments

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Problem

Wet, unstable subgrade soil conditions are often encountered during new or reconstruction projects. The problems are often unidentified during plan development stage. Once the existing pavement is removed, the unstable subgrade must be modified or replaced to provide an acceptable surface for pavement construction. This often results in change orders for the additional work, causing significant cost overruns.

ODOT has recently developed guidelines for subgrade treatments to be used during plan development and construction. This study evaluates these guidelines by comparing them with existing guidelines developed elsewhere and validating them through comparison of the actual treatment methods and quantities used with those suggested by the guidelines.

Objectives

1. To evaluate the existing Guidelines for Plan Subgrade Treatments (GB1) and Subgrade Construction and Stabilization Guidelines (Section 204) by comparing them with existing guidelines used by other agencies.
2. To validate the guidelines by comparing actual and suggested treatment methods and quantities.
3. To recommend any improvements to the existing Guidelines.

4. To reduce the cost overrun caused by unanticipated subgrade treatment needs during construction.

Description of the Research

GB1 is used during design and Section 204 is used during construction. Both guidelines uses data from soil borings, particularly the Standard Penetration Test (SPT) blow count, N_L, to estimate the undercut location and quantity. Section 204 can utilize additional proof rolling and test pit data to determine the subgrade treatment method. Criteria for reconstruction and new construction projects are different. Subgrade investigation and treatment guidelines from other agencies were reviewed and compared with the current ODOT guidelines. Soil boring data and construction record from 7 reconstruction (major rehabilitation) and 2 new construction projects were obtained. Actual treatment methods and quantities were obtained from the project field offices. Dynaflect deflection data, when available, were analyzed to determine their usefulness in subsurface assessments.

Findings

Soil boring and subgrade treatment guidelines from other agencies are not significantly different from the current ODOT guidelines in terms of boring depth, locations, spacing, and other field and laboratory testing required. GB1 criteria for excess moisture content predicted the undercut quantity reasonably well, but the criteria for acceptable moisture content tend to under predict the undercut quantity in many cases, likely due to increased soil moisture content after removal of existing pavement. For reconstruction projects, the average undercut depths (i.e., the overall undercut quantities) versus the corresponding SPT N_L values seem to fall reasonably well within the upper bound provided in the Section 204 guidelines. However, the actual undercut depths vary significantly even for soils with similar or same N_L values. Actual undercut depth and quantity are somewhat correlated with the average SPT N_L value, Dynaflect W5 deflection, and soil moisture content. The regression equation developed has a coefficient of determination (or R-square value) as high as 0.71. A cost analysis shows the break point for complete stabilization is 30% undercut for reconstruction projects and 70% undercut for new construction projects. The cost of deflection testing is insignificant.

Conclusions & Recommendations

Subgrade soils are highly variable. Using point specific data from soil borings to predict the exact location of undercut is difficult. Dynaflect deflection, W5, is as good a predictor as SPT N_L in estimating soil undercut and can be performed at much closer spacing; therefore, it should be included in the GB1 guidelines for reconstruction projects. All the reconstruction projects studied have more than 30% undercut and both new construction projects have more than 70% undercut. Therefore, complete chemical stabilization should be considered for all new or reconstruction projects, unless boring or deflection data show very strong subgrade.

Implementation Potential

The results of this study can be implemented by ODOT without significant increases in cost or staff commitment.