Florida Department of Transportation Research

Development of LRFD Resistance Factors for Retaining Walls
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Bridge approach embankments and many other transportation-related applications make use of reinforced earth retaining structures. Mechanically Stabilized Earth (MSE) walls are designed under the Load and Resistance Factor Design (LRFD) methodology, and make use of calibrated load and resistance factors to check for internal and external stability. This study focused on the calibration of resistance factors for bearing resistance with horizontal ground and sloping ground in front of MSE walls using scaled models.

In this project, University of Florida researchers developed resistance factors for MSE walls subject to sliding and bearing by considering the influences of variability in soil parameters as well as different analysis methods (coefficients of variation, or CVs) using numerical and physical modeling. Furthermore, load factors for vertical and horizontal earth pressures were determined and compared to other reported values as well as current practice.

Researchers conducted a parametric sensitivity analysis to determine the soil properties that are most influential on stability. This analysis of the influence of soil properties and their variability on the sliding and bearing stability of MSE walls was performed using Matlab simulations. Equations describing loads and resistances for each case were used with randomized soil properties to develop a histogram of capacity demand ratio (CDR). With a sufficient number of simulations, the probability of failure for each analysis was determined along with its influence.

Scaled models (1:40) of MSE walls were tested in a specially adapted centrifuge at 40 g, and several tests were conducted to determine the CVs of load and resistance. In addition, centrifuge models were tested with soil sloping at 2:1 in front of the wall for a variety of embankment soil and backfill, in order to quantify the effect on bearing resistance.

MSE wall being constructed from concrete panels for an overpass in Jacksonville.

Based on the CVs obtained from the tests, resistance factors were recommended for sliding and bearing stability. Analytical expressions for load and resistance CVs as functions of the soil properties were developed.

This in-depth examination yielded valuable information that will lead to a more consistent design methodology for MSE walls, which are so widely used in Florida. Improved designs will help ensure the reliability and longevity of MSE walls in transportation structures.

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