Florida Department of Transportation Research

Estimating Soil Pressure against Unyielding Surfaces

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Current Situation

Mechanically stabilized earth (MSE) walls are a cost-effective option for building bridges approaches, as well as highway separations or when construction space is limited.

Current design recommendations acknowledge increased tension in the areas of reinforcement when MSE walls are tied together in unyielding conditions, as may be the case when widening existing embankment. However, the actual soil pressure that results from internal forces was not found to be clearly documented in the literature prior to this effort. Too much soil pressure can cause acute corners of an MSE wall to give way and become distorted.

Research Objectives

The objectives of this research were to construct a full-scale MSE wall with an unyielding condition and measure the resulting internal earth pressures. In particular, the goal of the project was to determine whether design should be conducted under assumed at-rest conditions, or somewhere between at-rest and passive pressure.

An overview of the completely constructed MSE wall area prior to load testing.

Project Activities

Following an extensive literature review, the team created a system to simulate 23 feet of overburden (vertical stress) to accommodate the height limitations in the controlled laboratory environment. The team then constructed 10-foot tall MSE walls, bringing the total height to 33 feet, and added sensors to 140 locations within the investigated area.

During construction, earth pressure cells (EPC) were installed for each compacted layer of soil completed. After construction, the team activated the reaction frame loading system to induce controlled incremental surcharge loads from which the EPC was also derived for each load applied. The team then inspected both compaction efforts to make sure the monitored areas were accounted for.

The team used the analysis to validate design recommendations. The team found that the conventional MSE wall design and construction were generally consistent with the results of their research, with some exceptions as to the assumed stress distribution within the soil mass. Consequently, the researchers proposed a new equation that better aligns with the research data.

Project Conclusions and Benefits

The empirical results and numerical methods developed by this research provide increased accuracy in geotechnical design and can be applied to MSE walls with acute corners, widening conditions where a new wall is tied to the existing wall, and other scenarios where fill is placed and compacted against any unyielding structure.

For more information, please see fdot.gov/research.