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Parametric Investigation of Geo-Synthetics Reinforced Soil Wall Seated on Compressible Bed

V. Ghiasi, A. Farzan

Civil Engineering Department, Malayer University, Hamedan, Iran

ABSTRACT: The superiority of the geosynthetic reinforced soil wall to another reinforced soil systems, is led to the increasing expansion. So far many studied have been conducted on geosynthetics reinforced soil walls, with assuming rigid bed. But the behavior of this system and mechanism of it components has less been considered when the bed is compressible or loose. The present study investigated the effect of effective parameters (i.e., facing inclination, connection type of geogrids to the facing, toe condition, length of reinforcement and vertical distance of reinforcements) on the behavior of reinforced soil wall seated on compressible bed, using finite element method. Also the behavior of the wall under conditions of end of construction and surcharge loading has been investigated. The results showed that the parameters that had the greatest effect on the behavior of the reinforced soil wall during the weakening of the bed, is facing inclination, vertical distance between reinforcements and toe condition. Decreasing vertical distance of reinforcements and increasing facing inclination, has led to significantly decrease in horizontal displacement of wall and maximum reinforcement load. Also according to the results, the bed with compressible soil, the type of connection of reinforcement and length of reinforcement did not show a significant effect on the improvement of the wall's behavior, except when the wall was placed on a loose bed.

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1- Introduction

The low soil tensile strength is a major limitation in soil structure, while this limitation can be resolved by reinforcing the soil in a reinforced soil wall system. Geo-synthetic reinforced soil walls over the past two decades around the world are considered to be very popular and widely used due to many benefits, such as economic savings, accelerate in construction, apparent beauty and more flexibility, than conventional walls, such as gravity walls [1, 2]. Among the applications of the geo-synthetic reinforced soil wall can be expressing the maintenance of embankments, bridges abutment, and the widening and maintenance of roads or railroads in areas where exist differences height [3]. Generally, reinforced soil walls are composed of three parts, the backfill, facing and the reinforcement. The mechanism of the reinforced soil walls is based on the interaction between the reinforcement and the soil, which prevents the soil against ruptures.

Investigating the behavior of reinforced soil walls under the function of structural and geometric components of the wall on a rigid bed, has been discussed so far [3-13], however, the study of behavior of the reinforced soil wall considering the effect of the bed on the behavior of the wall has been less take into consideration. Most of reinforced soil walls are designed with the assumption that the wall's bed is rigid and the rigid bed does not have an effect on the tensile strength of the reinforcement and this assumption may not correct about the walls having a bed with the low resistance parameters. Considering the reasons mentioned, the effect of bed soil with different resistance parameters and the presence of groundwater at different levels in a bed of soil wall on the behavior of reinforced soil wall is a subject that needs to be further studied and understood and this paper has been dealt with.

Corresponding Author, Email: v.ghiasi@malayeru.ac.ir

2- Methodology

Numerical modeling of geo-synthetic reinforced soil walls in this study was carried out using the two-dimensional plaxis software [14], version 8.6, based on the finite element method, and also the general stability of the walls, including model safety factors coefficients has been investigated by Geoslope software, version 2012, based on the limit equilibrium method and is a subset of the software of the Geostudio. In Plexis for modeling, a two-dimensional strain-strain model, as well as triangular elements with 15 nodes and 12 stress points, is used because the element of the 15 nodes is very precise which provides better results for problem issues. Figure 1 shows the geometric model made in the software, which is similar to the full scale of the laboratory test.

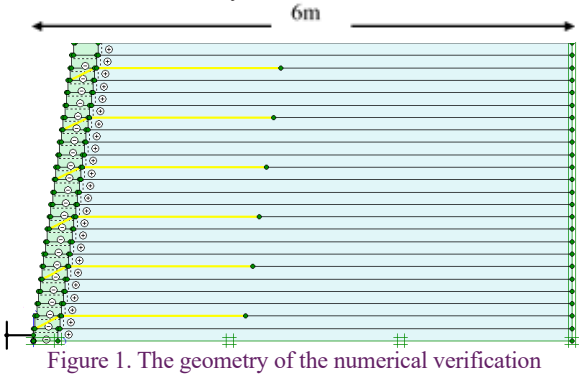

Figure 1. The geometry of the numerical verification model similar to the laboratory model

3- Results and Discussion

In Figure 2 the results of the analysis of the effect of the soil bed layer on the horizontal displacement and the maximum reinforcement load are observed in the end of the construction. With respect to Figure 2, walls with rigid bed, in both walls 4 m and 8 m, show more horizontal displacement in the upper half of the wall, and in the lower half of the wall has less displacement than the rest of the walls that have a dense and weak substrate.

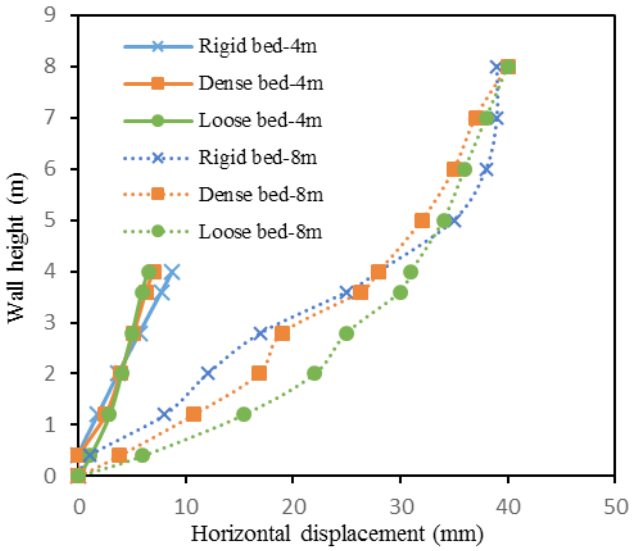

Figure 2. The effect of bed layer on the horizontal displacement of facing at EOC. dotted line: wall with a height of 8 m. continuous line: Wall with a height of 4 m.

4- Conclusions

The presence of groundwater has a significant effect on the lateral movement of the wall and the reinforcement loads, especially in a wall with a poor bed soil. As the level of groundwater reaches closer to the surface under the wall, the wall displacement and reinforcements load increase, and this increase will be in the range of zero to one meter, especially in the loose sandy bed will be maximum and it can be said that by reducing the water level from one meter to the bottom, the effect of groundwater on the behavior of the wall will disappear.

Also, by observing the stability of the walls, when the strength of the bed decreases from rigid to weak, the wall safety factors will be greatly reduced and the slipping surface will close to the wall surface. This is also evident for the existence of groundwater level, which is more perceptible in the bed with poorly sandy soil.

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