Effect of Changes of Mesh Size on the Numerical Analysis of Reinforced Soil Walls

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Abstract: The effect of mesh size changes on the model output results of compared to the model are calibrated. Therefore, the mesh size in a variety of software plaxis, the mesh size is very coarse, coarse, medium, fine and very fine, we have evaluated. Traditionally, the design of geosynthetic reinforced soil walls is performed using the simplified classical analysis or empirical methods. Unfortunately, the applications of these methods render various degrees of approximations in determination of major designing factors. In this paper, the behavior of geosynthetic reinforced soil walls is studied by the numerical method (FEM) with PLAXIS 2-D software. Change the type of mesh size on maximum displacement of the wall and on maximum deformation of the facing as well as tension in reinforcement can be expressed, that numerical analysis results with different mesh size changes little with the model are calibrated.

Key words: Mesh size, Reinforced soil wall, PLAXIS software.

INTRODUCTION

The technique of reinforced soil has been widely used in construction of retaining walls and levee foundations. A wide range of reinforcement elements of different materials are produced and developed for use in such structures. Most important elements of reinforcements are metal strips, steel bars and various geosynthetics. Soils are materials that have good resistance against pressure and cutting, but are weak in tension. Numerous efforts are performed to overcome the weakness of the soil stretching process. Polymer or synthetic fabrics such as geosynthetics are compatible with the soil in deformability. Moreover, they are resistant to corrosion and acid attacks. Nowadays geosynthetic reinforced soil walls are one of the important options in the design of retaining walls due to their superiority than other reinforcements. Many investigators have studied the reinforced soil walls, i.e., Hausman and Lee (1978), Pinto and Cousens (1996), Jewell (1985), Lawson et al. (2004), Juran and Christopher (1989), Palmeira and Lanz (1994), Wong et al (1994), Rowe and Ho (1997), Pinto and Cousens (1999), Filippo et al. (2000), Simonini et al. (2003), Hatami and Bathurst (2004), Ma and Wu (2004), Desai and Houseing (2005), Bathurst et al. (1992) and Kapurapu and Bathurst (1995), Madhav and Poorooshash (1988), Poorooshash (1989, 1991), Ghosh and Madhav (1994), Shukla and Chandra (1994, 1995), Yin (1997a, b, 2000), Maheshwari et al. (2004), Nogami and Yong (2003), Deb et al. (2005), Love et al. (1987), Poran et al. (1989), Abioghli (2011).

MATERIALS AND METHODS

In this paper, the behavior of geosynthetic reinforced soil walls is studied by the numerical method (FEM) with PLAXIS 2-D software. In a study conducted by Abioghli (2010), five of geosynthetic reinforced soil walls were modeled with the use of Plaxis software. Then, numerical models are calibrated by using instrumented model results or experimental model and the ability of PLAXIS software in prediction of wall displacement, facing deformation and tension of reinforcement layers is assessed. Here, one of the models is selected and the effect of mesh size changes on the model output results of compared to the model are calibrated. The mesh size in a variety of software plaxis, the mesh size is very coarse, coarse, medium, fine and very fine, we have evaluated.

Figure 1 shows the geometry of the reinforced soil wall. Properties of various materials used in the model reinforced soil wall is presented in study conducted by Abioghli (2010). The numerical model simulates the panel with beam elements, the reinforced layers with geogrid elements and the soil-structure contact area with interface elements. Furthermore, the Mohr-Coulomb plastic model is used for the soil. The wall construction is modeled with staged construction.

RESULTS AND DISCUSSION

Here, one of the models is selected and the effect of mesh size changes on the model output results of compared to the model are calibrated. The mesh size in a variety of software plaxis, the mesh size is very coarse, coarse, medium, fine and very fine, we have evaluated. Should be noted that the mesh size of 15 nodal element, is a better distribution of nodes and more accurate results than to element with six nodes. Therefore, the analysis
of 15 nodal element is used. Table 1 shows the effect of changes of mesh size on maximum displacement of the wall and on maximum deformation of the facing. Figure 2 shows the effect of changes of mesh size on deformation of the facing. Figure 3 shows the effect of changes of mesh size on tension in reinforcement in the upper reinforcement layer.

Fig. 1: Geometry of the model reinforced soil wall.

Table 1: Effect of changes of mesh size on maximum displacement of the wall and on maximum deformation of the facing.

<table>
<thead>
<tr>
<th>Change the type mesh size</th>
<th>Maximum deformation of the facing (mm)</th>
<th>Maximum displacement of the wall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very coarse</td>
<td>70.9</td>
<td>13.2</td>
</tr>
<tr>
<td>Coarse</td>
<td>69.5</td>
<td>13.5</td>
</tr>
<tr>
<td>Medium (calibrated model)</td>
<td>70.3</td>
<td>13.8</td>
</tr>
<tr>
<td>Fine</td>
<td>71</td>
<td>13.9</td>
</tr>
<tr>
<td>Very fine</td>
<td>72.6</td>
<td>13.7</td>
</tr>
</tbody>
</table>

Fig. 2: Effect of changes of mesh size on deformation of the facing.
Fig. 3: Effect of changes of mesh size on tension in reinforcement in the upper reinforcement layer.

As is clear from Table 1, when analysis with different mesh size have done, maximum displacement of the wall is small change compared to the calibrated model. It can be seen from Table 1, when analysis with different mesh size have done, maximum deformation of the facing is small change compared to the calibrated model. Figure 2 shows the effect of changes of mesh size on deformation of the facing in all cases the mesh size is minimal. As is clear from Figure 3, the change of mesh size on the size of the tension in reinforcement in the upper reinforcement layer in all cases the mesh size is minimal. It can be seen from Figure 3, the the tension in reinforcement at the beginning of the reinforcements in all cases with little difference in mesh size model is calibrated.

Conclusion:

Change the type of mesh size on maximum displacement of the wall and on maximum deformation of the facing as well as tension in reinforcement can be expressed, that numerical analysis results with different mesh size changes little with the model are calibrated. Should be noted that the mesh size of 15 nodal element, is a better distribution of nodes and more accurate results than to element with six nodes.

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