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Experimental and Numerical Investigation on Stability of Sandy Slope Reinforced by Using Geotextile Reinforced Stone Column

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1. Introduction

Slope stabilization is one of the most common issues in geotechnical engineering. Using conventional methods of slopes stabilization is extremely versatile according to environmental conditions, the importance of the desired area, and its degree of instability, consumption costs of existing materials, facilities, and other things. Using stone columns is one of the suitable and environmentally friendly methods to reinforce soil slopes. Using stone columns, besides its simplicity and comfort implementation, is also very economical. Slope stability can be increased by various methods such as changing the geometry of the slope surface, using soil reinforcement or installing reinforcing structures such as stone columns. Some of the reasons that make stone columns suitable for stabilizing soil slopes are as follows: Increasing load carrying capacity, reducing settlement, increasing shear strength (in silty and clay soils), controlling liquefaction, and drainage (due to high permeability). Stone columns act as resistant members, which are normally exposed to lateral forces. The efficiency of bearing capacity of the stone column depends on lateral stress. In some soils, it is necessary to provide additional confining, and different techniques have been proposed in order to improve stone columns behavior. Horizontal geotextile encasing increases confining pressure in addition to resistance to horizontal displacement. Due to additional lateral confining pressure of geotextile, the lateral bulging of geotextile reinforced stone column is less than the ordinary stone column. This research aims to better, and further understanding of mechanism and behavior of geotextile reinforced stone column as laminated disks in sandy slopes. In this investigation, the object is slope failure and plastic deformation occurrence; small strains or elastic deformations in slope are not considered. The aim of this research is experimental investigation of ordinary stone column and stone column reinforced with horizontal geotextile laminated disks in the stabilization of sandy slopes. The results of this experimental study, besides its originality, are also thought-provoking and have the potential to give valuable information about the effects of geotextile layers on the stability of reinforced earth slopes.

2. Experimental and Numerical Program

The models built in the test box with glass sides, as shown in Fig. 1. These glass sides were built sufficiently rigid to maintain plane strain condition for the prevention of lateral displacements, and they allowed the sample to be seen during model preparation, precipitation, and loading. These sides also allow observation of final deformation and slip surface after failure, as shown in Fig. 2. The models saturated through precipitation and reinforced by installing ordinary stone column and horizontal layers of geotextile within the stone column. Also, the experimental models are modeled using the finite element method (Fig. 3) that is one of a numerical method. Experimental and numerical results confirmed each other.

Fig. 1. Box text in Lab

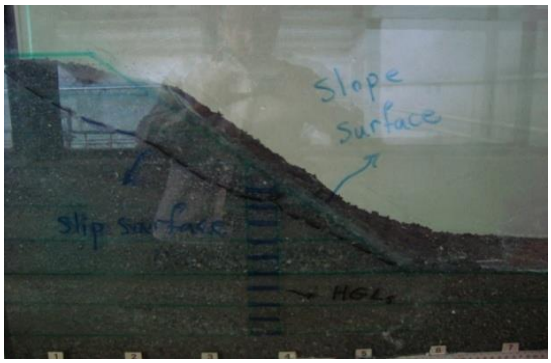

Fig. 2. Failure surface in sandy slope

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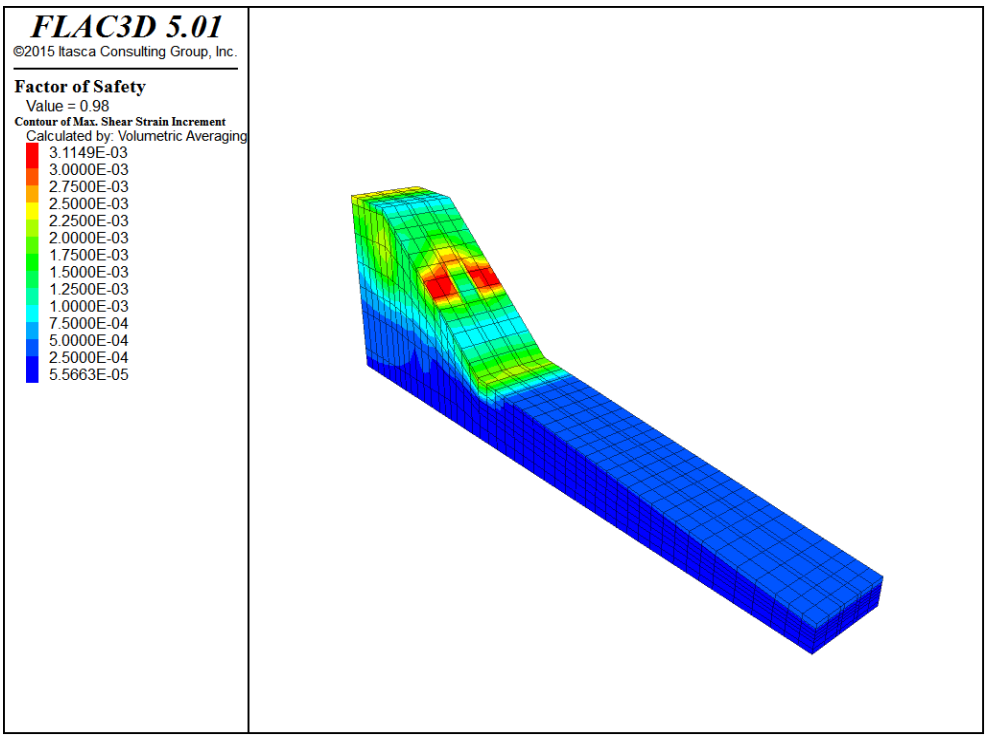

Fig. 3. Finite element model

3. Conclusion

Both experimental and numerical results showed that geotextile reinforced stone column in sandy slope has an impressive impact on increasing the stability of the reinforced slope. The numerical and experimental analysis also showed that the optimal location for the stone column is in the middle of the slope, since the maximum displacements occurred in the middle of the unreinforced slope. Reinforced stone columns enhanced slope stability up to and 50 percent, compared to ordinary stone columns.