Evaluation of the effect of shape and loading position on the stability of geotextile-reinforced slope using centrifuge modeling

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Abstract

Geosynthetic reinforced soil is recognized as one of the fastest and most economical ways to slopes and retaining walls. In this research, using centrifugal modeling, the behavior of soil walls reinforced with relatively high height and slope geotextiles (1H : 5V) under the influence of surcharge was evaluated. For this purpose, 3 models (samples) of reinforced soil slope with a height of 35 cm and a scale of 1:30 as well as another sample of unreinforced soil slope were made and loaded on the centrifuge during acceleration of 30 g. The results showed that the bearing capacity of the foundations on the reinforced soil slope was directly related to the shape of the foundations. As the square shape changed into the strip one (increasing the length of the foundations), the amount of the final bearing capacity increased. Through the investigation of soil reinforcing elements at different depths in terms of failure and elongation, it was revealed that regarding the elongation and failure of geotextiles and the depth of failure for footings with equal widths the maximum value is associated with strip footing and the minimum value is associated with square footing.

Keywords: *Reinforced soil slope, Geotextile, Centrifuge modeling, Load geometry*.

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Extended Abstract:

1. Introduction

With the development of the use of the reinforced soil in construction of high-rise walls, such as retaining wall and bridge abutments, in addition to stability, the deformation of the wall during the time is subjected to operation (Moein et al., 2015). Investigating the deformability of reinforced soil walls has been the subject of much interest in the recent decades with the development of retaining wall and collapsed bridges. Centrifuge modeling is one of the best methods available to solve the problems caused by the small scale and full scale laboratory wall models to date (Madabhushi, 2014; Rojhani et al., 2012; Wood, 2014)

2. Materials and methods

In this study, by modeling a reinforced soil wall at a height of 35 cm with six reinforcing layers at a velocity of 30 g (equal to 1050 cm height in reality) the effect of three types of rectangular, strip, and square loading surfaces is investigated. To achieve this, the slope of the reinforced soil as well as the unreinforced earth structure is first accelerated by centrifugation at 30 g and then applied vertically to the surface of the structure. A total of four physical models were developed to investigate the behavior of the reinforced soil wall according to Figure 1. This type of reinforced soil wall construction was carried out using a geotextile in accordance with the US Army's instructions (wrap around) (TSR101, 2013; Zornberg, 1994). The schedule of experiments is listed in Table 1

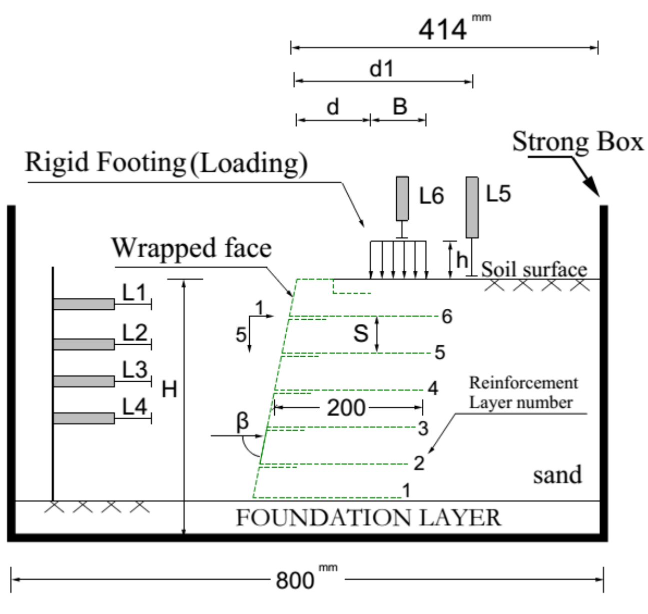

Fig. 1. Cross-section of model test.

Table. 1. Details of centrifuge tests

Test No.	Test label	Shape of Loading	Wall height (mm)	Slope (degree)	Distance of the Foundation from the edge (mm)
1	RSS 08	-	350	78.7°	-
2	RSS 02	Square	350	78.7°	50
3	RSS 07	Rectangular	350	78.7°	50
4	RSS 03	Strip	350	78.7°	50

3. Tests results

All geotextile reinforced soil models until the final acceleration of 30g remained undamaged and deformed after vertical loading. The unreinforced model breaks down at 3.37g at 120 seconds from the start of the experiment. The bearing capacity of the foundations on the reinforced soil slopes is directly related to the shape of the foundation. Examination of the final horizontal displacements of the wall at different alignments shows that with the constant distance from the slope edge, the horizontal displacements have the highest mean for the rectangular foundations and the least mean for the square foundations. Figure 2 shows an example of horizontal displacements and fractures of geotextiles.

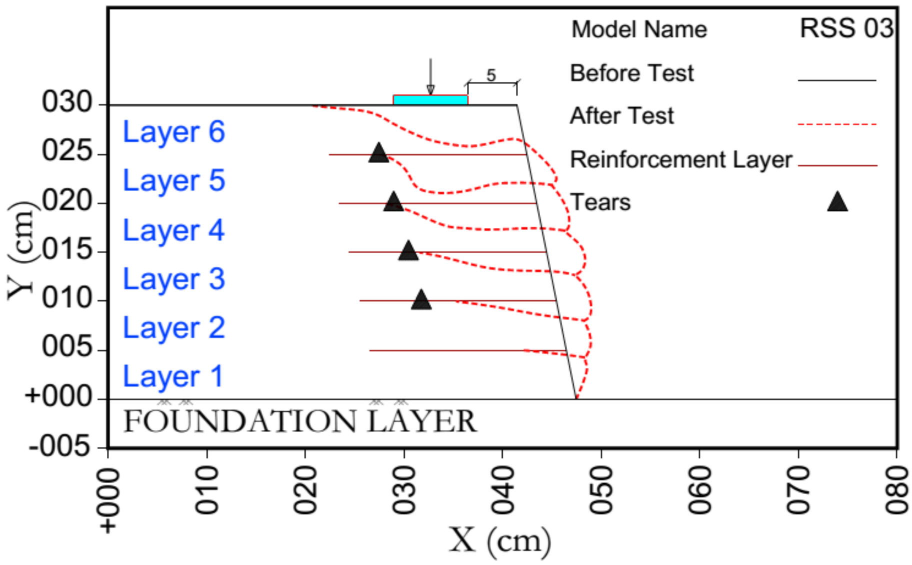

Fig. 2. Side deformation of slope and the location of Tears of the reinforcing materials; Test 1.

4. Conclusion

In this paper, the effect of surcharge type on the slope of soil reinforced with geotextile is investigated.

To achieve this, the slope of the reinforced soil as well as the unreinforced soil structure is first accelerated by 30g and then applied vertically to the surface of the structure.These experiments showed that all samples of reinforced soil were maintained to the final acceleration of 30g and deformed and fractured after vertical loading. However, the control sample (without geotextile) did not have the tolerance and stability to achieve acceleration of 30g. The bearing capacity of the foundations on the reinforced soil is directly related to the shape of the foundation and for the same widths, increasing the length of the foundation will lead to increase in ultimate bearing capacity.

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