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EXTENDED ABSTRACT

The effect of eccentricity of loading on the bearing capacity of strip foundations in the nearest of soil slope

Majid Kianpour [a], Ahad Bagherzadeh Khalkhali [a]*, Rouzbeh Dabiri [b], Mehdi Mahdavi Adel[c]

[a] *Department of Civil Engineering, Science and Research Branch, Islamic Azad University, Tehran, Iran*
[b] *Technical and Engineering faculty, Tabriz branch, Islamic Azad University, Tabriz, Iran*
[c] *Faculty of Engineering, Shoushtar branch, Islamic Azad University, Shushtar, Iran*

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1. Introduction

Civil engineers are faced with the challenges of designing foundations that are placed on top of or nearest to slopes due to eccentricity with the presence of weak layers. In this research, using small-scale model tests, the effect of loading from the center on the load-bearing position of the strip foundation adjacent to the multi-layer sloping gable with a weak soil layer has been investigated.

2. Methodology

2.1. Soil for Bed and Weak Interlayer

The sandy soil used in the model was obtained from the silica sand factory located on Firouzkoh road. Sand is used in dry weather conditions. According to the Unified Soil Classification System (USCS), it is described as poorly graded sand (SP). and Compactable clay powder with CL classification was used for the weak layer. Clay powder with a natural moisture content of 5.5% was used consistently in all experiments.

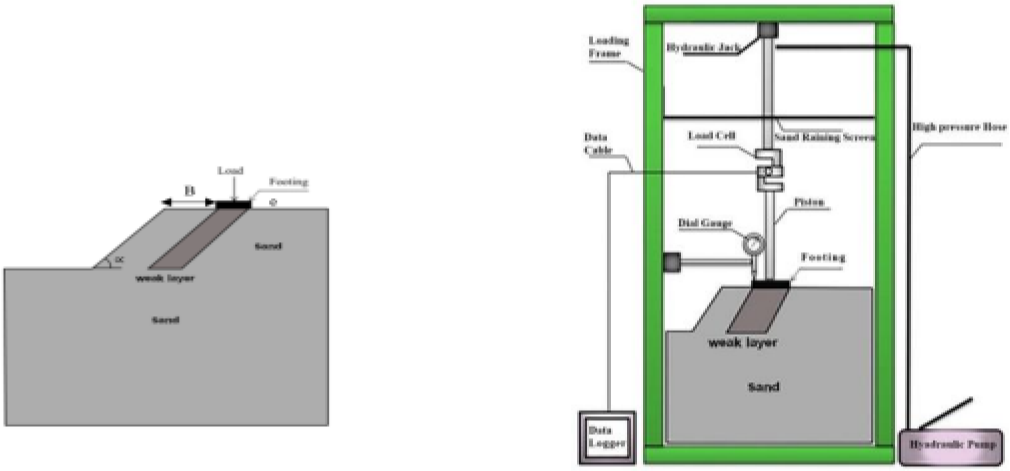
2.2. Physical Model Setup

The geometry of the Soil-Strip Footing system is schematically shown in Figure 3. The test is conducted under uniaxial conditions and the strip foundation is rigid. This strip foundation is located on a slope, on the other hand, the initial depth of the depression is zero. Figure 1a shows a typical schematic of the foundation model on a sand bed. Studies were conducted based on load eccentricity and footing distance from changes in slope crest. Crushed silica sand with medium density (SP) was used for bed sand. Materials with weaker resistance properties (compared to sand bed) were used for the thin layer. To conduct the experiments, a smallscale physical model was designed and built. The details of these tests are shown in Figure 1b. In the first stage, to avoid the effect of the wall conditions of the test box on the results, its net internal dimensions are equal to 100 cm (length), 70 cm (width), and 70 cm (height). The strip foundation is replaced by a rigid metal strip 70 cm long and 7 cm wide so that the experiments are not affected by the boundary constraints caused by the walls of the test box.

* Ahad Bagherzadeh Khalkhali
E-mail addresses: a-bagherzadeh@srbiau.ac.ir

2.3. Experimental Tests

At the first start of the Test, the sand rain system was located directly above the sand box. Then, the following sands were deposited in 5 cm thick layers by precipitation method. During the rain of sand, the density of the sand was controlled by placing cans with a certain volume in different spaces of the box. Then the sand slope (α=45) degrees with a specific angle was made using simple templates at the specified depths and thicknesses, as well as the weak layer in the same way, then the next sand layers were poured up to the required level and by placing the foundation model in A specific location was followed from the surface of the sand bed. At the end, the vertical pressure is transferred to the foundation model by a manual hydraulic jack with a constant speed of 1 mm per minute. Then a measuring gauge with an accuracy of 0.01 mm measured the vertical settlement to obtain some degree of confidence in the test result, in some cases, the tests were repeated.



a b

Fig. 1. a)- The geometry of the Soil-Strip Footing system b)- Cross-sectional view of the physical model

3. Results and discussion

To evaluate the effect of load eccentricity on the bearing capacity of a strip foundation on a layered soil slope, several tests were performed with different load eccentricities. In these experiments, other parameters affecting the foundation, including the distance of the foundation from the crest of the slope, were fixed, and eccentricity was considered in two directions (away from the crest of the slope (+) and towards the crest of the slope.

The analysis of the experimental results shown in the graphs shows that the eccentricity values affect the final bearing capacity of the foundation and increase the bearing capacity by moving away from the weak layer and the crest of the slope with positive values. Also, by increasing the amount of eccentricity to negative values (i.e., approaching in any shape, by changing the slope of the sloping crown), the bearing capacity increases. The settling process of soil pressure changes to some extent. The values of the bearing capacity of the foundation in each parameter D=0, in the maximum state, vary in the range of 20 to 25 kPa. These bearing capacity values have an average drop of 40% compared to the case of uniform sand. Also, in laboratory conditions, 6 test conditions have been performed for D=0, and the highest bearing capacity value occurs for the highest positive eccentricity value, i.e. +B/4. and the lowest value occurs for the largest eccentricity value in the steep crest (negative value).

4. Conclusions

In the present study, the behavior of strip footings adjacent to a sandy gable with a weak layer was investigated and compared using small-scale model testing and numerical analysis. The final bearing capacity of the strip foundation, which was on the gable bed, was made of sand. Based on the results described in this article, it can be said: the weak thin layer of the gable reduces both the bearing capacity and the hardness of the soil system under the foundation. The extent of this effect depends on the eccentricity and the distance of the foundation from the edge of the gable. The weak thin layer for the critical distance occurs when the foundation is attached to the crest of the gable, the final bearing *capacity is reduced by 43%, and the least effect of this condition is when the slope to the crest is equal to the width of the foundation. Comparing the results of the experimental model with the numerical results obtained in this research, which has been confirmed by different researchers, the maximum effect of these critical states varies from 20 to 43% depending on the angle of internal friction and the expansion of the sand. Also, in laboratory conditions, there are 6 laboratory states for each value. Different distances to the crest of the slope have been done, and the highest value of the bearing capacity occurs for the highest value of positive eccentricity and the lowest value for the highest value of eccentricity occurs in the negative value.*

By analyzing the results of the theoretical relationships, the bearing capacity values obtained from the Mirhoff and Vesik methods give values closer to our experimental results. The bearing capacity obtained by the theory method of Mirhoff is only 2% different from the bearing capacity value obtained in the laboratory. But Hansen's method gives closer values to our numerical results and the difference between the results obtained with it is about 9.5%. The bearing capacity increases by moving away from the weak layer and the crown of the gable, and also by increasing the value of departure from the center to negative values (i.e. approaching the edge of the gable), the bearing capacity decreases. It should be noted that due to the effects of scale, the results of small-scale tests are at high stress levels, in addition, the main goal of this paper is to evaluate and predict the general trend of the behavior of strip foundations on the slope behavior of poorly graded sand and to quantify the effect of parameters It was different from the results of the final load capacity, which was analyzed in detail

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