EFFECT OF A SHEAR KEY ON THE BEHAVIOUR AND STABILITY OF CANTILEVER TYPE RETAINING WALLS

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Retaining walls are categorised into several types, of which cantilever retaining walls are the commonly used retaining wall type. The stability of these walls should be ensured for its long-term use without any anticipated failures. A retaining wall can fail due to four main failure mechanisms: sliding, overturning, bearing capacity, and deep-seated failure. Shear keys are the structures incorporated in the cantilever retaining walls to increase their resistance to sliding, thus, increasing the Factor of Safety against sliding. The development of passive earth pressure due to the soil in front of the shear key will generate an additional resistance against sliding.

This study aims to identify the optimal location and depth of the shear key to yield maximum use from it. Both the theoretical approach based on limit equilibrium and numerical modelling have been adopted in the analysis. Limit equilibrium analysis was carried out using the Excel spreadsheet application, and two different scenarios were considered based on the distribution of lateral loads due to active soil conditions. Rankine's method was used for active and passive earth pressure computation. For the shear key, three different locations were considered: at the toe, middle of the base, and heel, and five different depths were considered: 0.4 m, 0.6 m, 0.8 m, 1.0 m, and 1.2 m. Soil strength properties were taken by referring to the commonly used backfill soil materials in Sri Lanka. The design soil parameters considered for the analysis were calculated using BS 8002:1994. From the Limit Equilibrium approach, the values of Factor of Safety (FOS) against sliding and overturning, varying with the shear key's depth and location, were obtained as graphical representations. Finite Element Analysis was carried out using PLAXIS 2D software to analyse the variation of the overall stability with the increasing depth of the shear key and validate the location of the point of rotation assumed in the limit equilibrium approach. Both the retaining wall and shear key were modelled as plate elements in PLAXIS 2D.

The results of limit equilibrium analysis suggested that the use of a shear key enhances the stability of the retaining wall against sliding. The location of the shear key does not influence the stability of the retaining wall against sliding. It was also found that the increased depth of the shear key reduces the stability of the retaining wall against overturning, and the optimum location of the shear key is at the heel of the wall base. Results from the Finite Element Analysis show that the overall stability of the retaining wall increases with an increase in depth of the shear key. The point of rotation is assumed to be located underneath the toe of the wall and at a depth of the shear key. From the Finite Element Analysis, changes in the direction of displacement were visible around the assumed location of the point of rotation for all three locations of the shear key. Hence, the assumed location of the point of rotation is reasonable in this study.

Keywords: shear key; finite element analysis; FOS; stability; limit equilibrium

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