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Stability of Soft Clay Slope along Mekong River

Slope failure, Slope rehabilitation, Cambodia

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1. Introduction

Cambodia is one of the countries in Southeast Asia in which very soft deposits of river alluvium and marine deposits are common. Every year the movement of sediment in the Mekong River by flood-water current creates a complex series of eroded and deposited slope. Furthermore, the active slump movement along the river provokes the importance of instability of natural and man-made slopes, which leads to the significant property loss and environmental destruction. The absence of a comprehensive geotechnical solution is one of the major failures in slope rehabilitation project in this country. In this study, the past and current situations of slope failure at some segments of Mekong River in Cambodia are presented.

2. Past and current situations of slope failure in Cambodia

Eroded and deposited slopes are simply observed every year along the riverside as the results of the heavy tropical rain and Mekong river flood. This phenomenon is not the new issue when Cambodia, a low land country where crossing the 486km-Mekong from the north (Lao border) to the south (Vietnam border) and networking in the central with many other rivers, has very limited in both technical and financial resource to improve this situation.

The past study was conducted in May 1997 over a project of 78m-slope rehabilitation along Tonle Sap River [1], Prek Pnov district, Phnom Penh. Gabion wall was first introduced to protect erosion as well as to retain the earth pressure. The amount gabions were placed in the woven containers, and every year those baskets settled. The more gabion adjusted, the more settle and slip to ground. Finally, this concept failed because of less technical design support. In May 2002 a new concept was proposed. Partial of gabion wall was removed and artificial slope was made by embankment with the inclination of 28^{o} and protected soil from erosion due to river flow and runoff by revegetating the site with perennial “gramineae” plants. Neither precise method nor sufficient data of soil investigation were proposed to design for supporting this project. (Fig.1a and Fig.1b)

Fig.1a Gabion retaining wall

Fig.1b Embankment slope

Another case observation in May 2002, a few days after raining, it occurred a failure of natural slope at a private house located along the Mekong River, Phnom Penh. A swimming pool behind the house, close to the riverside was demolished in order to reduce the surcharge pressure. This phenomenon was simply observed when the river water falls to the lowest level since April, collecting the discharge of underground water together with raining water which penetrated quickly to the ground during the onset of the monsoon rains in late May. (Fig.2)

Fig.2 Collapsed natural slope

In July 2004, an improper method of soil reclamation implemented by the land owner to the Basaac River, Phnom Penh, caused the failure of the landfill [2]. Both wall and filling materials collapsed to the river when the passive pressure of water decreased with river falls. (Fig.3a and Fig.3b)

Fig.3a Retaining structure

Fig.3b Collapse of retaining wall

A very recent project of slope rehabilitation was conducted in March 2006 at a Children Center located at National Road No.1, Phum Kdey Takoy, Khum Veal Sbov, Srok Hien Svay, Kahdal Province, Cambodia. Since 2004, when sediment movement transported by river flow concentrated naturally, along the Mokong riverside, at this place created the important deposited slopes. Some measures were used by the landowner to protect this deposited slope. Soldier piles were driven to a certain depth of the ground to retain the active saturated soil deposited. At the passive side laid the baskets of gabion wall placing as a series of steps to protect the erosion and collapse of the artificial slope at the footing. The flood in September 2005 made the deposited slope and embankment on the top very much saturated and weakened the effective stress of the soil.

Fig.4a Slope erosion

Fig.4b Collapse of wall (view from river)

Fig.4c Collapse of wall (view from side)

Fig.4d Slope rehabilitation works

Fig.4e Slope footing enforcement

Fig.4f Man-made slope rehabilitation

Excess pore pressure in the landfill embankment including the partial erosion of passive side leaded to a serious damage of the slope as well as the retaining material. This project was completely restored in July 2006 (Fig.4a to 4f). However, the consequences of this concept are not yet observed [3].

3. Future research

Most of the case studies mentioned above were observed that no precise design was implemented even some soil investigation works were conducted. The absence of numerical design supports and the lack of judgment overall the project could lead to financially loose and waste of time. Moreover, the consequence might be harm to the human being and the environment. As most of the failure histories were known, the following research will continue with the investigation of the sediment movement, eroded and deposited, level and nature of the ground water also take into account the impact to the stability of slopes and embankments, and following series of investigation shall be carried out.

i- Investigation of the characteristics of soft clay slopes failure

Through this investigation, the failure mechanism of soft clay slopes in Cambodia is expected to be clarified.

ii- Data collection through a series of test

Laboratory and in-situ tests on the clay at the sites of failure are to be performed. The data obtained from experiments will be analyzed aiming at verifying the hypothetical failure mechanism of the soft clay slopes.

iii- Possible material use for slope protection and stabilization with cost effective.

4. Conclusion

The current situation of slope failure in Cambodia was obtained from this study. Regarding to the methodology implemented in those projects, the concept of the rehabilitation of slope failure did not base on the reliable numerical design. The design theory was not well implemented.

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