SUMMARY: STABILITY ASSESSMENT OF MAN-MADE SLOPES A CASE STUDY IN YEN BAI (Alkema et al. 2011)

Introduction

Urbanization of mountainous areas often leads to excavation of slopes to create space for buildings and roads. Excavation of a slope may affect the slope’s stability, occasionally leading to slope failures that can cause significant property damage and loss of life. An excavated slope may be stable immediately after construction and fail many years later for various reasons including pore pressure dissipation, an unusually wet year which can cause saturation of the slope increasing the weight of the soil and decreasing effective stress, or weakening of the soil due to any combination of physical, chemical, and biological weathering.

Analysis

The purpose of this study is to determine the impact of weathering on man-made slopes in tropical climate regions. The area chosen in this study for analysis is a hill located in Yen Bai city, Vietnam. Three separate slopes were chosen in this study for analysis. All of the slopes were chosen from the same hill to ensure similar geotechnical and groundwater conditions, the same slope aspect, and the same vegetative land cover. Cross sections of different ages (2, 25, and 31 years) were chosen in order to determine the impact of weathering on the strength of the cut slopes over time. Cut angles of 65, 70, and 75 degrees were considered in the analysis. To analyze the different scenarios of rainfall and slope cut angle, the program GEO-STUDIO 2004 v6.22 was used to determine slope stability using the Bishop Method. Additionally, using critical rainfall conditions and the varying soil profiles, a steady-state model was created in SEEP/W to determine the distribution of pore-water pressure for each of the conditions (Krahn 2004a). The pore-water pressures were then added to the SLOPE/W model to determine the factor of safety for each of the slopes (Krahn 2004b).

Results

The weathering process causes a decrease in the soil strength with time that decreases the factor of safety against failure of the slopes. Based on the three time periods that the slopes were analyzed, a linear regression of the factor of safety against time indicates that all of the slopes will eventually have a factor of safety less than one due to the weathering of the soil. The number of years until the factor of safety reaches one decreases as the slope angle increases. The analysis predicts that the 65, 70, and 75 degree slopes will have a FS of one in 52, 48, and 44 years respectively. Hence, improvements of the slopes are necessary to ensure they remain stable.

Conclusion

In the tropical climate regions where the weathering process is strong, man-made slopes with cut angles 60-75 degree will all fail within approximately 50 years. As such, it is important for preventative measures such as applying shotcrete, benching, slope reduction, and excavating weathered soils to be taken in order to prevent slope failure in tropical climate regions (Abramson 2002).

References

Abramson, L. W. (Ed.). (2002). Slope stability and stabilization methods. John Wiley & Sons.

Alkema, D., & Hack, H. R. G. K. (2011). STABILITY ASSESSMENT OF MAN-MADE SLOPES A CASE STUDY IN YEN BAI.<http://www.itc.nl/library/papers_2011/msc/aes/tran.pdf>

Krahn, J. (2004a). Seepage modeling with SEEP/W: An engineering methodology. GEO-SLOPE International Ltd. Calgary, Alberta, Canada.

Krahn, J. (2004b). Stability modeling with Slope/W. Geo-Slope/W International LTD.