Abstract

Stability Analysis and Design of Slopes Using Stabilizing Piles

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The disasters owing to heavy rainfall has been gradually increased year after year in Korea. The landslide is one of the most significant disasters, which cause a lot of loss of human lives and properties. The method using piles has been used, as a countermeasure to control landslides. Several topics related on the stabilizing piles are studied in this dissertation. The results are summarized as follows.

1. The features of landslides in Korea can be divided into three regions topographically, such as the central area, the southern area and the the eastern area, which is coincidence with the rainfall characteristics. According to the frequency of the occurrence of landslides, the scale of landslides in Korea can also be divided into three categories, 'disastrous', 'severe', and 'minor'. Forecasting system of landslides by rainfall can be provided by foregoing classification. The charateristics of the rainfall in Pusan, Korea, is conicidence with regional classification of rainfall charateristics.
2. To analyze the behavior of infiltration of rainfall on the slope including tension cracks during rainfall, the program SPILE, which analyzes the infinite slope stability, are modified to include infiltration of rainfall. The condition of infiltration during rainfall is divided into three cases, such as advancing case of wetting zone beneath ground surface, rising case above groundwater level from potential sliding surface and occuring both cases at same time. Monitoring in situ shows that the slope stability is greatly influenced by wetting zone in ground developed by infiltration from ground surface during rainfall. The effect of advancing velocity of wetting front on the slope stability is more

significant than the effect of rising velocity of groundwater level from potential sliding surface in slope including tension cracks. The slope stability can be unstable due to reduction of suction and additional unit weight around ground surface.

3. The countermeasures used in Korea for stabilization of slope can be classified into two categories, which are based on the principle of stabilizing mechanism of slope. One is a method to maintain slope-stability and the other is a method to increase slope-stability. To maintain the original stability, the former seems to be effective to prevent shallow plane failure, which is typical failure patterns in Korea. In addition, additional stabilizing forces should be provided to improve the potential unstability of slope.
4. Since landslides occured in other countries are in large scale compared with those in Korea, cast-in-place pile with large diameter is adopted for the reinforcement of failed slope. The design problems on stabilizing piles arises from the ratio of pile spacing, D_2/D_1, restrained condition of pile head and the inserting depth of pile, etc.
5. A row of stabilizing piles designed and constructed to provide a successful reinforcement for a cut slope located near the construction site of apartment. Special instrumentation system was available to measure deflection and stress of piles as well as the soil deformation. The groundwater level on slope could also be measured. Two factors affecting the stability of the reinforcement slope checked. One is the effect of heavy rainfall itself and the other is the effect of construction work. The behavior of the piles and soil can be restrained within elastic range. The wetting front affects the stabilities of piles and slope because the driving force of slope is increased by additional weight of soil by reduction of suction in the wetting zone.
6. The stabilizing piles can be used as one of the most useful methods to stabilize landslides. To estabilish a reasonable design method, stability analysis of the slope containing stabilizing piles was presented by theoretical equation including lateral force acting on the piles in soil undergoing lateral movement. In addition, an existing landslides slope was selected to verify the program SPILE(ver1.0), which simulates pile behavior aganist landslides and slope stability.

7. A graphic method is estabilished to analyze pile behavior for stability easily. A sets of graphic charts are based on differential equation. In addition, the example to design stabilizing piles for control landslides is presented to ensure reliablility of suggested graphic method.
8. The finite element method is adopted for simulation of the in-situ tests. The analysis model on the stabilizing pile to control landslides is constructed under the assumption of nonlinear elastic model for soil, elastic model for soft rock and elasto-plastic model for joint element for the interfaces of each layer and soil-structure.