



Estimation of Average Shear Strengths along the Slip Surface of Rainfall induced Mudstone Landslides

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Landslides have several contributory causes. Among them, soil shear strength is important for the activation and reactivation, and the shear strength of the soil at the slip surface is directly related to sliding. Soil shear strength is not a uniform characteristic of a particular soil, but it changes from post-peak to fully softened and residual strength according to the soil condition. In order to plan effective control works for the prevention of landslides, what is important in the safety evaluation of landslides is to understand shear strengths of the soil or rock along the slip surface, based on both the slide patterns and actual slip surface conditions and to determine the appropriate average shear strength that acts along it. In Japan, the average shear angle of shear resistance is generally estimated by back calculation assuming the average cohesion in kilopascals to be equal to the average depth in meters of the slip surface. This method is practical and relatively based on empirical factors, but the basis of soil mechanics is scant. Although, in several studies, it has been attempted to use the shear strength obtained from laboratory shear tests in the stability analysis of landslides, it takes a long time to determine shear strength using a ring shear and triaxial tests.

As far as landslides in Okinawa, Japan, are considered, many have occurred in the Shimajiri-mudstone area in the past. The Neogene Shimajiri-mudstone is widely distributed in the central and southern areas of the Okinawa Island and along the marine terrace in the North Eastern part of Miyako Island. The average shear strength of the Shimajiri-mudstone landslides having different slide patterns have been obtained by two methods involving an estimation method using the shear strength diagram, the relationship between the shear strength and mineralogical properties of landslide soils and an ordinary method using the results of laboratory shear tests of soil samples. The deference of the two average shear strengths was small in the case of the landslides where the residual and fractured-mudstone peak strengths had been mobilized, while the two methods produced close agreement in case of the landslides where the residual and fully softened strengths had been mobilized. Although, the determination of appropriate average shear strength is done using the measured shear strength of slip surface soil as a fundamental rule, when it is difficult to do so due to certain restrictions, the average shear strengths can be effectively estimated using the shear strength diagrams.