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Soil strength properties of the Shimajiri-mudstone Yonabaru layer and Shinzato layer

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In the central and southern areas of the Okinawa Island, where the Shimajiri-mudstone is distributed and a hilly topography exists, the landslides triggered by heavy rainfall are frequent. The Tyunjun landslide that occurred in the aftermath of local downpour in October, 1998, the Asato landslide that occurred with a rainfall of 519mm in June, 2006 and other landslides were hard to predict until just before they occurred, which could have caused harm to human life as it was sudden sliding. The central and southern areas of the Okinawa Island is a densely populated region, where development activity of the land is carried out round the year. In order to think about not only an activation mechanism of landslides but also to use land wisely, it is important to investigate soil strength characteristics of landslides of this Shimajiri-mudstone area. In this study, we conducted triaxial and ring shear tests of landslide soils and non-landslide soils of Yonabaru-mudstone and Shinzato-mudstone formations and intend to shed light on physical properties and shear strength characteristic of both mudstones types.

We used soil samples which were collected in the areas of Yonabaru mudstone and Shinzato mudstone from Ozato, Nanjo city as representative samples for non-landslide soils and samples from Asato landslide (Yonabaru mudstone) and Ihara landslide (Shinzato mudstone) as representative samples for landslide soils.

The non-landslide soil samples in the Yonabaru-mudstone had a peak friction coefficient (c'$_f$) of 235.4 kN/m^2 and a peak friction angle (ϕ'$_f$) of 45.3˚, while in the Shimaziri- mudstone, the corresponding parameters were a c'$_f$of 32.1 kN/m^2 and a ϕ'$_f$ of 29.3. The reason why c'$_f$ and ϕ'$_f$ of Yonabaru layer were large in value is the fact that this particular non-landslide soil has not undergone much weathering. Therefore, it is thought that the height of the agglomeration degree was reflected. As for the fully-softened strength (ϕ_{fs}) and residual strength (ϕ_r) of the non-landslide soil samples at an assumed cohesion (c) of 0 kPa, ϕ_{fs} and ϕ_r were 28.6˚and 22.3˚respectively in the Yonabaru-mudstone, and in the Shimaziri- mudstone, the corresponding parameters were 29.0˚and 23.2˚respectively. There were a little differences of ϕ_{fs} and ϕ_r between both mudstones. Decrease from complete softening strength to residual strength was approximately 6 degrees in both mudstones. As for the fully-softened strength and residual strength of the landslide soil samples at an assumed cohesion (c) of 0 kPa, ϕ_{fs} was 27.8˚and ϕ_r was 10.8˚in the Yonabaru-mudstone, while the parameters for the Shimaziri- mudstone were 26.4˚and 12.0˚respectively. The difference of ϕ_{fs} and ϕ_r between both mudstones were 1.4˚and 1.2˚. The drops from complete softening strength to residual strength became 14.4˚to 17.0˚ and are considered as significant. As for a possible reason for this, it may be suggested that the presence of clay minerals may have greatly affected the deterioration of strength of soil. It is thought that the landslide soil samples may carry more clay minerals that are prone to reorientation than does the non-landslide soil samples.