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Recovered strength of landslide soils and its relationship with re-consolidation time

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Reactivated landslides have been subjected to repeated sliding and recession. The shear strength of shear zone is reduced to the residual state during sliding, but could be recovered to some extent during a stable period. Chandler investigated the Barnsdale landslide and indicated that the shear strength of slip-surface zone was recovered during such a stable period prior to re-sliding (Géotechnique, 1977). Nakamura and Gibo recognized the significant recovery of the shear strength from residual state under normal stresses of 30 to 150 kN/m2 in the soil containing large amounts of silt and sand particles, in which the remolded landslide soils were subjected to large-displacement shear, two days re-consolidation, and re-shear (J. of Japan Landslide Society, 2000, Géotechnique, 2002). After mobilizing the recovered strength, about 10 mm of shear displacement was required for the shear resistance to reach the initial residual shear stress again. On the other hand, in case of the soil containing large amounts of clay particles, a fall in the shear strength to the residual state was great, but the strength recovery due to re-consolidation was negligible for the whole range of normal stress. In contrast, Stark et al. carried out healing tests subsequent to shear on shale samples and had reported the strength gain in cohesive soil containing large amounts of clay particles increased with the increase of healing time (J. of Geotechnical and Geoenvironmental Engineering, 2005, 2010).

The present paper describes the results of strength recovery from the residual state due to re-consolidation in a series of ring-shear tests for Miaowan landslide soil dominated by silt and sand particles and Nakanojo landslide soil dominated by clay particles. The samples passing through a 425-μm sieve were subjected to large-displacement shear under the drained condition in a ring shear apparatus, and fully-softened and residual strengths were measured. They were then re-consolidated for two, four and fourteen days and re-sheared to measure the recovered strength. Recovery of shear strength was clearly observed in the Miaowan soil sample for any re-consolidation duration. In shearing, where the effective normal stress was strictly controlled to be constant, the strength increased up to the fully-softened strength. On the contrary, strength recovery was not essentially recognized in Nakanojo landslide soils for any re-consolidation duration, due to the development of slickensided residual shear surface. In the relationship between the vertical displacement of specimen and the duration of tow and fourteen days re-consolidation, there were no significant differences in the amounts of vertical displacement for two soils.