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# Shear Strength of Landslide Soils of Different Geological Origins

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Shear strength of slip surface soil is what governs if a slope would be subject to sliding and geology plays a most basic role in contributing to shear strength of soil. The minerals that accumulate inside the body of a slope are crucial in determining whether these products of rock weathering will be potentially able to create sufficient conditions to pave the way for a slippage fairly easily or otherwise in that slope. Therefore, understanding local geology and relating it with the kind of minerals that it produces could positively strengthen our knowledge base of how to predict and tackle the risk of unknown landslides in known geologies found in specific localities. In 1996, Terzaghi et al discussed shales, stiff clays and pure minerals based on the fully softened and residual shear strength results of remoulded samples in laboratory tests and gave different ranges of fully softened and residual shear strength values expected for soils belonging to those geologies. This paper discusses broadly the geology of three landslides occurring in Japan, and China, namely, Kamenose, O'dokoro and Miaowan, under temperate climates. Slip surface soil samples of these landslides are related to their geologies based on the mineralogy and the test results for fully-softened and residual shear strength obtained through drained, large displacement ring shear tests.

The Kamenose area is composed of Tertiary volcanic rocks and sedimentary rocks on top of a base of granitic rocks. Its slip surface soil has been found to consist of highly argillized clay layers. Its mineralogy is dominated by smectite (77.0%) with quartz (14.0%) and slight amounts of feldspar and Mica (3.0% and 4.0%, respectively) in sub-425-$\mu$m fraction. The O'dokoro has two contrasting mineralogy in its serpentine (O'dokoro-1) and silicified shale (O'dokoro2) fractions. The former is dominated by serpentine (99%), while the latter has more smectite (5.5%), vermiculite (44.0%) and chlorite (27.5%). Miaowan, which is a loess, is dominated by quartz (56.0%), feldspar (21.0%) and Mica (15.0%). The variation of fully softened friction coefficients shows that, with the increase of effective normal stress from 50 kPa to 400 kPa, the fully softened friction coefficient tends to decrease clearly in the Kamenose and (O'dokoro-2) samples. This behaviour can be expected from similar, taking into account of the existence of high contents of platy clay minerals in them. As the effective normal stress increases, the edge-to-face interactions are reduced, while the face-to-face interaction of smectite and vermiculite particles dominates the matrix. At large shear displacements, the high content of such platy layer silicate minerals promoted better orientation along the shear plane that it produced polished and striated slickensides on the shear surface. On the contrary, Miaowan and O'dokoro-1 samples showed markedly less decrease of fully softened strength within the effective normal stress range of 50 kPa - 400 kPa, which is expected with the presence of large and rotund sand-sized particles. The $\phi_r$ values for the Kamenose samples in the present study ranged from 7° to 11.5° and the difference $\phi_{sf} - \phi_r$ ranged from 8.4° to 19.6°. Those values for O'dokoro-2 were 9.5° to 14.6° and 12.7° to 14.8° respectively. Miaowan and O'dokoro-1 samples found their places in the extreme zone of the $\phi_r$ against $\phi_{sf}$ graph.