The shear strength of clayey soils from reactivated landslides

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1. Introduction

Reactivated landslides, which are usually found in Upper Tertiary mudstone-tuff formations, are common phenomena in Japan. According to the geotechnical classification of landslides proposed by Prof. Sassa (1985), the reactivated type of landslides is a residual slide that occurs on gentle slopes and moves slowly mainly due to an increase in ground water level. Resent studies have shown that the sliding surface is likely to be formed in clayey soils and exists in the residual state due to the previous movements. Clearly, knowledge of residual shear strength of these soils as well as factors affecting it is necessary for the hazard assessment of the area and the design of remedial measures.

This article presents the results of two case studies of reactivated landslides which occurred in Hyogo Prefecture ("the Muraokacho landslide") and in the vicinity of Biwa lake. Special attention is given to factors affecting the residual shear strength of clayey soils such as clay content and clay mineralogy. This work shows that an increase in clay content decreases shear strength of clayey soils, and the presence of montmorillonite significantly reduces shear strength of clayey soils.

2. The Muraokacho landslide

Three different soils were taken from the sliding zone of the Muraokacho landslide: amber silty clay, black clayey sand and brownish clayey sand. A comprehensive laboratory examination including grain size distribution and X-ray analyses, and a series of drained slow speed-controlled ring shear tests showed a significant influence of clay content and clay mineralogy on the residual shear strength of the tested soils. The mineralogical compositions of the amber silty clay and black clayey sand were found identical; however, the former had a significantly higher amount of clay, a property that presumably accounted for its lower value of residual shear strength compared to the latter.

Comparisons made between the samples of black clayey sand and brownish clayey sand revealed very similar fine particle distribution but different mineral composition; that is, the presence of montmorillonite in the brownish clayey sand. This difference in clay mineralogy seemed to be responsible for the lower residual shear strength of the brownish clayey sand compared to that of the black clayey sand.

Finally, it was concluded that the extremely low value of residual shear strength of the amber silty clay contributed greatly to the reactivation of the Muraokacho landslide.

2. Reactivated landslide in the vicinity of Biwa Lake

Two different clayey soils (B1 and B2) were taken from the sliding zone of this landslide for laboratory examination. The results of X-ray analysis showed almost the same mineralogical composition of the studied samples. However, grain size distribution analysis revealed a higher amount of clay in the samples of B1. Presumably, it was the reason for higher plasticity and lower residual shear strength of this soil.