直接せん断試験機による地すべり土のせん断強度
ー亀の瀬および仲順地すべりー
Shear Strength of Kamenose and Tyunjun Landslide Slip Surface Soils Measured in Direct Shear and Ring Shear Devices

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Introduction

This paper presents results of a laboratory study designed to compare shear strength parameters of slip surface soils (from two landslides) in direct shear and ring shear devices. Remoulded soil samples obtained from the two landslides, Kamenose (Osaka, Japan) and Tyunjun (Okinawa, Japan) were normally consolidated from slurry, pre-cut and polished on a glass plate using one directional, manual sliding for a pre-determined distance. Subsequently, the two halves of the specimen was re-set in the direct shear box and sheared with one single sliding without reversal of movement. The samples from the two landslides, namely, Kamenose and Tyunjun, contained predominantly clayey slip surface soil material.

Methodology

The soil samples were obtained from the slip surface through bore hole cores of the landslides. The specimen preparation procedure for the ring shear and direct shear apparatuses followed Japanese Soil Testing Standards. Each soil sample was divided into three sub samples and each sub sample was sheared as a separate specimen at a given effective normal stress to detect experimental errors. It should, however, be noted here that even when the samples are collected from the same location, some deviations of properties could arise even in similar samples (Bromhead, 1992; Harris and Watson, 1997). Grain size analysis was performed

Table 1. Grain size distribution and index properties of soil samples

Landslide	*LL*	I_p	Grain Size Distribution %			
			Clay <2μm	Silt 2-20μm	Sand 20-200μm	Course sand 200-425μm
Kamenose (K-1)	114	64	73.2	17.8	5.0	4.0
Tyunjun (T-1)	71.5	48.6	52.1	45.0	2.7	0.1

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according to the standards set out by the Japanese Geotechnical Society (1997). Mineralogical analysis of the soil samples were done according to the protocol described by Egashira and Ohtsubo (1982) and Egashira and Gibo (1988).

Discussion

Preparation of artificial shear planes to measure residual shear strength is not new to geotechnical literature, although, except in a limited number of studies, researchers have not widely addressed the use of artificially polished specimens in direct shear tests to measure residual strength. The index properties and grain size distribution are shown in Table 1. The stress paths of Kamenose and Tyunjun samples in direct shear and ring shear tests are shown in Figures 1 and 2. The estimated cohesion and friction angle values in direct shear test (DST) were higher than the respective values measured in the ring shear test (RST). The cohesion, c, measured by the DST is approximately 2.75-3.2 times higher than the cohesion, c_r, measured by the RST in all the tested samples. The friction angle, Φ, measured by the DST is approximately 1.7-2.1 times higher than the friction angle, Φ_r, measured by the RST in K-1 and T-1 samples. Meehan et al., (2010) reported differences in the residual friction angle values between DST and RST but there was no consistent pattern. Anayi et al., (1988) reported that the direct shear tests of Lias clay produced 1.5° higher values than the Bromhead ring shear device. Townsend and Gilbert (1973) concluded that the residual strength values measured in DST and torsional ring shear test for remoulded specimens were not significantly different.

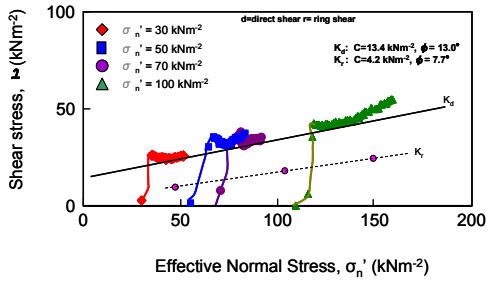

Fig.1. Stress paths and stress envelopes for Kamenose sample within ENS range of 30-150 kNm^{-2} in direct and ring shear tests

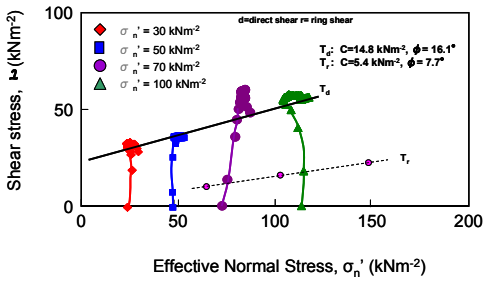

Fig.2. Stress paths and stress envelopes for Tyunjun sample within ENS range of 30-150 kNm^{-2} in direct and ring shear tests

References

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