# FABRICATION OF IN-SITU TEST APPARATUS AND APPLICATION TO VOLCANIC SOILS

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## 1. INTRODUCTION

Slope failure is an important disaster that should be taken into consideration, such as slope failure of highway slopes that have a large negative impact on society and slope failure that occurs near residential areas that can cause loss of human life. This study was initiated to investigate the shear properties of a mountain slope composed of volcanic soil at an elevation of about 1,400 m, where a landslide occurred in the past. However, we experienced the difficulty of carrying the undisturbed sample back to the site because of the 2.5 km long uphill and downhill mountain road and the water spewing from the disturbed sample that we brought back. Therefore, a testing machine was fabricated to conduct in-situ tests with less disturbance to the site-specific soil structure.

## 2. METHODOLOGY

The fabricated direct shear box test apparatus is shown in Figure 1. Many of the parts were fabricated using a 3D printer, making the whole machine easy to carry with a weight of just over 5 kg. The shear box is equipped with a metal hollow pipes so that it can move only in the horizontal direction, and the parts in front and behind the shear box are anchored to prevent it from moving against the reaction force of the shear force to be applied. Load cells for vertical and horizontal loads and displacement transducer for horizontal displacement are used as sensors. The digital data of the above sensor values were acquired by a microcontroller unit (Arduino Mega), and the data was output to a CSV file at an equal interval of 10 Hz by FreeRTOS and stored in an SD card. The test procedure is as follows: a shear box is placed over a block-shaped specimen, a vertical restraining load is applied, and a jack is used to shear the specimen. Multiple tests were conducted by changing the vertical confining load.

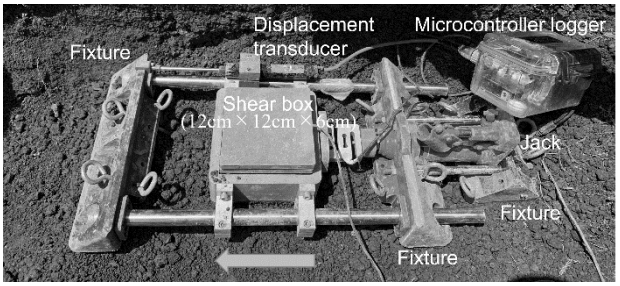


Figure 1. In-situ direct shear box test apparatus

## 3. RESULTS AND DISCUSSIONS

The 2008 earthquake caused the collapse of a volcanic soil slope with a soil layer thickness of up to 30 m near the top of the mountain. We conducted in-situ tests using the mentioned test apparatus, and the results are shown in Figure 2. In order to confirm the validity of the in-situ test results, undisturbed samples were taken to prepare a specimen, and the specimen was reconstituted from disturbed soil to conduct laboratory direct shear box tests. Figure 3 shows that the in-situ and undisturbed specimen results are in close agreement, indicating the validity of the in-situ test. The results of the reconstructed specimens are smaller than those of the undisturbed specimens, suggesting that the specimens under test may have shear strength due to soil structures unique to the study site that cannot be reproduced by reconstruction. [1]

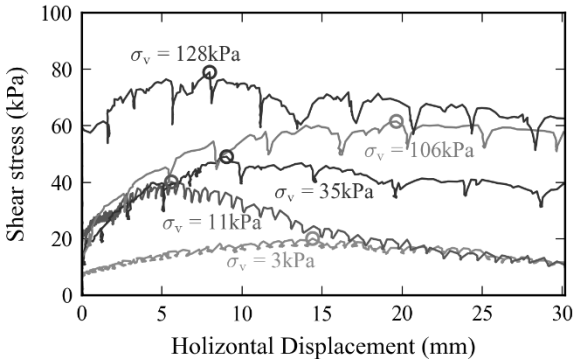


Figure 2. In-situ test result

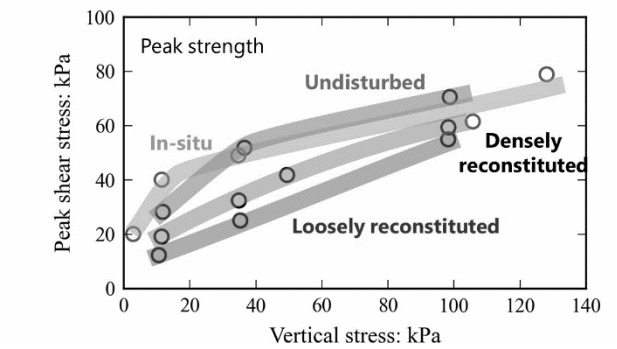


Figure 3. Compare in-situ test results and lab test results

## 4.CONCLUSIONS

We fabricated in-situ direct shear box test apparatus and applied to volcanic soils. Its results are almost same as laboratory test results of undisturbed samples. To make field testing more convenient, we are currently improving our testing equipment so that test results can be viewed on a smartphone in real time.

## REFERENCES

Reference to a journal publication:
[1] I.Sato, R.Kuwano, T.Sato, Seisan-kenkyu, *69*(6) (2017) 329-332