EFFECT OF STRONG CONTRACTANCY ON THE SHEAR BEHAVIOUR OF VOLCANIC SOIL

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1. INTRODUCTION

Increasing awareness of danger caused by landslides has aroused the need for investigating into the mechanism in which shear behaviour is affected. Sato et.al (2019) investigated vulnerability of volcanic soil by using artificially made loose soil. By analyzing effective stress paths, Umar et.al (2019) observed that reconstituted pumice soil shows purely contractive behavior with the post peak shear state characterized by strain softening behavior. Although these studies have contributed to the understanding of the mechanism in which shear behaviour of volcanic soil is affected, it is important to base the studies on the more fundamental contractancy characteristics. This paper therefore focuses on investigating the effect of strong contractancy on the shear behavior of volcanic soil.

2. MATERIAL AND EXPERIMENTAL METHOD

Contractive material such as volcanic soil can decrease in volume when it is sheared. The contractancy characteristics of volcanic material and its effect on the shear behaviour can therefore be investigated. The tests were performed on a volcanic soil from Atsuma in Hokkaido. The soil is characterized by the gradation shown in Fig.1 with uniform distribution and contains porous grains. The soil has specific gravity of 2.66g/cm^3 and void ratio of 6.33. Microstructural features of reconstituted samples were investigated by the means of Scanning Electron Microscope (SEM) images Fig. 2. The specimen shows intra-grain pores.

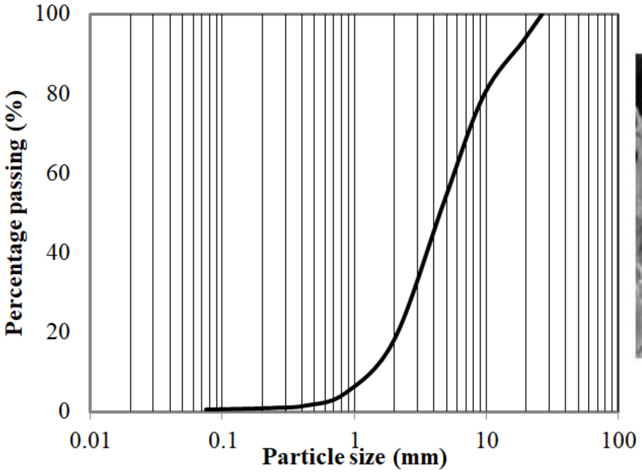

Fig. 1 Particle size distribution curve.

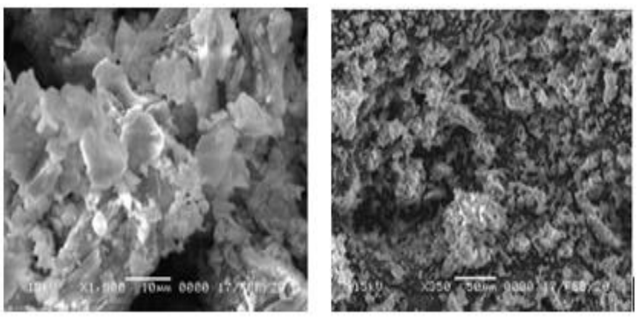

Fig. 2 Scanning electron microscope images of a natural volcanic size

Standard Triaxial apparatus was used to conduct tests on specimens of 50 mm diameter by 100 mm height. Specimens were obtained by gently adding moist soil into the mold then compacting in 10 layers to attain the target void ratio of 5.266 and initial density ρ_d 0.424 g/cm^3. Double vacuuming method was applied in order to ensure full saturation. The specimens were isotropically consolidated to different effective mean stresses of 50,100,150 and 200 kPa. The specimens were then sheared.

3. TEST RESULTS AND DISCUSSION

3.1 Isotropic consolidation test

Fig.3 shows the volumetric strain (%) plotted against the isotropic consolidation pressure for Atsuma volcanic soil at same density under isotropic consolidation pressures from 50 kPa to 200 kPa. The volumetric strain increases with the increase in confining pressure. The higher the confining pressure the higher the volumetric strain which correspond to the amount of water in the specimen. The porous nature of the specimen results to the development of high volumetric strain, this explains that the higher permeable the specimen is will increase the amount of water infiltrating the specimen.

Keywords: Strong contractancy, volcanic soil, shear behaviour, void ratio
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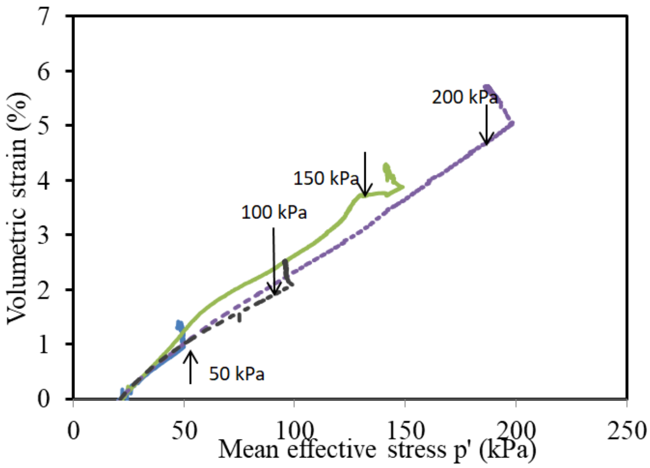

Fig. 3 Volumetric strain effective mean stress relationship

3.2 Undrained monotonic test

The results of the consolidated undrained monotonic triaxial tests on reconstituted volcanic soil are expressed in terms of the effective stress path and deviator stress-axial strain relation. Fig.4 shows the stress-strain behaviour of Atsuma volcanic soil in undrained monotonic compression triaxial tests .The corresponding effective stress paths are shown in Fig.5.At 50kPa confining pressure the specimen shows less contractive behaviour compared to those under high confining pressure. The specimens attain the phase transformation point at a small axial strain level, less than 5%,this indicates that initially the particles are crushed as the deviator stress is applied making the structure stable and increase resistance but later the resistance is lost hence steady state is reached. From the effective stress path with exception to 50kPa confining pressure all other samples contract towards steady state while the effective stress gradually decrease.

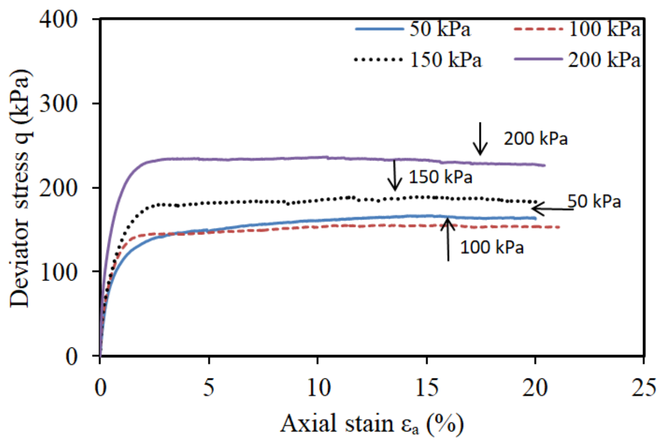

Fig. 3 Stress-strain relationship.

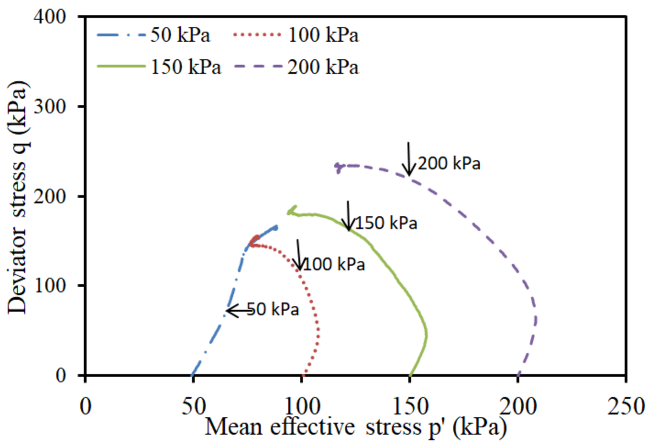

Fig. 4 Stress path curves.

4. CONCLUSION

A series of undrained monotonic triaxial tests were performed on Atsuma volcanic soil at uniform initial density and four different confining pressures. The influence of contractancy behaviour on the shear characteristic was investigated. Increase in mean effective stress results in the occurrence of particle crushing and a remarkable contractive behaviour of the specimen. Under all confining pressures the steady state was attained. Also the SEM image showed that pumice particles are porous with surface and internal voids and have complex surface shape, which may lead to interlocking effects leading to higher void ratio.

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