EXPERIMENTAL INVESTIGATIONS ON THE DRAINED TRIAXIAL BEHAVIOR OF UNDISTURBED ARIAKE CLAY

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1 INTRODUCTION

The stress-strain behavior of undisturbed specimens of Ariake clay is presently being investigated at Saga University under a large variety of applied stress paths. This paper presents the results of a series of fully drained triaxial compression tests carried out on clay specimens taken from the Kawasoe area in Saga City.

2 EXPERIMENTAL DETAILS

Undisturbed samples of Kawasoe clay were obtained from 2m depth using a thin-walled stainless steel sampler. Cylindrical specimens were prepared with 5cm diameter and 11cm height. All samples were saturated under a back pressure of 2 kgf/cm^2 and were isotropically compressed under effective pre-shear consolidation pressures (p_0) of 1, 2 and 3 kgf/cm^2. A strain rate of 0.0075%/min was employed for all tests. Some initial properties of the clay specimens are: ω_n=136%, ω_L=89%, G_s=2.62, I_p=42.5% and p_c=0.4 kgf/cm^2.

3 RESULTS AND DISCUSSIONS

Stress paths for the series of drained tests are straight in the q:p plot and rise at a slope of 3 from the initial value of p_0 for each sample, as shown in Fig. 1. The samples failed at values of q and p which define a straight line with a slope of M=1.13. It is interesting to point out that the failure points from a similar series of undrained triaxial tests for Kawasoe clay also lie along this failure line. The failure points also have linear projections on the e:ln p plot (Fig. 2), with the slope of the failure line of λ=0.44. Figure 3 shows that the stress paths can be collapsed into one by plotting q/p_e against p/p_e, where p_e is the equivalent pressure defined by Roscoe and Burland (1968). Such characteristics of the stress and state paths and the existence of a unique failure line for normally consolidated clays is in accordance with the Cambridge Critical State Concepts (Atkinson and Bransby, 1982).

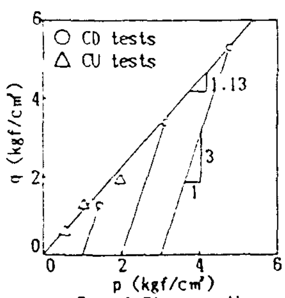

Fig. 1 Stress paths

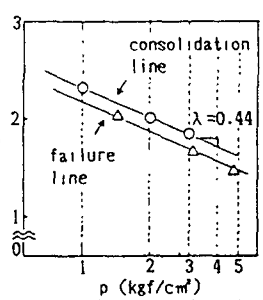

Fig. 2 e:ln p relationships

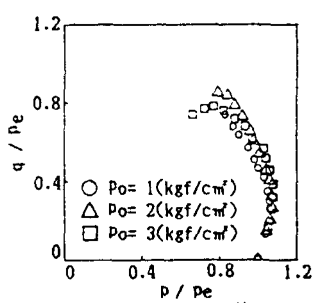

Fig. 3 State paths

The deviator stress (q) and axial strain (ϵ_a) curves were found to have the same shape, with samples compressed to higher pre-shear consolidation pressures (p_0) exhibiting higher values of q at failure. It was thus possible to normalize the q:ϵ curves as shown in Fig. 4, with all data points falling close to a single curve. On the other hand, Fig. 5 shows that the volumetric strain (ϵ_v) and the axial strain (ϵ_a) relationships are not affected by p_0 since they are the same for all tests.

The stress ratio (η)- strain relationships (η:ϵ_a and η:ϵ_v) were found to be unique for the series of drained tests carried out, as shown in Figs. 6 and 7. This means that the strains developed during the drained loading of Kawasoe clay are unique functions of the stress ratio and are independent of the pre-shear consolidation stress.

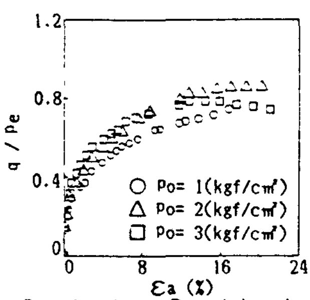

Fig. 4 q / Pe : εa relationships

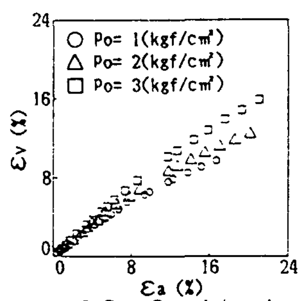

Fig. 5 εv : εa relationships

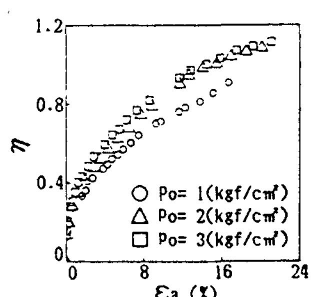

Fig. 6 η : εa relationships

4 CONCLUSIONS

The results of a series of fully drained triaxial compression tests carried out on undisturbed samples of Kawasoe clay revealed the following stress-strain characteristics: (1) the failure points lie on a critical state line with a slope of M=1.13 in the q:p plot, and λ=0.44 in the e:ln p plot; (2) the state paths in the q/p_e:p/p_e plot are unique and independent of p_0; (3) the volumetric strain - axial strain relationships are similar for all tests; and (4) the axial and volumetric strains developed during drained loading are unique functions of the stress ratio and are not affected by the pre-shear consolidation pressure.

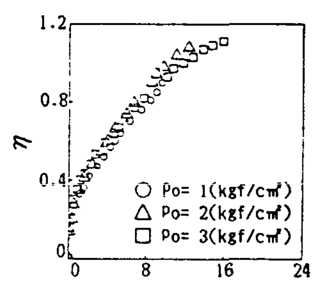

Fig. 7 η : εv relationships

5 REFERENCES

Atkinson, J.H. and Bransby, P.L. (1982). The Mechanics of Soils. McGraw-Hill Book Co. Ltd., U.K.

Roscoe, K.H. and Burland, J.B. (1968). "On the generalized stress-strain behaviour of wet clay". Engineering Plasticity. Cambridge Univ. Press, U.K. pp. 535-609.