STRESS-STRAIN CHARACTERISTICS OF UNDISTURBED ARIAKE CLAY

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1 INTRODUCTION

The shearing behavior of saturated clays has been the subject of numerous researches for the past several decades, and typical characteristics have been observed for the soil behavior under particular test conditions. In this study, the characteristics of the undrained stress-strain behavior of undisturbed natural deposits of soft Ariake clay are presented together with the predictions of the soil behavior based on the Cam clay and Modified Cam clay critical state theories (Roscoe and Burland, 1968).

2 DETAILS OF EXPERIMENTS

Conventional undrained triaxial compression tests (CIU) were carried out on fully saturated, isotropically consolidated specimens of clays obtained from 2m depth at Kawasoe area, Saga City. The effective consolidation pressures (p_o) were 1, 2 and 3 kgf/cm^2, and a strain rate of 0.03 %/min was employed. Initial properties of the 5 cm dia. x 11 cm height specimens are: ω_n=132%, G_s=2.62, ω_L=90%, I_p=43%, and p_c=0.4 kgf/cm^2.

3 RESULTS AND DISCUSSIONS

Normalized behavior Typical stress-strain relationships are of the form illustrated in Figs. 1 and 2, from which normalized q/p_o:ϵ and u/p_o:ϵ plots can be drawn. Normalized behavior has previously been reported for remolded Kaolin and soft Bangkok clay (Balasubramaniam, 1991). Also, a unique relationship between the stress ratio (η) and axial strain exists as shown in Fig. 3, indicating the possibility of using the critical state models to predict the strains, as will be discussed later.

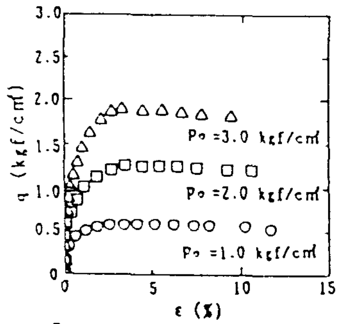

Fig.1 q:ε relationships

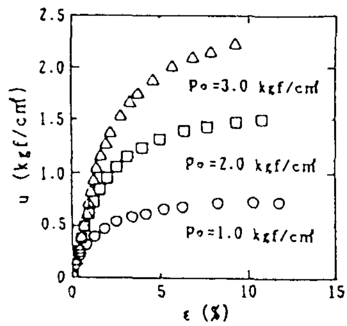

Fig.2 u:ε relationships

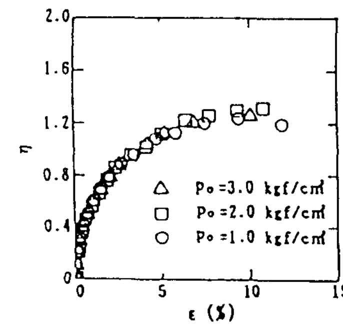

Fig.3 η:ε relationships

State boundary surface The Critical state concepts postulate the existence of a critical state line on which all test paths from triaxial compression tests on isotropically consolidated samples terminate, and also a unique state boundary surface along which the stress paths must proceed during undrained (and also drained) tests. The three dimensional state boundary surface may be represented in the two dimensional plot

q/p_e:p/p_e (Roscoe and Burland, 1968). Stress paths for the series of tests carried out terminate at a critical state line with M=1.2 (Fig. 4) while a unique state boundary surface is shown in Fig. 5, where p_e=p_0 for undrained tests.

Prediction of strains The fundamental soil parameters used in the critical state theories are λ, k and M. λ is the slope of the isotropic consolidation line in the e:ln p plot, k is the slope of the isotropic swelling line in the e:ln p plot, and M is the slope of the critical state line in the q:p plot. Isotropic consolidation and swelling tests carried out indicate that the value of λ is 0.44 and that of k is 0.04. Also the critical state parameter M based on the undrained tests is 1.2. The experimentally observed strains and those predicted from the critical state theories are shown in Fig. 6. Although both theories slightly underpredict the strains particularly at low strain levels, it is seen that the Modified Cam clay theory predicts the strains, as well as the state boundary surface (see Fig. 5), relatively better than the Cam clay theory.

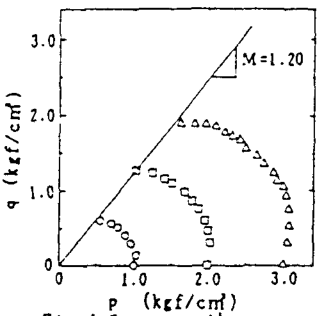

Fig.4 Stress paths

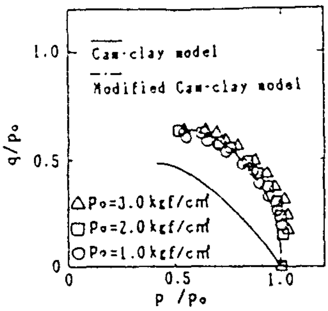

Fig.5 q/Po :p /Po plot

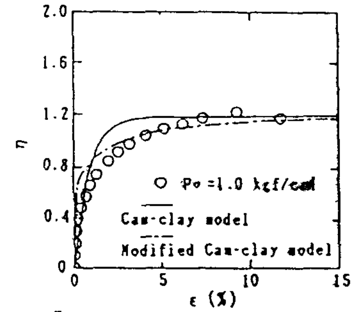

Fig.6 Prediction of strains

4 CONCLUSIONS

Based on the results presented in this paper, the following conclusions can be made: (1) normalized stress-strain behavior exists for natural deposits of soft Kawasoe clay; (2) a unique state boundary surface could be seen from the state paths obtained from the series of CIU tests; and (3) the Modified Cam clay theory predicts well the behavior of soft Kawasoe clay, with the critical parameters being M=1.2, λ=0.44 and k=0.04.

5 REFERENCES

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.

Balasubramaniam, A.S. (1991). Contributions in geotechnical engineering-soil mechanics and foundation engineering. Inaugural lecture presented at the Asian Institute of Technology, Bangkok, Thailand.