III-393 A REMARK ON SAMPLE DISTURBANCE DEGREE FOR ARIAKE CLAYS

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INTRODUCTION

Stress relief and mechanic disturbance are never avoidable for soil samples for laboratory testing. How to correct laboratory determined undrained strength for stability analysis and compression curve for settlement analysis to render them those in situ is an important research project. In doing that, disturbance degree, an index reflecting the extent of stress relief and mechanic disturbance, is a key concept.

A STUDY ON DISTURBANCE DEGREE FOR ARIAKE CLAY

Several definitions on representing mechanic disturbance have been suggested, such as, the ratio of residual effective stress caused by negative pore pressure in perfect samples, suffered from stress relief but no mechanic disturbance, over that in undisturbed samples (e.g., Okumura 1971); the ratio of deformation modulus E_{50} to undrained strength determined in unconfined compression test suggested by Skempton (Onitsuka, 1983) and the ratio of preconsolidated pressure to the field yield stress determined in oedometer tests suggested by Nagaraj et al. (1990). Among these approaches, that suggested by Nagaraj et al.(1990) is simple and convenient, more importantly, it can be extended to take into account the combined effects of mechanic disturbance and stress relief. Nagaraj's method is, therefore, reviewed and a new definition is given for the disturbance degree of Ariake clays as follows. Following Nagaraj et al., the compression curves responsible for samples suffered different mechanic disturbance, and the predicted field ones are schematically shown in Fig.1, in which the predicted field yield stress is determined as the point of intersection of a horizontal line from initial void ratio, e_0 and a line normal to the laboratory-obtained compression curves at the point of maximum curvature based on the assumption that the compression can be neglected up to predicted field yield stress. In fact, for samples tested in the laboratory the compression process from the residual effective stress to the field yield stress is a reconsolidated one, and the larger the stress relief is, the longer this process. While for the normally consolidated and lightly overconsolidated clay in situ no this process occurs since consolidation process under external loading begins at the stress in situ. It is generally assumed that the water content of sample is kept unchanged during sampling and handling (e.g., Nakase et al., 1985). It is logical to adopt this assumption for the sensitive Ariake clays because of their strong cementation bondings among the particles or their aggregates, which prevent the sample volume swelling and negative pore pressures occur due to the mechanic disturbance and stress relief during sampling and handling. Based on this assumption, Fig.2 shows schematiacally the compression path and the stress states for various samples,

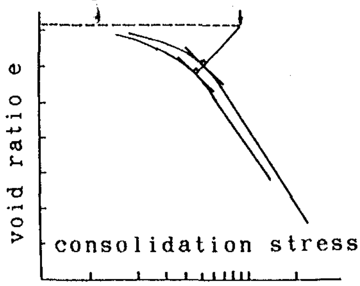

Fig.1 Nagaraj's Approach

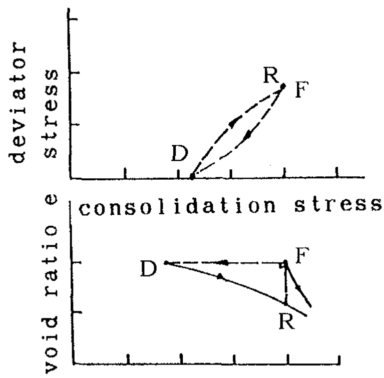

Fig.2 Schematic Plots For Various Samples

In which the points F, D and R represent the state responsible for the in situ, for the sample at the start of a conventional unconsolidated undrained test and for that after consolidated to the same effective stress state as one in situ, respectively. F - D represents the process of mechanic disturbance and stress relief during sampling and handling, and D - R shows the reconsolidated one. Generally, the water content at point R is different from that at point F although both have the same stress state. It is obvious that the field yield stress is different from the laboratory determined one, and there is also difference among the yield stresses obtained from the samples suffered from different disturbed extents. Since the variation of yield stress is directly affected by mechanic disturbance and stress relief, disturbance degree, SD, a combined index reflecting the extent of mechanic disturbance and stress relief, can be quantitatively calculated in Eq.1, which is the same form as that proposed by Nagaraj et al.

$$SD(\%) = (\sigma'_{vf} - \sigma'_{v}) / \sigma'_{vf} \times 100 \quad \ldots (1)$$

where σ'_{v} is the laboratory-determined yield stress from compression curve of the oedometer test in Casagrande's approach and σ'_{vf} is the predicted field yield stress determined in the similar way to that by Nagaraj et al. (1990) based on the assumption of the water contents for soil samples unchanged during sampling and handling.

Fig.3 shows oedometer-obtained compression curves responsible for the samples of an Ariake clay taken from different depths underground, and the laboratory-obtained yield stress and the predicted field yield as well as the disturbance degrees calculated in Eq.1 are shown in Tab.1. The significant difference for the disturbance degrees of upper and lower layers is due to the different extent of stress relief since the clay shows almost the same grand size distribution, activity and liquidity index, moreover, all samples are sampled in the same way, suffered from the same extent of mechanic disturbance.

Table 1 : Disturbance Degrees

No	DEPTH (m)	e_0	σ'_v(kgf/cm²)	σ'_{vf}(kgf/cm²)	SD(%)
2	2.3-2.4	4.61	0.37	0.45	17.8
4	4.3-4.4	4.30	0.425	0.68	37.5
8	8.3-8.4	3.87	0.255	0.97	73.7
10	10.3-10.4	3.34	0.405	1.30	68.9

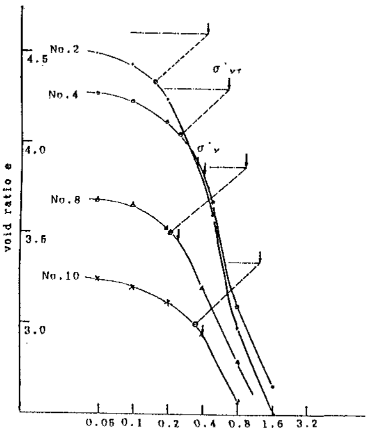

Fig.3 Compression Curves For An Ariake Clay

CONCLUSIONS

1)New definition for disturbance degree, a combined index reflecting stress relief and mechanic disturbance, is given based on the concept by Nagaraj et al. (1990).

2)Disturbance degree is dependent, not only on the mechanic disturbance but also on the stress relief.

REFERENCES

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