Comparative Study on Undrained Shear Strength and Sensitivity of Ariake Clay

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1. Introduction

Ariake clay deposited around Saga plain causes many geotechnical problems due to its high water content, sensitivity, and compressibility, but low shearing strength. The aim of this paper is to present additional data obtained from field and laboratory vane shear together with unconfined compression tests.

2. Location and Testing Program

Thin wall samples 7.5 cm in diameter were secured from the rice field at Umaarai, western part of Shiroishi town.Several field vane shear tests were performed at 2 or 3 m apart from the borehole. The laboratory testing program consisted of classification, unconfined compression and vane shear tests.

3. Soil Properties

Fig.1 shows engineering properties of the clay from which the natural water contents are higher than the liquid limit the whole depth. Other values are typical of very soft Ariake clay indicating high sensitivity and low strength. At 75 cm below ground level, water table is indicated. The clay is homogeneous down to 10 m.

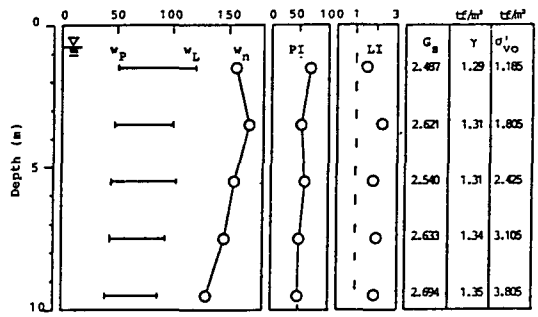

Fig.1 Engineering properties of Ariake clay

4. Results and Discussion

Undrained shear strengths from field vane and unconfined compression tests are shown in Fig. 2. Both distribute between 1 to 2 tf/m2. It should be noted that the vane shear tests are at 2 to 3 m from the borehole, its size 5 cm x 10 cm. The apparatus is of the push-in type. Both undisturbed and remolded strength were measured at 6 deg/min. The average field vane strengths are little higher than that from unconfined compression tests, not surprising results. The undrained strength ratio decreases from 1 to 0.5, an indication that the clay is sligthly overconsolidated. If it were normally consolidated, the ratio would have been around 0.35. Comparison of strengths from field and laboratory is revealed in Fig. 3. The strengths from miniature vane, 2 cm x 4 cm, measured at 6 deg/min are the least of them.

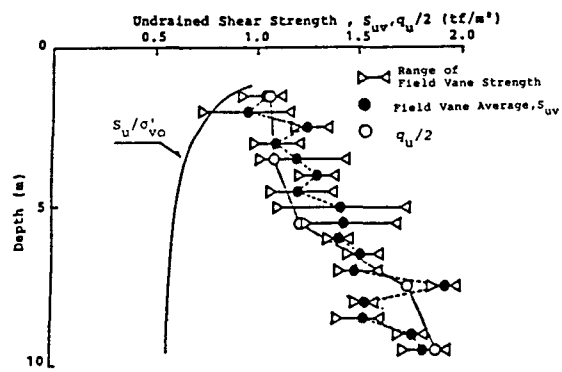

Fig.2 Undrained shear strength of Ariake clay

It can be seen that when a choice of test have to be made, the difference in field vane and unconfined compression is little. The field vane is commonly used in soil exploration program to measure strength for bearing and stability problems though factors affecting the strength are not well understood. It is more economical and rapid than the unconfined compression test.

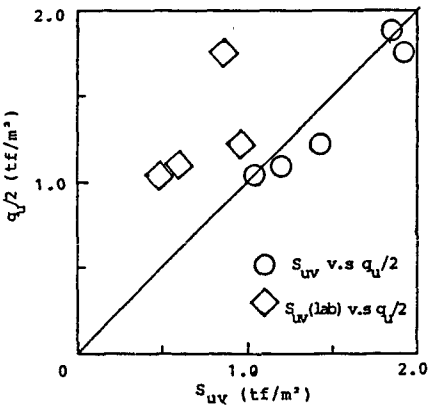

Fig.3 Relationship of field and laboratory undrained strength of Ariake clay

In Fig. 4 is shown the sensitivity of Ariake clay from Shiroishi area. It was determined from the ratio of the undisturbed to remolded undrained strength. Since the clay lost most of its strength upon remolding, laboratory vane was used to determine the remolded strength while the unconfined compression was employed to measured undisturbed strength. The sensitivity of the clay is very high and the clay belongs to extra sensitive type. The new data were added to the old ones and shown together.

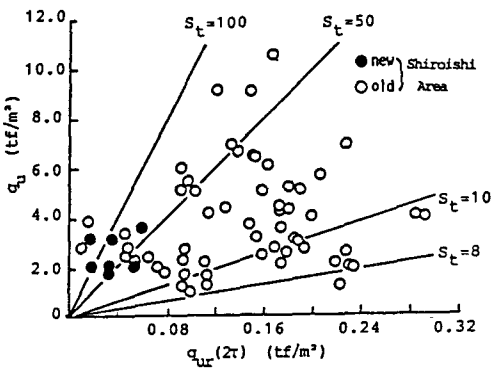

Fig.4 Sensitivity ratio of Ariake clay from laboratory tests

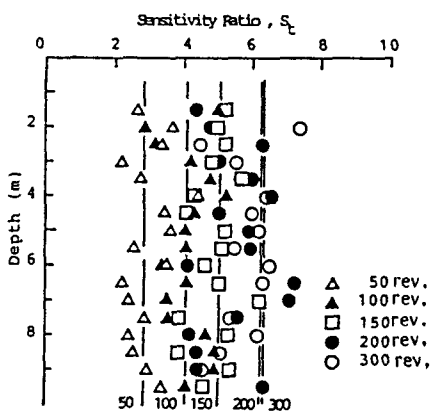

Fig.5 Sensitivity ratio of Ariake clay from field vane test

Sensitivity from the field vane tests is illustrated in Fig. 5 from which it is quite impossible to attain the same degree of sensitivity as measured in the laboratory. The sensitivity increases from about 3 to 7 when the revolution of the vane blade increases from 50 to 300 in order to remold the clay before measuring its remolded strength. From this study, it is clear that at least 200 revolutions are required in order to measure the remolded strength from field vane test in Ariake clay ground. The sensitivities obtained after 200 and 300 revolutions are nearly equal. If one classify the clay based on the field vane result ,it would have been in a different category. In laboratory it is easy to remold the clay, but not in the field where the boundary condition can not be control. In real situation when the instability of clay slope occurs because of load increase, the strength may not drop to that as measured in the laboratory.

5. Conclusions

Results from this study indicate that the field vane strength is little higher than the unconfined compression strength. The difference between them in practical sense is not much. The sensitivity obtained from the field vane is much lower than that from the laboratory.