Performance of Model Pile in Ariake Clay

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Introduction: Following previous study by Ichinose (1989). This study aims to present more data on the behaviour of Ariake clay, in particular, the load bearing capacity of friction pile in it. The properties of the Ariake clay used were as follows: specific gravity, 2.619; natural water content, 133.9%; void ratio, 3.518; liquid limit and plastic limit, 127.5% and 47.2% and Sr, 98.2%.

Method: Four model piles, namely timber pile, smooth concrete pile, rough concrete pile and steel pile, each of 5 cm diameter and 50 cm length, were used. The piles, initially saturated with the surface wiped dry, are referred to as wet piles. For each pile, two test programs were followed.

In the first program, the pile was driven into previously reconstituted Ariake clay at the rate 0.8 mm/sec. Two load cells attached to the pile provided data on the total penetration resistance and the tip resistance. Data of the load and the penetration depth were collected at 10 sec interval. The penetration was stopped when the depth of 32 cm was reached. The set-up is shown in Fig. 1. Also to investigate the effect of surface moisture on the frictional resistance of the piles, the four piles were air-dried and then again driven into the clay.

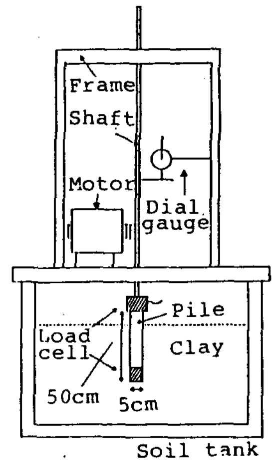

Fig.1 System set up

The second experiment program followed the same procedure as the first except that the pile was stopped for 1 week at the depth of 16 cm before penetration was resumed. At this stage, only total resistance was recorded.

Results and discussion: Results of the 30-cm continuous penetration are shown in Figs. 2 and 3. While there was not much difference between concrete and timber piles, the steel pile yielded lower resistance. The curves of adhesion resistance, Ca, in Fig. 3 reveal little differences in the behaviour of the two coefficients from one pile to another, after a certain penetration depth. In relative term, however, it may be stated that initially, Ca was high in timber and smooth concrete piles and low in rough concrete and steel pile. It is suspected that the contact surface area of rough concrete piles was substantially less than that of smooth concrete. This could have resulted in the low value of Ca.

The gradual decrease in Ca with the increase in penetration depth may be due to disturbance of the surrounding clay by the penetration action. Effects of surface moisture may be studied by comparing the performance of wet materials with those of the dry ones. The latter are shown in Fig. 4 and 5. It is clear that while surface moisture had some influence on the performance of timber piles, it had little effect on others. The swelling of timber due to absorption of water may have contributed to this result. A study by Ichinose (1989) revealed a moisture drawdown effect in the vicinity of the pile, indicating moisture movement from the clay to the pile. This could cause the slight Ca increase, observed at 6 cm depth of the timber pile. Results of the second experiment program are shown in Fig. 6. The stoppage allowed the recovering of clay strength due to thixotropy, and probably caused an apparent increase in the pile's effective diameter resulting in the sharp rise in the penetration resistance at the resumption of penetration. The

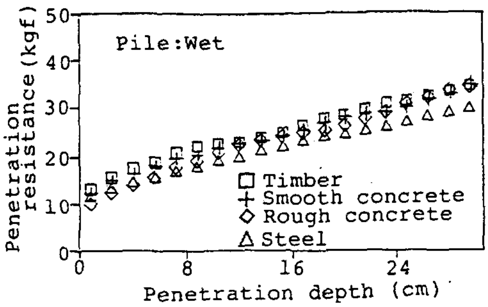

Fig.2 Total resistance

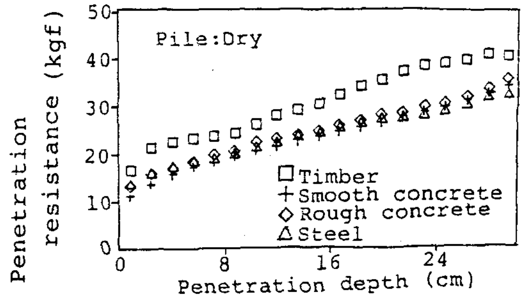

Fig.4 Total resistance

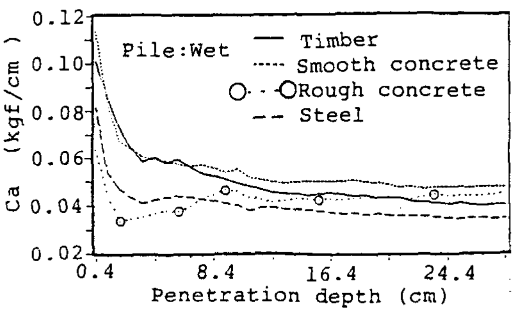

Fig.3 Change of adhesion : Ca

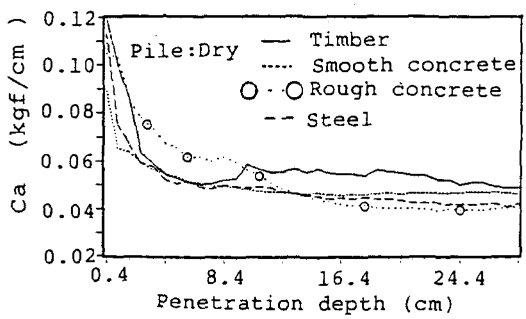

Fig.5 Change of adhesion : Ca

movement of water from the soil to the pile material, reported by Ichinose (1989) might also contribute to this increase. This could explain the sharp drop in the resistance after the resumption in all the materials except steel which did not absorb any water.

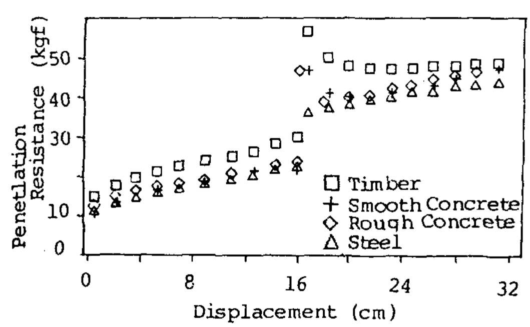

Fig.6 Total resistance

(Elapsed time 1 week)

<u>Conclusion:</u> 1) The penetration resistance of the pile is moderately affected by the material. When wet, timber and concrete piles perform equally well. Steel pile yields slightly lower resistance.

2) Initital value of Ca is high in timber and smooth concrete pile. Steel and rough concrete show lower Ca. After some depth of penetration, the differences become small.

3) Effect of moisture in the pile material is highest in timber's penetration resistance, and very little in others.

4) Stopping the penetration for seven days results in a steep rise in the total resistance of all the piles. This is thought to be due to the effect of moisture movement from soil to the pile materials, causing the thickening of the clay layer around the pile surface and the recovering of clay strength due to thixotropy.

<u>Reference:</u> 1. Ichinose, T., Miura, N., Nanri, T. (1989). Model tests on bearing capacity of friction pile in Ariake clay. JSSMFE. pp.1393-1394.