Experimental study on the flexible group piles under lateral statnamic loading

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1. Introduction

Statnamic load test has been proved as one of the alternate for economical and timesaving test for pile foundation. However, for the lateral load test, the rational interpretation has not been established since few is known about the pile-soil interaction during lateral statnamic loading. Using a small-scale statnamic loading device (Kimura et al., 1998), a series of tests on the group piles are done. By this approach, we can conduct the experiment under similar ground condition for each time of test. In this report, the 'flexible' group piles are used as the model piles.

2. Tests conditions and details

Hollow brass pipes are used as the model piles. The diameter, length, and the thickness of the piles are 24 mm, 122.5 cm and 1 mm, respectively. The bending stiffness is determined from the bending tests. The model ground is made of the No.6 silica sand. It is prepared by vibro-compaction method. Firstly, the model pile is placed in the center of the soil chamber. After the model pile is set up, the sand is filled into the soil chamber, and then, it is compacted evenly throughout the twenty-four locations by injecting a vibration rod into the ground.

The statnamic load tests are performed by a developed device called 3SLD-Mk2, which is shown in Fig.1. In this study, the pressure of 0.5 MPa is used to generate the statnamic load. In order to disregard the interaction through the footing, each pile is loaded under the same displacement with the free head condition. The applied load is measured by load cell. The point of loading is 1 cm higher than the ground surface. The displacement of piles is measured at the pile cap by the laser displacement gauge. This gauge is installed on the additional stand, which is isolated from the soil chamber.

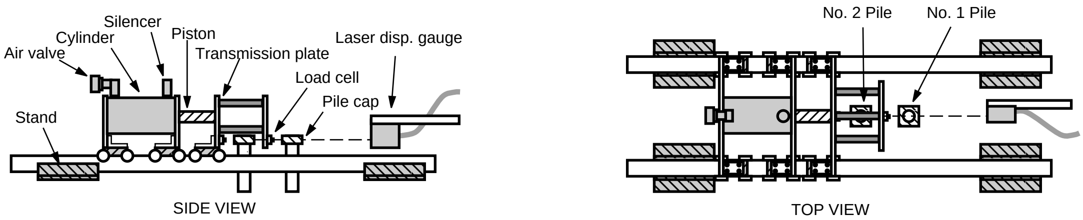

Figure 1 The outline of 3SLD-Mk2.

In this study, the statnamic load is applied on the two-piles group piles. By varying the spacing of piles, three types of tests are performed. The spacing between the center of piles for the pattern TG1, TG2, and TG3 are 2.5, 3.5, and 5.0 times of the piles' diameter, respectively.

After the statnamic load tests are carried out, their estimations are compared with the results from the static load tests. These coresponding static tests are done under the conditions similar to the statnamic tests. Using the mechanical jack, the piles are loaded statically with a speed of 0.6 mm/min.

The relation density of ground is about 60% with the overall density of 1467 kg/m3. The properties of model piles and ground are summaried in Table 1 and Table 2, respectively. For each pattern, the tests are conducted twice in order to ensure that there is no disparity in the records.

Pile, Statnamic load test, Model test, Flexible pile
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Table 1　Properties of model piles.

Thickness (mm)	1.0
Length (cm)	122.5
Weight (g)	591.0
Diameter (mm)	24.0
Young's modulus (MPa)	8.53×10^4
Bending stiffness (Nm^2)	4.09×10^4

Table 2　Properties of sand and model ground.

Specific weight	2.63
Maximum void ratio	1.03
Minimum void ratio	0.64
Moisture ratio (%)	0.3
D_{60} (μm)	310
D_{10} (μm)	120
Density (kg/m^3)	1467
Relative density (%)	59.6
Frictional angle (°)	36

3. Experiment results and interpretations

The load - displacement relations of the TG1 and TG3 are shown in Figure 2. When the comparisons between these cases are made, the pile group effect is noticed especially from the plots of the No.2 piles.

The static load - displacement relations of the tests are, then, estimated by the unloading point method. When only the mass of piles are used, the estimated static behavior of the TG1 and TG3, as shown by Figure 3, are obtained. It can be seen from the plots that the estimated lines are far away from the measured static lines

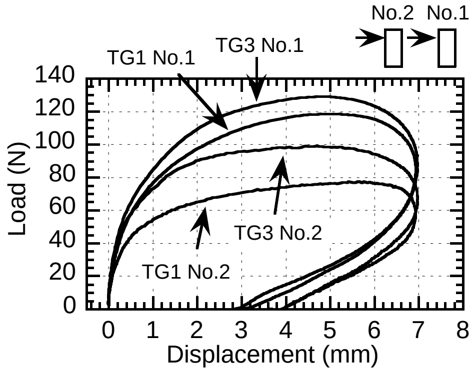
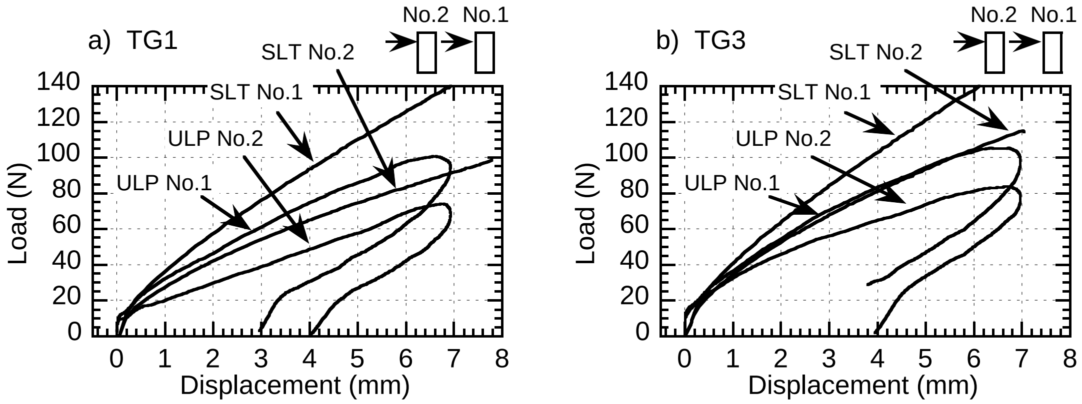


Figure 2　Statnamic load-displacement relations.



*ULP = estimated by the unloading point method
*SLT = measured from the static load tests

Figure 3　Estimated and measured static load-displacement relation.

4. Conclusions

When compared to the short piles (Kimura et al., 1999), the unloading point method for the lateral loading shows the poor prediction. For the flexible piles, the effect of pile bending stiffness becomes an important factor to be considered.

References

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