BEARING CAPACITY OF FOOTING ON REINFORCED GRANULAR BED OVER PILE IN SOFT ARIAKE CLAY

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INTRODUCTION: Soft clays, such as the Ariake clay, have a low bearing capacity and are highly compressible (Guido et al, 1986; Kim and Cho, 1988). Large differential settlements occur at locations of box culverts (Miura et al. 1992). This research work estimates from laboratory model tests, the increase in the bearing capacity and the reduction of settlement of foundation on soft clay with a reinforced granular bed over it and a driven pile in the soft clay directly beneath the footing.

EXPERIMENTAL SET-UP: In all the tests, model footings 80 mm in diameter were used. The inside of the tank (500 mm ϕ x 600 mm) was coated with grease and a plastic sheet placed to reduce the side friction. Reconstituted Ariake clay was prepared in the tank (consolidated to 10 kPa). Both unreinforced and reinforced sands (80 mm thick) were employed. Furthermore, the soft Ariake clay was tested with and without a pile (26 mm ϕ and 300mm long) beneath the footing. The rate of loading was 1 mm/min. The length of the reinforcement used was twice the diameter of the footing. One week was allowed after the pile was driven to let the pore pressures dissipate.

The properties of the Ariake clay are Wn=93.7%, Wl=95.0%, Wp=37.9%, Ip=57.1%, Cu=3.3 kPa. The parameters for sand are Dr=54%, Unit weight =1.54 g/cc, friction angle = 37-40 degrees. The reinforcement used had a mesh size of 28 mm x 33 mm. Pullout resistances along the length and the width are 3500 and 4500 kgf/m, respectively.

TESTS RESULTS: Various tests were performed to investigate reinforcement of sand and pile effects on the bearing capacity of a footing on the surface (Fig. 1). Figure 2 illustrates the load versus settlement

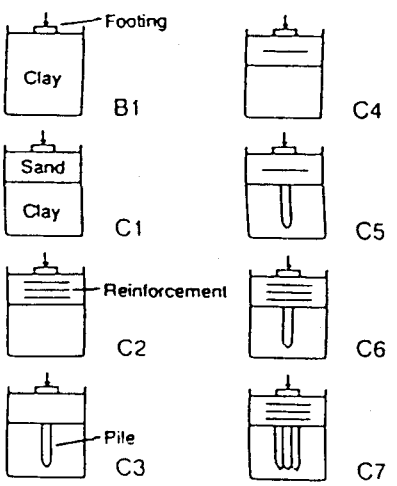

Fig .1. Tests performed.

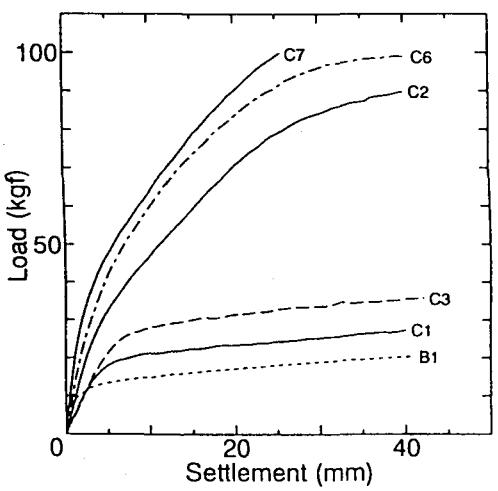

Fig .2. Load-settlement curves.

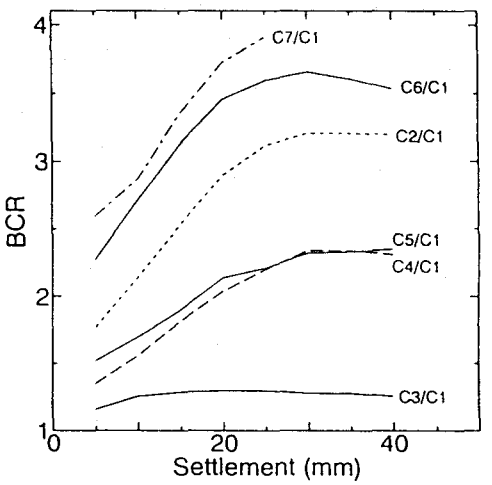

Fig. 3. BCR-settlement curves.

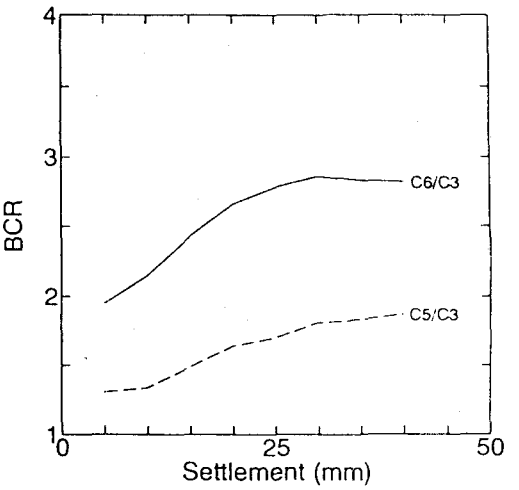

Fig .4. BCR-settlement curves for one or three layers of reinforcement.

curves. The maximum loads on the footing for (i) soft clay alone (B1), (ii) unreinforced (C1) and (iii) reinforced (C2) sand on clay, (iv) unreinforced sand on clay with a floating pile (C3), (v) reinforced sand on clay with one (C6) and three (C7) piles , are respectively. 20, 28, 90, 35, 100, and 125 kgf. The improvement in bearing capacity is significant in case of a reinforced granular layer on floating piles in soft clay. The initial part of the load - settlement curve is steeper indicating smaller settlements at working loads.

The effect of a pile (C3/C1) is to increase BCR (defined as the ratio of loads at a given settlement) to about 1.2 to 1.3, while the effect of reinforcing the granular layer (C4/C1) is to increase BCR to 1.4 to 2.3 (Fig. 3). The combined effect of reinforcing the granular layer and a pile (C5/C1) is to increase BCR to 1.5 to 2.4. The effect of three layers of reinforcement without (C2/C1) and with one (C6/C1) and three (C7/C1) piles is to increase BCR to 1.8 to 3.2, 2.3 to 3.7, and 2.6 to 3.9, respectively. The BCR increases up to a settlement of 30 mm and remains constant for larger settlements. Fig. 4 shows the BCR (defined as the ratio of loads with and without reinforcement) in the cases with one (C5/C3) or three layers (C6/C3) of reinforcement of sand and with one pile. The effect of one (C5/C3) and three (C6/C3) layers of reinforcement of sand on clay with pile is to increase BCR to 1.3 to 1.9, and to 2.0 to 2.9 respectively.

CONCLUSION: Reinforcing a granular layer with geogrid improves the bearing capacity of soft clay in which a pile is driven, by about 200%.

REFERENCES:Guido. V. A et al. Comparison of geogrid and geotextile reinforced earth slabs. CAN. G. J. Vol. 23, 1986, pp. 435-440.
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