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REINFORCED GRANULAR BED OVER CLAY

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ABSTRACT: Experimental investigations were carried out in the laboratory to study the improvement in bearing capacity of soft Ariake clay by providing a reinforced granular bed over it. The efficiency of a piled raft was also studied and compared to that of a reinforced granular bed overlying pile in clay. The model tests indicated that the reinforcement effect is predominant in improving the bearing capacity. The reinforcements increase the stiffness of the upper granular layer and help to distribute the load from the footing onto the underlying clay layer over a larger area.

MATERIAL PROPERTIES & LABORATORY MODEL TESTS

A series of constant strain loading tests were conducted with model footing (80 mm dia. rigid steel plate) in a soil tank measuring 500 mm dia. and 600 mm. height. The inside of the soil tank was coated with grease, and a plastic sheet was provided to reduce the effects of side wall friction. Remoulded Ariake clay, consolidated to 10 kPa, was prepared in the soil tank. The rate of loading was 1 mm/min. The moisture content varied from about 90% at surface to about 100% at a depth of 400 mm, while the unconfined compressive strength of the clay varied from about 4.6 kPa at surface to about 3 kPa at a depth of 400 mm. These variations were found to be more or less linear with depth in the soil tank. The granular material used was a well graded sand (D_r = 50%) with angular particles having an internal friction angle of 39° and dry unit weight of 15.4 kN/m³. The reinforcement used was a polymer geogrid with mesh size of 28 mm x 33 mm having L/B ratio of 2, where L is length of the reinforcement and B is the diameter of the footing. Model piles, 300 mm long and 26 mm dia., apex angle of 60° (conical tip), were made of PVC and had their surfaces roughened. Figure 1 shows the various tests performed in this study. Figures 2 and 3 show the load-settlement curves obtained from these tests.

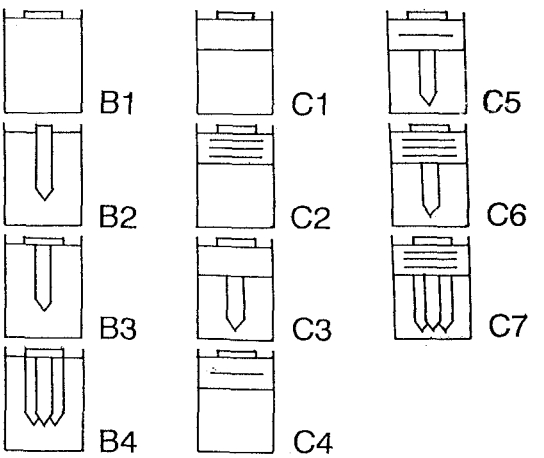

Fig. 1 Tests performed

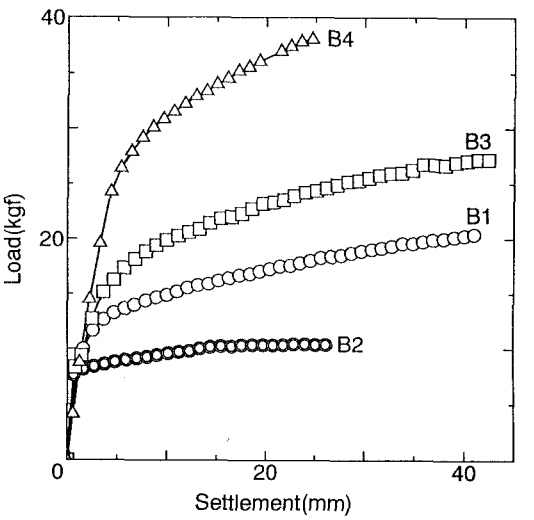

Fig. 2 Load-settlement curves

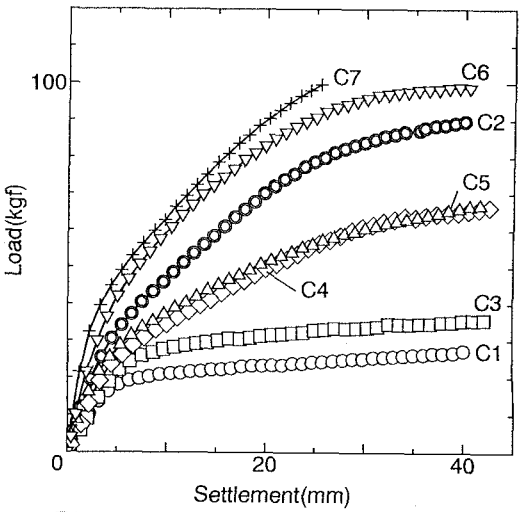

Fig. 3 Load-settlement curves

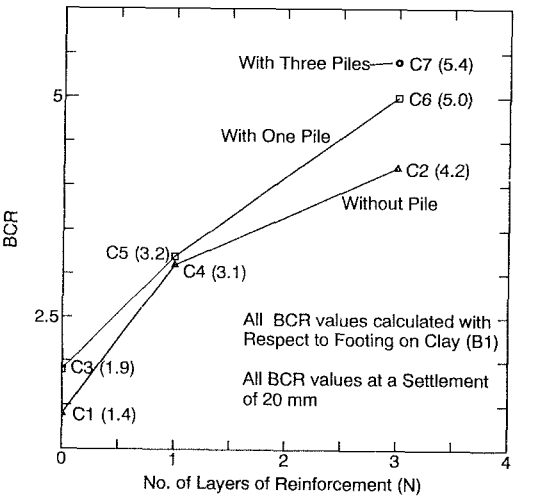

Fig. 4 Reinforcement effect

EFFICIENCY OF PILED RAFT & REINFORCED GRANULAR BED OVER CLAY

The efficiencies of piled raft with a single pile defined as [B3/(B1+B2)], and with three piles defined as [B4/(B1+3B2)], were found to be 0.84 and 0.81, respectively. The efficiency of a granular bed over pile in clay defined as [C3/(C1+B2)] was found to be 0.94. The efficiencies of reinforced granular bed, with one and three layers of reinforcement, over pile in clay defined as [C5/(C4+B2)] and [C6/(C2+B2)] were found to be 0.87 and 1.02, respectively. The efficiency of a reinforced granular bed with three layers of reinforcement overlying three piles in clay, defined as [C7/(C2+3B2)] was found to be 0.89.

BEARING CAPACITY RATIOS

Figure 4 shows the increase in bearing capacity ratios (BCR) due to the increase in the number of layers of reinforcement (N) in the granular bed for the cases of no pile, with a single pile and with three piles, in clay.

EMPIRICAL PREDICTION OF BCR OF REINFORCED GRANULAR BED OVER CLAY

From the results of tests B1, C1, C2 and C4, the BCR could be fitted as a function of (H/B), N and (L/B) as:

$$BCR = 1 + a(H/B) + b\sqrt{N}\,(L/B) \qquad (1)$$

where H is the thickness of the granular bed. For the test and soil conditions in this study, the value of a and b were found to be 0.16 and 0.25, respectively. Earlier studies have indicated that for optimum results the values of H/B and u/B should be less than or equal to 1, z/B should be less than or equal to 0.25, L/B = 2 to 3 in the case of geogrid reinforcements, where u is the depth to the topmost layer of reinforcement and z is the vertical spacing (eg: Guido et al., 1986).

CONCLUSIONS

Reinforced granular bed over pile in clay behaves similar to a piled raft in clay. Reinforced granular bed over clay improves the bearing capacity of clay significantly.

REFERENCES

Guido, V. A., Chang, D. K. and Sweeney, M. A. (1986). Comparison of geogrid and geotextile reinforced earth slabs, Can. Geotech. J. 23, 435-440.

Umezaki, K., Shivashankar, R., Madhav, M. R. and Miura, N. (1993). Bearing capacity of footing on reinforced granular bed over pile in soft Ariake clay. Paper III-2, JSCE (Kyushu chapter) conference, Kagoshima.