ABSTRACT

Due to rapid rise in land prices and scarcity of suitable sites, construction on unsuitable or less suitable sites having extremely poor ground conditions has become necessary. Such ground conditions pose serious problems of large ground settlement and instability of structures and hence it becomes mandatory to improve the soft ground. Among available ground improvement techniques, soil-cement column technique is, perhaps, the most important method to treat soft soils in an effective way. Presently, there are very few experimental studies available on the behavior of soft soil improved with floating soil-cement columns. Previous studies are still inconclusive on the behavior and failure mechanism of floating soil-cement columns under different group foundation parameters, such as area ratio, amount of binder content, water-cement ratio, and length and diameter of columns. No study is presently available on comparison of end-bearing and floating columns behavior over a range of group parameters.

In this study, undrained strain controlled load tests are performed on soft clay bed improved by a group of soil-cement columns under plane strain and axisymmetric conditions and the effect of various group foundation parameters, such as area ratio, length and diameter of columns, and binder content are evaluated. Model tests are also performed on slurry deposited clay ground improved with single soil-cement column and failure pattern of the soil-cement column is examined after the test by exhumation technique. Pore pressure response of the model ground subjected to undrained loading is also studied. Three-

dimensional elasto-plastic finite element analyses are also performed to validate the model test results and failure modes.

The results show that the stiffness and ultimate failure stress of the ground increase in the following order- soft soil bed, floating column foundation and end-bearing column foundation. Smaller diameter columns are more efficient in load transfer compared to larger diameter columns for the same area ratio. In case of group of end-bearing columns under axisymmetric condition, area ratio has a significant effect on failure pattern. At an area ratio of 25%, the column failed by outward displacement and bending. On the other hand, at an area ratio of 32%, the columns failed due to bending at a distance of approximately one-half to two-third of the column length from the base of the footing. In plane strain configuration, for end-bearing columns, the exhumed shape showed that outer columns moved outward and central columns failed in bending and shearing. In the case of floating columns, block failure was observed with slight outward displacement and some horizontal cracks. When the applied load approaches the failure load, the column begins to crumble and a higher proportion of the applied load begins to transfer to clay, thereby giving rise to sharp increase in pore water pressures in clay near failure. After failure, the applied load decreases and consequently, stresses as well as pore water pressures in clay decrease.