ABSTRACT

Ground improvement using coir is ideally suited for the state of Kerala, India because of the abundant availability of coir at practically no cost and also due to its environment friendly nature. The studies on the use of coir – both fibres and geotextiles – in ground improvement started in the early 1990’s. Field experiments have established the efficiency of coir geotextiles in soil erosion control, slope stabilization and soil conservation. Coir geotextiles are suitable for applications where they are meant to serve only in the initial stage and final strength is attained by vegetative or soil consolidation. Though coir geotextiles have been used for limited projects, no studies have so far been done on understanding the effectiveness of certain types of coir geotextiles on stabilization of foundation soils. In the present investigation, the beneficial effect of one variety of woven coir geotextile and two varieties of hand knotted coir netting on the pressure versus settlement behaviour of a model square footing on loose sand is studied in detail through plate load tests. A series of conditions were considered by varying parameters such as length of coir geotextile/netting, its depth of embedment, number of layers and vertical spacing between layers. Preliminary test results indicate that woven coir geotextile as well as hand knotted coir netting can be expected to be at least equally effective as many of the synthetic reinforcing materials used previously. About three-fold increase in strength obtained with even with a single layer of woven coir geotextile and more than two-fold increase in strength obtained with hand knotted coir netting indicate that bearing capacity sufficient enough to eliminate the need of a deep foundation is achievable by these forms of reinforcement. Optimum depth of placement below the base of footing, of a single layer
of woven coir geotextile reinforcement lies in the range 0.33B-0.5B and for the hand knotted coir nettings, the range is 0.25B-0.4B. Optimum value of geotextile length is obtained as about two times the width of the footing for woven coir geotextile while it is three in the case of hand knotted coir netting. The degree of improvement obtained with length ratio of 1.2 is also significant. Multi-layer coir geotextile reinforced soil system is most effective when the subsoil upto a depth of 0.4B-0.8B is reinforced with three to four layers of coir geotextile. As far as hand knotted coir netting is concerned, optimum beneficial effect is obtained by reinforcing the zone of soil up to a depth of about 0.4B-0.6B beneath the footing with three layers. Comparison of the results obtained with those reported in the literature indicates that reinforced soil behaviour and the resulting strength improvement are unique for each reinforcement type and configuration. Predictive equations for strength improvement of footings on woven coir geotextile/hand knotted coir netting reinforced sand are also presented.

Several studies are reported in the literature which address the effectiveness of randomly oriented coir fibres in soil improvement. The stabilization of natural subsoil through inclusion of discrete, randomly oriented fibers may be difficult, if not impossible, particularly when the vertical extent of soil to be improved is large. Inclusion of fibers through provision of a columnar reinforcement may be an effective alternative in such a situation. All the previous studies have examined the effectiveness of coir fibers either through triaxial shear tests or one-dimensional consolidation tests. Plate load testing which simulates static loading in a field situation has not so far been used to investigate the response of coir fiber reinforced soft clays. This investigation also focuses on whether soft clay soils can be effectively stabilized through installation of sand-coir fiber composite columns. Plate load testing of very soft clays (water
content nearer to the liquid limit water content) strengthened by columnar reinforcement of sand-coir fiber mixture, with a program including single and multiple columns and with different values of relative column area (defined as the ratio of the total cross-sectional area of the columns within the plan area of the test plate to the cross-sectional area of the test plate) has been carried out. The provision of four identical sand-coir fibre columns just inside the corners of the loaded area is found to be the optimum configuration as far as ground improvement is concerned. The investigation also discusses the possibility of expressing the degree of improvement as a unique function of relative column area and normalised column depth.

In order to use coir as a permanent construction material, it is necessary to ensure that it lasts for a period of useful life in the environment in which it is exposed in the soil. No information is available at present on the rate of degradation of coir geotextile/netting under different environment. The present investigation examines the durability of coir geotextiles/nettings to a limited extent. The behaviour of woven coir geotextile and hand knotted coir nettings subjected to alternate cycles of wetting and drying as well as complete wetting conditions has been analysed. The study indicates that coir geotextiles and nettings degrade at a faster rate when subjected to alternate wetting and drying, while the rate of degradation of woven coir geotextile is only marginal when permanently submerged under water. Increasing demand for environment friendly engineering solutions coupled with abundant availability of coir at practically no cost are expected to make coir geotextiles/nettings a preferred choice of ground improvement in future with advancement in the durability enhancement studies on coir.