ABSTRACT

KEY WORDS: Bearing capacity, California Bearing Ratio, coir fibre, coir geotextile, embankment, ground improvement, interface friction, soil-fibre composite, unpaved roads, vertical drains.

The increasing tempo of construction activity the world over creates heavy pressure on existing land space. The quest for new and competent site often points to the needs for improving existing sites, which are otherwise deemed unsuitable for adopting conventional foundations. This is accomplished by ground improvement methods, which are employed to improve the quality of soil incompetent in their natural state. Among the construction activities, a well-connected road network is one of the basic infrastructure requirements, which play a vital role for the fast and comfortable movement of inter-regional traffic in countries like India.

One of the innovative ground improvement techniques practised all over the world is the use of geosynthetics, which include geotextiles, geomembranes, geogrids, etc. They offer the advantages such as space saving, environmental sensitivity, material availability, technical superiority, higher cost savings, less construction time, etc. Because of its fundamental properties, such as tensile strength, filtering and water permeability, a geotextile inserted between the base material and subgrade can function as reinforcement, a filter medium, a separation layer and as a drainage medium. Though polymeric geotextiles are used in abundant quantities, the use of natural geotextiles (like coir, jute, etc.) has yet to get momentum. This is primarily due to the lack of research work on natural geotextiles for ground improvement, particularly in the areas of unpaved roads. Coir geotextiles are best suited for low cost applications because of its availability at low prices compared to its synthetic counterparts. The proper utilisation of coir geotextiles in various applications
demands large quantities of the product, which in turn can create a boom in the coir industry. The present study aims at exploring the possibilities of utilising coir geotextiles for unpaved roads and embankments.

The properties of coir geotextiles used have been evaluated. The properties studied include mass per unit area, puncture resistance, tensile strength, secant modulus, etc. The interfacial friction between soils and three types of coir geotextiles used was also evaluated. It was found that though the parameters evaluated for coir geotextiles have low values compared to polymeric geotextiles, the former are sufficient for use in unpaved roads and embankments. The frictional characteristics of coir geotextile - soil interfaces are extremely good and satisfy the condition set by the International Geosynthetic Society for varied applications.

The performance of coir geotextiles reinforced subgrade was studied by conducting California Bearing Ratio (CBR) tests. Studies were made with coir geotextiles placed at different levels and also in multiple layers. The results have shown that the coir geotextile enhances the subgrade strength. A regression analysis was performed and a mathematical model was developed to predict the CBR of the coir geotextile reinforced subgrade soil as a function of the soil properties, coir geotextile properties, and placement depth of reinforcement.

The effects of coir geotextiles on bearing capacity were studied by performing plate load tests in a test tank. This helped to understand the functioning of geotextile as reinforcement in unpaved roads and embankments. The performance of different types of coir geotextiles with respect to the placement depth in dry and saturated conditions was studied. The results revealed that the bearing capacity of coir-
reinforced soil is increasing irrespective of the type of coir geotextiles and saturation condition.

The rut behaviour of unreinforced and coir reinforced unpaved road sections were compared by conducting model static load tests in a test tank and also under repetitive loads in a wheel track test facility. The results showed that coir geotextiles could fulfill the functions as reinforcement and as a separator, both under static and repetitive loads. The rut depth was very much reduced while placing coir geotextiles in between subgrade and sub base.

In order to study the use of coir geotextiles in improving the settlement characteristics, two types of prefabricated coir geotextile vertical drains were developed and their time-settlement behaviour were studied. Three different dispositions were tried. It was found that the coir geotextile drains were very effective in reducing consolidation time due to radial drainage. The circular drains in triangular disposition gave maximum beneficial effect.

In long run, the degradation of coir geotextile is expected, which results in a soil-fibre matrix. Hence, studies pertaining to strength and compressibility characteristics of soil-coir fibre composites were conducted. Experiments were done using coir fibres having different aspect ratios and in different proportions. The results revealed that the strength of the soil was increased by 150% to 200% when mixed with 2% of fibre having approximately 12mm length, at all compaction conditions. Also, the coefficient of consolidation increased and compression index decreased with the addition of coir fibre.

Typical design charts were prepared for the design of coir geotextile reinforced unpaved roads. Some illustrative examples are also given. The results demonstrated
that a considerable saving in subbase / base thickness can be achieved with the use of coir geotextiles, which in turn, would save large quantities of natural aggregates.