CHAPTER-1

INTRODUCTION

1.1 GENERAL

Foundations that need to transfer load from superstructure over poor sub-soil conditions need special attention by structural engineers. Reinforced soil under the foundations has been widely used in various civil engineering applications, such as bridge approach slab, bridge abutment, building footings, and embankment. Past investigations have shown that the inclusion of reinforcement in soil for increasing its load carrying capacity is a cost-effective solution as it also assists in reducing the settlement of shallow footings compared to the conventional methods of soil stabilization.

The most common type of reinforcement used in soil foundation applications are grids/mats as shown in Figure 1.1. The technique of soil reinforcing is a proven alternative to the conventional ground improvement technique under appropriate conditions to increase the bearing capacity of soil. Extensive research carried out using a wide variety of synthetic material and products have resulted in the use of these synthetic materials. They have a long life, but are costly and may create environmental problems in the future.

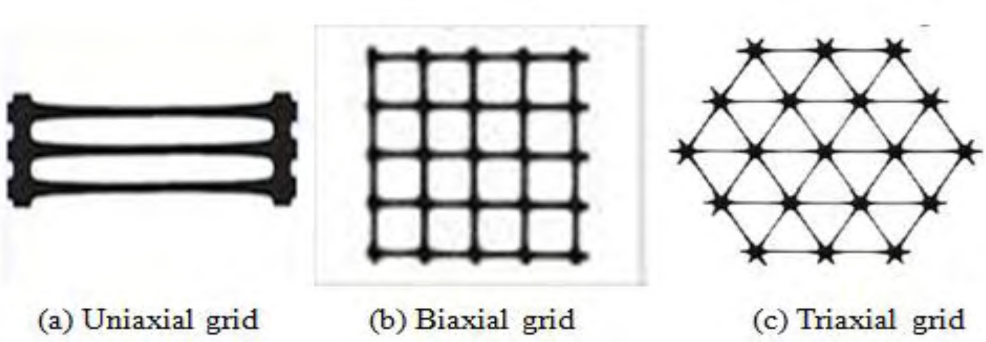

Fig 1.1 Grids/Mats Used

Randomly distributed fibers reinforced soil (RDFS) is one of the latest ground improvement techniques wherein the fibers of desired quantity and type are randomly mixed and added in to the soil and laid in position after compaction, a method similar to conventional stabilization techniques. RDFS is different from other soil-reinforcing methods in its orientation. Unlike reinforced earth, in RDFS fibers are mixed randomly in soil thus making a homogenous mass and maintain the isotropy of the soil mass. Hence, the mechanism of interaction of fibers in soil differs from reinforced earth. The use of RDFS as a soil strengthening material is gaining increasing attention of researchers world wide as it is relatively easier to mix and place below the foundation before the construction of structures. Many synthetic fibers have been tried with encouraging results with regard to its performance. However, the potential of natural materials for use as soil reinforcing elements is worth examining. Amongst the naturally occurring materials, coir is a cheap and abundant waste material in India, Degradation of coir is very much slower when compared to other naturally occurring materials. Also it has acceptable strength properties and it does not pose much environmental problems on its long run.

1.2 PRINCIPLES OF REINFORCED EARTH

Soil mass is generally a discrete system of soil grains and cannot bear tensile stresses. Reinforced earth is a combination of soil and reinforcement suitably placed to bear the tensile stresses developed and also to improve the resistance of soil in the direction of greatest stress. The presence of reinforcement alters the stress field giving a restraint mostly in the form of friction or adhesion so that less strain is induced and tension is avoided. Inclusions like discrete & short fibers placed random or in definite layers will also impart additional resistance by way of cohesion and friction. The mechanism of reinforced earth can be best explained by equivalent confining stress concept as described below.

1.2.1 Equivalent Confining Stress Concept

Failure stresses on unreinforced and reinforced soils is shown in Fig. 1.2. The increase in the deviatoric stress is seen to be $\Delta\sigma_3$ times k_p(coefficient of passive earth pressure equal to $\tan^2(45°+\varphi/2)$) and $\Delta\sigma_3$ is the equivalent confining stress on the sand imposed by the reinforcement.

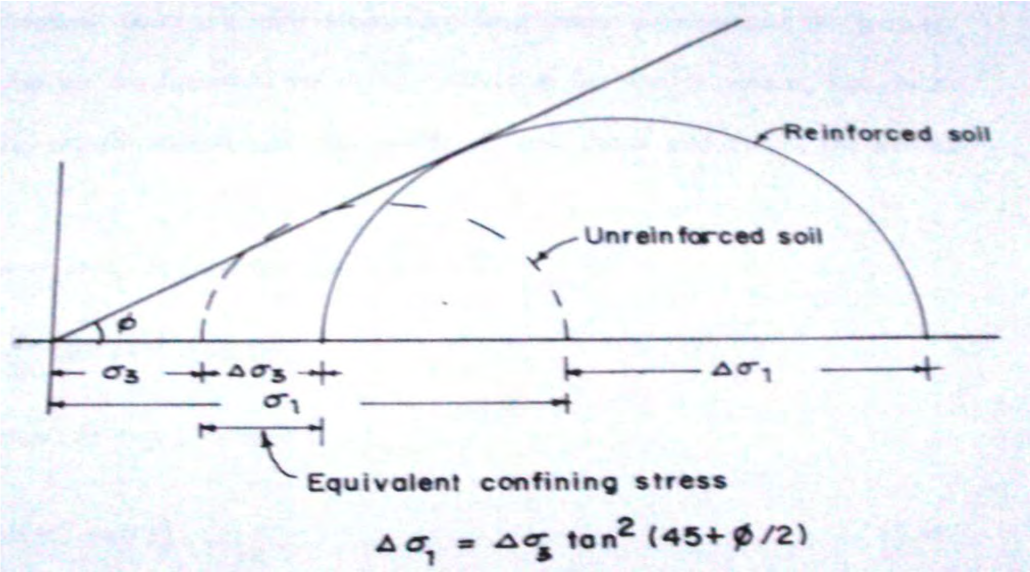

Fig 1.2 Equivalent Confining Stress Concept

Hence placing of reinforcement in the form of grids/mats at specified locations within the soil introduces additional confining stress because of which the stress field is altered and the Mohr's circle shifts rightward making the reinforced soil mass to be more stable.

However, fiber form of reinforcement in soils have a different mechanism in which the stress field is altered due to "bending" and "interleaving" mechanism as shown in Fig. 1.3. In bending mechanism, the fiber in the distribution of the soil is composed of numerous curved transitions. When the soil withstood external force, the fiber is in tension, the pressure and friction of soil particles are produced by the earlier concave side of curved fiber, (Figure 1.3(a)) .In interleaving mechanism, there are numerous interwoven fibers points due to random distribution fibers in the soil. When the fibers are forced at the intersection, the interleaved fibers prevent such displacement, hence any deformation of the fiber will affect the fibers which were interwoven in all directions and form the force area (Figure1.3 (b)).

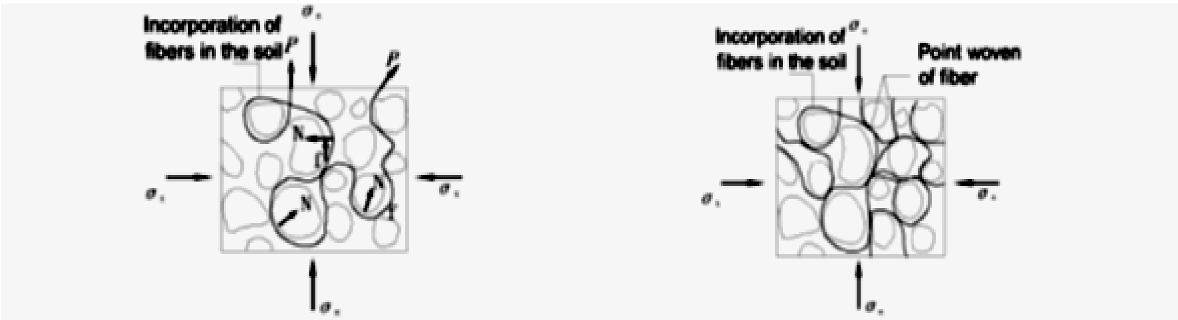

Figure 1.3(a) **Figure 1.3 (b)**

Fig 1.3 Mechanism of RDF in soil.

Thus Randomly Distributed Fiber-reinforced Sand (RDFS) can be considered as soil under the action of friction and cohesion and forms a spatial network structure. Tensile stress was borne and the displacement and deformation were constrained by the fibers when deformation occurred in the soil. Several studies by various investigators have assessed independently the behavior foundations under both mat form and fiber form of reinforcement subjected to static and cyclic loading. Both the different types of reinforcement have indicated that strength and stiffness of reinforced soil increases with the introduction of reinforcement. However, not many literatures are available to assess the comparative performance of two different forms of reinforcement especially under **dynamic loading**. There are several situations wherein live loads in a structure may be greater than dead load of the structure itself. Further this LL is found to change with time, thereby subjecting the underlying soil to the repeated or cyclic loads. In such situations, performance of foundations depends on frequency and amplitude of the cyclic loading. As the *reinforcement-soil interaction mechanism* in both the cases are different, the need to address the comparative performance assumes greater significance in the design of many civil engineering structures subjected to cyclic loads. In this context, an experimental study to assess the comparative performance of both the forms of reinforcement under model footing subjected to cyclic loading were intended to be performed.

1.3 Organization of thesis

The thesis report is organized into SIX chapters. **Chapter 1** presents a brief **introduction** with regard to the topic in general. **Chapter 2** reviews **previous literatures** carried out by various investigators in the related field. **Chapter 3** presents **objective and scope** of the present study. **Chapter 4** presents **materials and methods** of the experimental study. **Chapter 5** presents the **results and discussion**s of the experimental study. **Chapter 6** provides brief **conclusions** on the basis of results on present experimental study.