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# A STUDY OF SOIL RESPONSE USING POLYPROPYLENE AS REINFORCEMENT

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## ABSTRACT

*Fibre reinforcement in recent time has more or less established itself as an important civil engineering material having significant effect in improving the characteristics such as static strength characteristics of granular soil such as sand. This study is done to know the effect of randomly distributed polypropylene fibre reinforcement in modifying the characteristics of sand. Fibre reinforced soil is one of the modern techniques in which the different fibres of desired type and quantity are mixed with the soil uniformly in random direction and then laid in position. Now a days it is one of the most popular techniques used to improve the soil that is poor in strength. The soil reinforcement causes a significant improvement in tensile strength, bearing capacity, shear strength as well as economy. In this study we involve possible use of polypropylene fibre for soil stabilization. To investigate the strength characteristics of fibre-reinforced soil the compaction and unconfined compression tests are conducted on soil sample. Tests will be conducted on both stabilized and non-stabilized soil by addition of waste fibre material by weight of the dry soil sample.*

***KEYWORD-*** *Direct shear strength, Fibres of waste plastic, Polypropylene, Reinforcement, Soil stabilisation*

## 1. INTRODUCTION

Soil is highly Complex, Heterogeneous and Unpredictable material which has been subjected to vagaries of nature, without any control. The properties of soil change not only from one place to other but also at the place with depth and with a change in the environmental, loading and type, drainage and the conditions under which it exists. In comparison to other construction materials such as concrete or steel, it is not economically feasible to transport the soils from one place to other, because a huge quantity of soil is involved and it is not opened to inspect at greater depth for foundations of different structures .Sometimes, civil Engineers are forced to construct structure at site selected for reasons other than soil conditions. Thus, it is increasingly important for the engineer to know the degree to which the engineering properties of the soil may improve or other alternatives that can be thought off for the construction of intended structure at the stipulated site. If unsuitable soil conditions are encountered at the site of a proposed structure, unsuitable soil can be bypassed by means of deep foundation extended to a suitable bearing material, poor material can be removed and replaced by a suitable material, or soil in-place can be treated by using any suitable ground improvement methods (soil stabilization) to improve its engineering properties such as Shear Strength, Compaction, permeability etc. In this project experimental work has been done to determine the effect of waste plastic fibre as an admixture in soil to enhance the property of soil. This work is focused on the review of performance of plastic fiber as a soil stabilization material.

### 1.1 Advantages of fiber-reinforced soil

Randomly distributed fiber-reinforced soil have many advantages to be considered such as Increase in shear strength with maintenance of strength isotropy, Beneficial for all type of soils (i.e. sand, silt and clay),Reduced Post peak strength loss, Increased ductility, Increased seismic performance, No catastrophic failure, Great capacity to use natural or waste material such as coir fibers and recycled waste plastic strips, Provide erosion control and facilitate vegetation development ,Reduce shrinkage and swell pressures of expansive soil, No noticeable change in permeability, Unlike lime, cement, and other chemical stabilization methods, the construction using fiber-reinforcement is not greatly affected by weather conditions, Fiber-reinforcement has been helpful in discarding the shallow failure on the slope face and thus reducing the cost of maintenance. The strength and properties of randomly distributed fiber-reinforced soil was affected by the factors such as type of soil , type of Fiber: monofilament or fibrillated ,fiber content: expressed in % with respect to weight of soil, density of fiber ,fiber length ,aspect ratio and fiber-soil surface friction. Among the synthetic fibers, poly-propylene fiber (PP) is one of the most popular fibers used in soil reinforcement due to high tensile strength and resistance to biodegradation. Unconfined compressive strength (UCS) is a quick and reliable mechanical parameter that is used to judge the representative strength of soil for the initial design and analysis of various geo- technical infrastructures [UCS of reinforced soil is known to be influenced by fiber content, fiber type as well as soil parameters such as soil moisture content and soil density

## 2. INVESTIGATION and LITERATURE REVIEW

The conception of soil reinforcement was first developed by vidal (1969). He established that the introduction of reinforcement elements in a soil mass increases the shear resistance of the soil matrix. The main purpose of reinforcing soil mass is to improve its stability, increase its bearing capacity and reduce settlements and lateral deformation (Housman- 1990, Prabhakar & Sridhar- 2002). the investigations point towards the strength properties of fiber reinforced soils are the function of fiber content, fiber – surface friction along the soil mass and fiber strength characterizes. (hoare- 1979, gray and ohashi- 1983,maher- 1988, Ranjan et al.- 1996, nataraj & mcmanis-1997,kaniraj & havanagi- 2001,yetimoglu & salbas-2003, Praveen Kumar & swami - 2008, ameta-2009). mcgown, andrews & hytiris(1985) drained triaxial test and model footing tests were done. result showed that mesh increased the deviator stress developed at all strains, even at very small strains and the peak stresses in the sand-mesh mixture occurred at slightly higher axial strains than for the sand alone.

geotechnical engineers often encounters problems in designing foundations of structures on highly compressible clayey soil due to its poor bearing capacity, low shearing strength, etc. soil reinforcement is an effective and reliable technique for improving strength and stability of soils. Maheshwari, k.v. desai, a.k. solanki, c.h. investigated the influence of randomly distributed fibers on highly compressible clayey soil, series of laboratory model footing tests were conducted. The dosages of polyester fibers having 12 mm in size were taken as 0.25%, 0.50% and 1.00%. the results of load settlement curve of different sizes of square footing on unreinforced soil and soil reinforced with various amount and depths of fiber reinforced soil were recorded. The bearing capacity is also calculated in term of bearing capacity ratio. The results indicate that reinforcement of highly compressible clayey soil with randomly distributed fibers caused an increase in the ultimate bearing capacity and decrease in settlement at the ultimate load.

a series of triaxial compression tests were carried out by Gopal Ranjan,l r. m. Vasan and h. d. Charan on cohesionless soils reinforced with discrete, randomly distributed fibers, both synthetic and natural, to study the influence of fiber characteristics (i.e., weight fraction, aspect ratio, and surface friction) soil characteristics and its density, and confining stress on shear strength of reinforced soils. a regression analysis of test results has been carried out to develop a mathematical model to bring out the effect of these factors on the shear strength of reinforced soil. The model estimates the strength of soils reinforced with any type of fiber and under given stress environment. The model predictions agree reasonably well with the experiment results and the results published in the literature. The test results show that the failure envelopes of soil-fiber composites have a curvilinear failure envelope, with a transition occurring at a certain confining stress, termed as "critical confining stress," below which the fibers tend to slip. The amount of the critical confining stress is affected by the fiber aspect ratio. Fiber inclusion increases significantly the shear strength of soil. The increase in strength is task of fiber weight fraction, aspect ratio and soil grain size.

Pramod s. Patil (jun-2014), “innovative techniques of waste plastic used in concrete mixture. “

Disposal of plastic waste in an environment is considered to be a big problem due to its very low biodegradability and presence in large quantities, in recent time use of such, industrial wastes from polypropylene (pp) and polyethylene terephthalate (pet) were studied as alternative replacements of a part of the conventional aggregates of concrete. plastic recycling was taking position on a significant scale in an India, as much as 60 % of both industrial and urban plastic waste is recycled which obtained from diverse authors, masses in India have released plastic wastes on a large scale have huge economic value, as a result of this, recycling of waste plastics plays a major function in providing employment.

Rabindra Kumaret al.; (2012), “plate load rest on fiber-rein forced cohesive soils. “

This report discusses the load settlement response from three plate load tests (0.3m × 0.3m square 25 millimeter deep) carried out on a thick homogeneous stratum of compacted cohesive soil, reinforced with randomly distributed polypropylene fibers and coir fibers, as well as on the same soil without the reinforcement. the plate load test on the soil-fiber layer was performed to relatively high pressures, and yielded a noticeable stiffer response than that carried out on the unreinforced stratum. it is concluded from plate load tests that the settlement under a particular load in unreinforced soil is much more compared to the reinforced soil, minimum settlement being observed for the soil reinforced with polypropylene coir fibers. the ultimate load for the unreinforced soil is found to be 42KN and the values for soil reinforced with coir fibers and polypropylene fibers are 70 KN and 80 KN respectively. Thus, the ultimate load of the soil reinforced with 0.8% fibers and 0.5% polypropylene fibers increases by 67% and 90% respectively as compared to unreinforced soil. fiber reinforced soil is capable of absorbing more strain energy prior to failure. thus, soil-fiber matrix may be used as an improved material in the field of geotechnical engineering.

## CONCLUSION

The inclusion of fibers causes an increase in peak shear strength and reduction in the loss of post-peak stress. Thus, residual strength of fiber-reinforced soil is higher as compared to unreinforced soil. Shear strength increases roughly linearly with increase in amount of fiber, then approaches an asymptotic upper limit governed essentially by confining stress and fiber aspect ratio. Direct shear tests, unconfined compression tests and conventional triaxial compression tests have confirmed that shear strength is increased and post-peak strength loss is reduced when discrete fibers are mixed with the soil. In other words, discrete, randomly distributed fiber inclusions appreciably increase the peak shear strength, lessen the post peak strength loss, increases the axial strain to failure and in some cases change the stress–strain behavior from strain softening to strain hardening. Fiber inclusions also hinder the compaction process, causing a reduction in the maximum dry density of reinforced specimens with increasing fiber content. The strength losses associated with in-service saturation are significantly reduced with fiber reinforcement. Altogether, it is necessary to mention that research on the use of fibers with cohesive soils has been more limited. The main reason is that while chemical binders improve the stability of the soil, at the same time, they decrease the ductile behavior of the soil. Fibers, in this way, help to reduce the brittleness factor of the composite soil. Availability, economical benefits, easy to work and rapid to perform; and feasibility of using in all weather conditions are the general advantages of short fiber composite soils. The technical benefits of using fibers in soil reinforcement include: preventing the formation of the tensile cracks, increasing hydraulic conductivity and liquefaction strength, reducing the thermal conductivity and weight of building materials, restraining the swelling tendency of expansive soils; and decreasing the soil brittleness. As well, a comprehensive literature shows that using natural and/or synthetic fibers in geotechnical engineering is feasible in six fields including pavement layers (road construction), retaining walls, earthquake engineering, railway embankments, protection of slopes; and soil-foundation engineering. At final, it is emphasized that short fiber composite soil is still a relatively new technique in geotechnical projects as a mimics of the past.

## REFERENCES

[1.] Shivanand Mali and Baleshwar Singh Former PG Student, Department of Civil Engineering "*A study on Shear Strength of Sand reinforced with Glass fiber*." International journal of scientific and engineering research volume 4, May 2013.

[2.] Gray, D. H., and Al-Refeai, T. (1986). "*Behavior of fabric-vs. Fiber-reinforced sand*." J. Geotech. Engrg., ASCE, 112(8), 804–820.

[3.] Gray, D. H., and Maher, M. H. (1989). "*Admixture stabilization of sands with discrete, randomly distributed fibers*." Proc., XII Int. Conf. on Soil.

[4.] Mech. and Found. Engrg. Gray, D. H., and Ohashi, H. (1983). "Mechanics of fiber reinforcement in sand." J. Geotech. Engrg., ASCE, 109(3), 335–353.

[5.] Al-Refeai, T. (1991). "*Behavior of granular soils reinforced with discrete randomly oriented inclusions*." Geotextiles and Geomembranes, 10, 319–333.