

# Emerging Technique of Soil Reinforcement for Foundations: A Review

Mr Sohail Ali, Asst. Professor Civil Engg. Dept. CSMSS CSCOE Aurangabad, (MS) India.

Dr. Manish S. Dixit, Asso. Professor Civil Engg. Dept. M.I.T Aurangabad, (MS) India.

**Abstract -** For any type of civil engineering work some basic criteria which are to be followed is that the structure should be economical and safe as far as possible. Therefore, ground improvement is essential to obtain the above criteria. The experimental and numerical studies concluded that the geosynthetic is the most suitable type of soil reinforcement technique. The use of geosynthetic reinforcement increases the strength and stiffness property of the soft soil. This paper deals with the study of various reinforcing material for soft soil and their applications.

**Key Words-** Geosynthetic, Reinforcement, Soft Soil.

## I. INTRODUCTION

Reinforced soil is one of the fast-growing trends of ground improvement which is gaining popularity all over the world. Using this technique overall stability of soil can be improved. There are various types of reinforcement layers, for example geotextiles, geogrids and galvanized steel strips are generally embedded in weak foundation soils basically to reduce footing settlements, and to increase the ultimate bearing capacity of soil below foundations. Use of the reinforcements in a soil mass became very popular after the innovative work of Vidal in 1966. Generally, for calculating the effect of the reinforcements on load carrying capacity and settlement of the footings, Various researchers have performed a series of model test for their studies.

Now a days use of geosynthetic materials for improvement of the load bearing capacity and settlement performance of shallow foundation has gained popularity in the field of geotechnical engineering. From last two three decades, various studies have been conducted on the field and laboratory model tests, related to the effects of the geosynthetic materials on weak soils. Now a days use of geosynthetics as a reinforcement become common for railway projects base courses or earth work etc. It is observed that like reinforced concrete, the engineering properties of soil can also be improved by using geosynthetics, as geo-synthetic reinforcement materials are ability to absorb tensile forces.

From the studies of number of researchers, we can conclude that the bearing capacity of soil may alter due to various factors like type of soil, ratios of reinforcing material, number of reinforcement layers, and foundations such as footing width, soil texture, and unit weight of soil. Now a days geocells are widely used in geotechnical engineering

for various applications by reinforcing soft soil strata and stabilizing slopes and embankments.

### A Typical Geocell



Figure-1: Strata Web Geocell



Figure-2: HDPE Geocell Mesh

**A Typical Geotextile**



Figure-3: PET Woven Geotextile

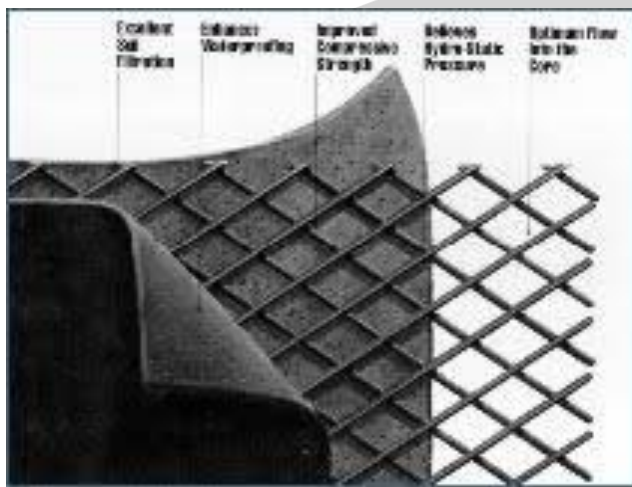


Figure-4: Woven Geotextile Fabric

**II. LITERATURE REVIEW**

Several research work and study have been done to found the benefits of the various types of soil reinforcement technique on various types of footings, and their effects to enhancing the property of soil. This chapter presents a review of previously reported work on the use of soil reinforcement to increase the stability of foundation. Some of the previous studies have been summarized below

Murad Abu-Farrakhan, Qiming Chena, Radhey Sharma [1] has conducted various laboratory model test to investigate the effect of reinforcement on sandy soil foundations. From the result he concluded that layout of reinforcement also plays the vital role and has a significant effect on reinforced sand foundation. And by using multiple layers of reinforcement settlement can also reduced.

Shripad S. Somvanshi, Prof. Dr. V. J. Sharma, Mr. Bhanudas Abhale [2] In this study the behaviour of soft murum is tested with single model footing with or without geosynthetic material i.e. geogrid. The various laboratory tests are conducted to find the properties of murum, it is observed that as the load eccentricity goes on increasing

there is decrease in the load carrying capacity. In the both type of footing i.e. square and circular showing better load settlement behaviour for centric load. Circular footing shows better result as compare to rectangular footing for sustaining load.

Latha, M.G., Somwanshi, A. [6] in their study they have concluded that the one can take different types of geosynthetic like geocell, planar layer and mesh elements to improve the load carrying capacity and got reduction in deformation. The quantity of reinforcement is kept same in tests with different forms. Studies indicated that the bearing capacity improvement factor is significantly affected by the form of reinforcement.

S.Panda1, N.H.S Ray2 [10] they have studied that foundation on homogeneous sand in centrally loaded foundation on homogeneous sand bed, when they increased the depth of foundation, peak load increased at failure. Foundation on reinforced sand in centrally loaded foundations the load carrying capacity increases with increase in the depth of foundation in surface footing providing geogrids in "four layers increases the load carrying capacity to 3.55 times where as providing three layers of geogrids above value reduces to 2.28 and for two layers the above value reduces to 1.82. The less number of geogrid layers decrease the load carrying capacity.

Dash et al. [12] put strip loading on different sand beds reinforced with geocell, planar and randomly distributed mesh elements to compare the performance of various types of soil reinforcement. Figure 5 shows a plot of bearing pressure vs settlement for various types of reinforcement. It can be seen that the geocell is most effective technique for reinforcement of soil. This finding can be attributed to the cellular structure of geocells which allows soils to be confined within the cells more effectively than other types of reinforcement.

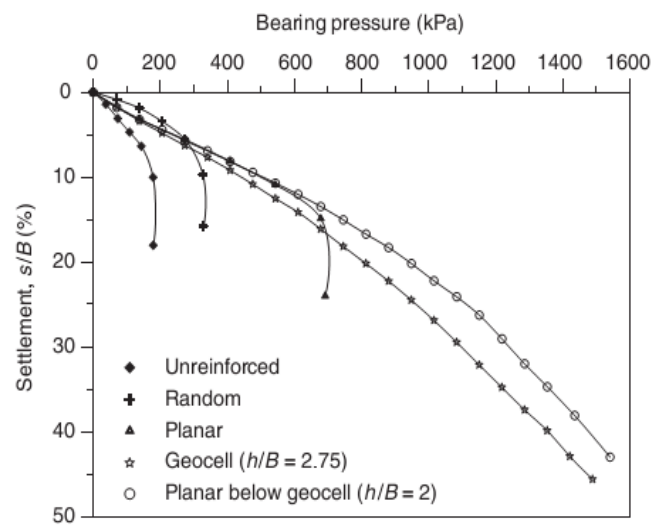


Figure-5 Plot showing the bearing pressure corresponding to different value of settlement.

From above figure we can observe that geocell reinforcement is quite effective compare to other that's why now a days use of geocell as a soil reinforcement is becoming very popular.

### III. APPLICATIONS

Geotextiles and geocells are widely used to reinforce soil masses in the design of foundations, pavement and road constructions, in slope protections and railways etc. In these applications, horizontal layers of the geosynthetics are sandwiched between compacted layers of fill during construction. Lateral spreading of the soil mass is resisted by shearing along the soil-geosynthetic interface and the development of tensile stresses within the reinforcing layers. Geocell reinforced sand underlain by soft clay concluded that provision of geocell reinforcement in the overlying sand layer improves the load carrying capacity and reduces the surface heaving of the foundation bed substantially.

### IV. CONCLUSION

From the studies conducted by many previous researchers, discussed in this paper one can conclude that introduction of geosynthetic reinforcement below a footing brings about appreciable increase in ultimate bearing pressure and decrease in settlement of the foundation. It also concludes that the use of geocell reinforcement increase the bearing capacity, strength and stiffness property of the foundation over soft soil. Still there are other applications which are yet to be discovered. In addition, overall behaviour of the geocell reinforced soil is of interest for future research.

### REFERENCES

- [1] Murad Abu-Farsakha,n, Qiming Chena, RadheySharmab “An experimental evaluation of the behavior of footings on geosynthetic-reinforced sand” Soils and Foundations 2013;53(2):335–348.
- [2] Shripad S. Somvanshi<sup>1</sup> Prof. Dr. V. J. Sharma<sup>2</sup> Mr. Bhanudas Abhale<sup>3</sup> “Experimental Study of Load Settlement behavior on Silt Clay Loam (Soft Murum) with or without Geogrid” International Journal for Scientific Research & Development| Vol. 5, Issue 05, 2017.
- [3] Das, B. M., Omar, M. T. (1994). “The effect of foundation width on model tests for the bearing capacity of sand with geogrid reinforcement.” Geotechnical and Geological Engineering 12, pp. 133-141.
- [4] Manash Chakraborty, JyantKumarn Bearing capacity of circular foundations reinforced with geogrid sheets “Soils and Foundations2014;54(4):820–832
- [5] Monir Kazi, Sanjay Kumar Shukla\* and Daryoush Habibi “Behavior of embedded strip footing on sand bed reinforced with multilayer geotextile with wraparound ends” International Journal of Geotechnical Engineering. 2014 pp. 01-16.

- [6] Latha,M.G.,Somwanshi,A.,2009. Effect of reinforcement form on the bearing capacity of square footings on sand. Geotextile sand Geo- membranes 27(6),409–422.
- [7] Latha G.M., Somwanshi A. (2009). “Bearing Capacity of square footings on geosynthetic reinforced sand. “Geotextile and Geomembrane.” 27, 16 July 2014 pp. 281-294.
- [8] N.K.Kumawata,\* , Dr.S.K.Tiwarib, Bearing capacity of square footing on geocell reinforced fly ash beds. Proceedings 4 (2017) 10570–10580
- [9] Sahu, R., Behera, R.N., Patra, C.R., (2013). “Bearing capacity prediction of eccentrically loaded footing on reinforced sand by ANN” The 5th International Geotechnical Symposium-Incheon, 22-24 May, 2013, pp. 407-414.
- [10] S.Panda<sup>1</sup>, N.H.S Ray<sup>2</sup> An Investigation on Behavior of Centrally Loaded Shallow Foundation on Sand Bed Reinforced with Geogrid International Journal of Engineering Research and General Science Volume 2, Issue 4, June-July, 2014
- [11] Dixit, M. S. and Patil, K. A. (2014). Effect of Reinforcement on Bearing Capacity and Settlement of Sand. Electronic Journal of Geotechnical Engineering 19: 1033-1046.
- [12] Dash S. K., Krishnaswamy N. R. and Rajagopal K., (2004) Performance of different geosynthetic reinforcement materials in sand foundations, Geosynthetics International, 11(1), pp. 35-42