Experimental Study on Behaviour of Woven Filament Geotextile on Reinforced Soil

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***Abstract*:** The expansive soil problems lead to structural and geotechnical engineering challenges all over the world. Expansive soils are the type of soils which their volume changes considerably depend on their water content. It is worth mentioning that, the expansive soil problems can occur in both humid environments and arid/semi-arid soils. Buildings, roads, pipelines, and other structural members have always been subjected to damages resulted from expansive soils which this damage is even more than twice the damage resulted from floods, hurricanes, earthquakes, and tornadoes. Understanding the behaviour and characteristics of these types of soils can help scientists control their mposed damages to the structure. This paper is a comprehensive study on expansive soils, its nature, shrinkage-swell behaviour, as well as expansive soil causes and treatments. Geotextile reinforced earth technique is a very effective ground improve technique because of its cost effectiveness, easy adaptability and reproducibility and workability etc.In this project reportwork, order to investigate the behavior of geosynthetic-reinforced soil (GRS), a series of laboratory experiments were conducted on GRS samples made up of two different types of soils and a woven filament geotextile. The California Bearing Ratio (CBR) and unconfined compressive strength of the GRS mass were the parameters examined to evaluate the performance of the GRS samples. Soil reinforced with randomly distributed discrete woven filament geotextile at different aspects ratios of layers of 0,1,2,3.The focus of the tests was to study the effects of the vertical spacing of the reinforcement and the relative compaction of the granular soil on the performance of the GRS mass. Further more, the well-compacted granular soil reinforced with closely spaced geotextile not only has a higher compressive strength compared to that with widely spaced reinforcement, but also exhibits both ductile and flexible failure mode making it a desirable composite material for the construction of supporting structures.

Keywords:Atterbergs limits,unconfined compression test and Direct shear test.

INTRODUCTION

In largest networks of roads in the world. Due to rapid growth in traffic, the existing roads have become structurally inadequate. Traditional design and construction practices do not fulfil construction standards. To overcome these constraints, researchers are forced to seek alternative designs using substandard materials and innovative design practices. Geosynthetics products have helped designers and contractors to solve several types of engineering problems.Use of geosynthetic on road surface eexpansive soil subgrade found to be one of feasible and economic solution.The idea of the actual strengthened soil along with organic dietary fiber supplies originated from historic occasions. Throughout historic intervals hand materials , wooden, bamboo bedding as well as creatures pores and skin had been employed for enhancementAssociated with stones qualities as well as improve associated with basis showing power .These days through organic or even veggie materials because coir, banana, jute, reed, Bamboo bedding as well as wooden materials are utilized with regard to enhancement associated with mechanized qualities associated with soil.These types of materials are utilized with regard to improve associated with tensile, data compression as well as strength associated with soil (especially upon clay based soils), to avoid through soil erosion within downward slope, waterways as well as coastline .the majority of beneficial software associated with organic materials when compared with steel as well as polymer bonded supplies is actually that they air pollution free of charge, readily available as well as economical. jute geotextiles are available in the form of mats, sheets, grids and webs made of woven, non woven,,knitted,or extruded fabrics .Geotextiles are made from natural or synthetic materials, or a combination of both. The actual color of woven geotextiles are different ,the woven fibre is actually fairly eater proof as well as is among the couple of organic materials proof in order to harm through Sodium drinking water . The main reason for reinforcing the dirt bulk would be to enhance its balance through growing the actual showing capability associated with dirt, as well as through decreasing its negotiation as well as horizontal displacement within horizontally path. There are numerous supplies with regard to reinforcing g into the dirt bulk included in this the actual arbitary addition of numerous kinds of materials is really a customisation methid, where the materials behave in order to inter locking mechanism dirt contaminants as well as aggregates inside a unitary coherent matrix.Using organic supplies for example bamboo bedding ,jute as well as coir because dirt reinforcing materials may be utilized because through very long time in a number of southern hard anodized cookware countries.Soil has been used as a construction material for roads, buildings, irrigation works are all over the world .Because of weakness in mechanical properties and needs to be improved according to the requirement. The stabilization has been performed since many past centuries to improve engineering properties of soil .The primary purpose of reinforcing its materials and lateral displacement in horizontal direction .There are various materials for reinforcing in to the soil mass among them the random inclusion of various types of fibers is a modification technique , in which the fibers act to interlock soil particles and aggregates in a unitary coherent matrix .The use of natural materials, such as woven ,non woven, ,jute, bamboo, coir as soil reinforcing material has been used since from long time in several south Asian nations .The main advantage of using these fibers was these are locally available materials and are of low cost and also they are bio degradable.Utilization of organic artificial materials for example bamboo bedding ,coir ,as sell as jute and so an within Geotechnical has been around the building associated with side walk levels, stress as well as train embankments as well as keeping wall space in addition to eithin the safety associated with inclines.Present days mostly woven ,non woven geotextiles are used for the construction of roads ,bridges, railway embankments etc.

LITERATURE REVIEW

P. B. Ullagaddi, T.K.Nagaraj was Investigate the geosynthetic reinforced two layered soil system which says that investigation has been carried out with different thickness configuration of the two soils and three types of woven and non-woven geotextiles,

having different physical and mechanical properties**.** Based on experimental work it infers that there is improvement in CBR Value and therefore increases bearing capacity.Due to increase in bearing capacity, thickness of soil layer can be reduced to serve the same functioning. Based on U.S .corps and IRC method, woven geotextile found to be more effective in increasing CBR value than non-woven geotextile

Sarika B. Dhule and S.S.Valunjkar (2011) was made an experimental study on Improvement of flexible pavem**ent** with use of geo-grid which says that Geogrid+murrum-increase CBR value and factors affecting the compaction characteristics are shear strength and low permeability. CBR value depends upon degree of compaction.

A.K.Choudhary, K.S.Gill and J.N.Jha (2011) was conducted the research on Improvement in CBR values of expansive soil sub-grades using geo-synthetics which says that expansion ratio decreases when number of reinforcing layer is increased.CBR value increases by increasing number of reinforcing layer. Reinforcing efficiency: Geo-grid better than jute geo-textile.

K. Rajagopal, S. Chandramouli, Anusha Parayil & K. Iniyan Was Studies on Geosynthetic-reinforced road pavement structures which says that by using geosynthetic material there is improvement in strength and stiffness and shows better performance under repeated loads.Under monotonic loading, modulus improvement factor is higher.

Vaishali S. Gor L. S. Thakur Dr. K.R. Biyani was to experimental study on Typical characteristics of expansive subgrade with geotextiles and cushion materials which concludes that by Addition of metakaolin, swelling pressure of black cotton soil reduces but further increment in the amount of metakaolin results in increase in swell pressure.Increase in unconfined compressive strength has been noticed.

Dr. P .senthil kumar and R .rajkumar was conducted the research on Effect of Geotextile on CBR Strength of Unpaved Road with Soft Subgrade which concludes that it's more advantageous for unpaved road and provide more resistance at lower penetration. It also enhances CBR value.

R. Ziaie Moayed and M. Nazari was conductrd the research on Effect of Utilization of Geosynthetic on Reducing the Required Thickness of Sub base Layer of a Two Layered Soil which says that by inclusion of geogrid improves the shear resistance at the interface by offering interlocking resistance and reduce the lateral movement of the soil. It also offers more separating function and prevent the sand layer entering into the underneath layer (clayey soil)

METHODOLOGY

The two soil samples are used in the study and Black cotton soil collected from the Rajupalem (Kadapa) and Red soil collected from the Tanguturu (Kadapa).For these Soil samples the Engineering and Index properties are determined are tabulated in the Table.1and Table.2.The Black cotton soil is collected from the trial pits at a depth of 4.0m from ground level.The soil lumps were broken into pieces and sieved through 4.75mm sieve and then dried in oven atb 105^0c for 24 hours. The soil are classified as I.S Classification system(IS 1498-1970).

Table:1 properies of soils

Descriptopn	Sample A	Sample B
% Gravel	1.75	4.56
% Sand	22.82	47.12
%Silt + Clay	75.43	48.32
Liquid limit	52	57.08
Plastic limit	18	23.03
Plasticity index	34	34.05
Free swell index	130	90
Specific gravity	2.52	2.63
Maximum Dry Density(g/cc)	17.3	15.45
Optimum MoistureContent(%)	18.62	16.50
Classification of soil	**CH**	**CH**

Note:Sample A is Black cotton soil
Sample B is Red soil
CH-High Compressible Soil

EXPERIMENTAL PROGRAMME AND DICUSSION

The following tests are conducted in this investigations as per standard specifications

1. INDEXPROPERTIES
2. SPECIFIC GRAVITY
3. COMPACTION CHARACTERISTICS
4. CALIFORNIA BEARING RATIO
5. SHEAR STRENGTH

4.1 Mixing proportion details

Here the commericial grade Woven Filament Geotextile(WFG) is used as a geotextile(WFG) added at laters n=0,1,2,3 layers presnt by the weight of soil the quantity of geotextile computed corresponding to the above layers is directly placed to the soil in required depth in order to obtain even distribution of the Geotextiles.

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Figure 2:Woven Filament Geotextile used for control erosion at Embankments

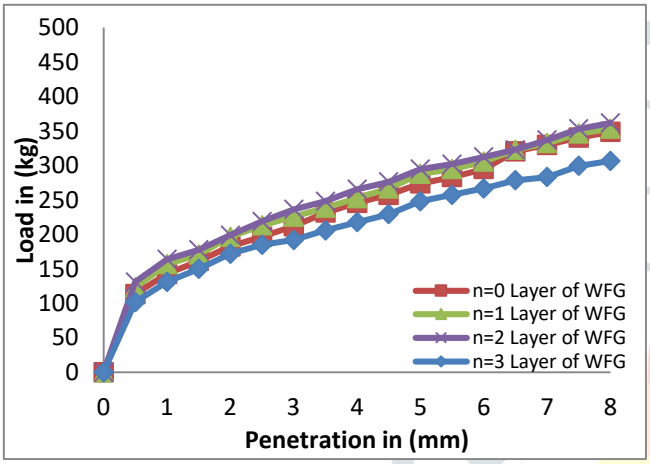
COMPATRITIVE STUDY ON CBR VALUES OF SAMPLE A AND SAMPLE B

The Soil samples ,Sample A and Sample B is classified as CH(Clay with High Compressibility).From this Soil Samples reinforced with Woven Filament geotextile of different layers of n=0,1,2,3

Table 2: CBR values of Sample A and Sample B

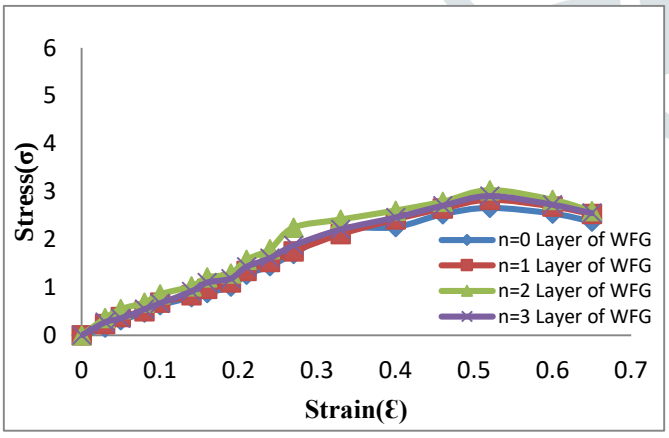
Description	CBR values of Sample A	CBR values of Sample B
Soil+ n=0 layer of woven Filament Geotextile	14.34%	21.0%
Soil+ n=1 layer of woven Filament Geotextile	15.53%	22.1%
Soil+ n=2 layer of woven Filament Geotextile	15.96%	22.79%
Soil+ n=3 layer of woven Filament Geotextile	13.48%	18.86%

The table shows the comparative study on CBR tests of soil Sample A(CH) amd Sample B(CH), the CBR value of reinforced with Woven Filament Geotextile(WFG) increased with an layers of(n=1,2)WFG and decreased with an layer of (n=3)WFG by Relative compaction(k).



Graph 1: CBR values of Sample A

It observed from Table 1 and Graph 1.The CBR value of soil sample A renforced with Woven Filament Geotextile(WFG) increased the layers of (n=1,2) and decreased the layer of(n=3) It is found that the excess of WFG more than three layers(n=3) by Relative compaction(k) causes decreases the CBR values.



Graph 2: CBR values of Sample B

It observed from Table 1 and Graph 2.The CBR value of soil sample A renforced with Woven Filament Geotextile(WFG) increased the layers of (n=1,2) and decreased the layer of(n=3). It is found that the excess of WFG more than three layers(n=3) by Relative compaction(k) causes decreases the CBR values.

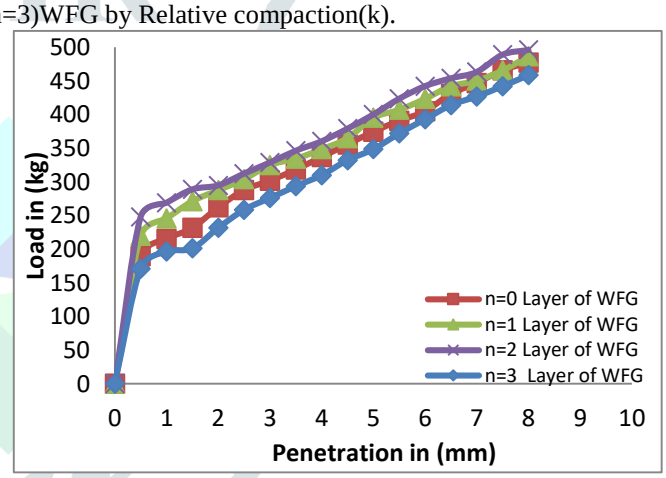
COMPATRITIVE STUDY ON UCC VALUES OF SAMPLE A AND SAMPLE B

The Soil samples ,Sample A ansd Sample B is classified as CH(Clay with High Compressibility). From this Soil Samples reinforced with Woven Filament geotextile of different layers of n=0,1,2,3

Table 2: UCC values of Sample A and Sample B

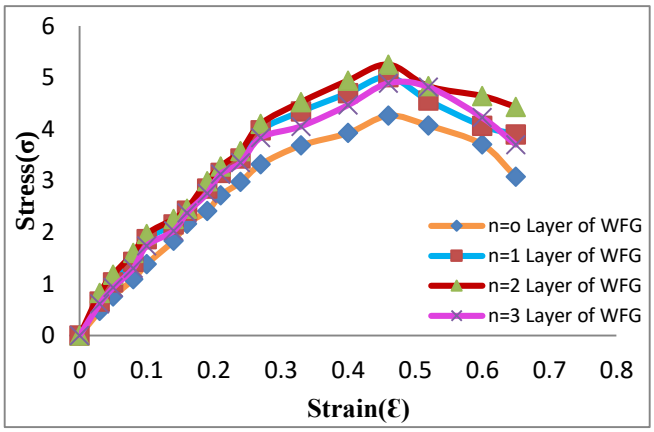
Description	UCC values of Sample A	UCC values of Sample B
Soil+ n=0 layer of woven Filament Geotextile	4.26 kg/cm^2	2.657 kg/cm^2
Soil+ n=1 layer of woven Filament Geotextile	5.007 kg/cm^2	2.827 kg/cm^2
Soil+ n=2 layer of woven Filament Geotextile	5.249 kg/cm^2	3.027 kg/cm^2
Soil+ n=3 layer of woven Filament Geotextile	4.886 kg/cm^2	2.907 kg/cm^2

The table shows the comparative study on UCC tests of soil Sample A(CH) amd Sample B(CH), the CBR value of reinforced with Woven Filament Geotextile(WFG) increased with an layers of(n=1,2)WFG and decreased with an layer of (n=3)WFG by Relative compaction(k).



Graph 3: UCC values of Sample A

It observed from Table 2 and Graph 3.The UCC value of soil sample A renforced with Woven Filament Geotextile(WFG) increased the layers of (n=1,2) and decreased the layer of(n=3) It is found that the excess of WFG more than three layers(n=3) by Relative compaction(k) causes decreases the UCC values.



Graph 4: UCC values of Sample B

It observed from Table 2 and Graph 4.The UCC value of soil sample B mixed with WFG increases in number(n) of layers of WFG upto two layers(n=2)WFG admixed soil.It is found that the excess of WFG more than three layers(n=3) causes decreases the UCC value.

OBSERVATIONS

CBR Test

CBR test Samples of Sample A and Sample B had a diameter of 15.4cm and height of 17.7cm. The Soil in the Samples of Sample A and Sample B respectively compacted to Relative compaction(k) of 88%,92%,96%,100% of the maximum dry density at the optimum moisture content 0f 18.62% for Sample A and16.50 % for Sample B. For the given pressure of the CBR of geotextile reinforced soil Samples of Sample A and Sample B, increased with two layers of (n=1,2) of relative compaction(k) of 92% and 96% and decreased with three layers of (n=3) of relative compaction(k) of 100%.Generally CBR tests of the samples increases with(k) by fluctuates with n.

UCC Test

UCC test Samples of Sample A and Sample B had a diameter of 3.8cm and height of 7.6cm.The soil in the Samples of Sample A and Sample B respectively compacted to Relative compaction(k) of 88%,92%,96%,100% of the maximum dry density at the optimum moisture content 0f 18.62% for Sample A and16.50 % for Sample B. For the given pressure of the UCC of geotextile reinforced soil Samples of Sample A and Sample B, increased with two layers of (n=1,2) of relative compaction of 92% and 96% and decreased with three layers of (n=3) of relative compaction of 100%.Generally UCC tests of the samples increases with(k) by fluctuates with n.

CBR test methods are unsuitable for geotexrile-reinfirced soil because the geotextile cannot be anchored strongly in the small sample ro avoid sliding along the geotextile –soil interface under test loading .The compressive strength of geotextile-reinforced soil increases significantly with the decrease of reinforcement spacing and with the increase in the degree of relative compaction of the soil.

The well-compacted granular soil reinforced with closely spaced geotextile has a highrt compressive strength and exihibits a ductile and flexible failure mode

CONCLUSIONS

Based on performance of reinforced soil, above researches gives a wide variety of results on several issues from which the following conclusions can be drawn:

1. A geosynthetic reinforced soil is stronger and stiffer than soil without reinforcement.
2. Geo-grids improve sub-grade restraint and base reinforcement applications.
3. Inclusion of geosynthetic ensures a long lasting pavement structure by reducing excessive deformation and cracking.
4. Geosynthetic reinforcement improves the service life of pavement.
5. Addition of geosynthetic in form of geotextile, geogrid reduces pavement thickness significantly.
6. Placing of geotextile material in soil improves bearing capacity and therefore implies that geotextiles increase load carrying capacity of soil.
7. Geosynthetics delay the propagation and accumulation of primary micro cracks.
8. Reinforced soil shows better resistance under repeated loads

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