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Research paper

Reduction in Pavement Thickness by Using Geogrid

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Abstract

An effective way of improving the properties of naturally occurring soils for pavement construction is by using geo-synthetics. In many tropical countries, weak lateritic sub grades are common and often rejected after proof rolling during construction due to poor strength. The main aim of this research was to check the effect of geo-grid reinforcement on CBR value on a sample of relatively Red soil subgrade under soaked and Unsoaked conditions and to Establish the effect of geogrid reinforced subgrade on the design thickness of low volume paved roads. Even though Red Soil has high strength but if we apply geogrids results going to be checked. Then by placing a layer of a Bi-axial geogrid at different heights like one layer at h/2, two layer at h/5 top and bottom ,three layers at h/6 top, bottom and middle , the effects of geogrid reinforcement on California Bearing Ratio values are investigated. This was undertaken for three strengths of geogrid and without geogrids in both soaked and Unsoaked conditions. The CBR values were used to determine the pavement thicknesses. The results indicate that the pavement thickness is reduced by 21.31% by using double layer in the Soaked condition i.e. Worse condition.

Keywords: *geo-synthetics, geo-grid, CBR value.*

1. Introduction

Now a day's huge number of constructions is going on in view of this, developed replacing or stabilizing techniques to improve properties of soil. One of this is geo-synthetics. These geosynthetics can be used in high rise retaining wall, can built steep soil slopes, can construct hazardous waste land fillings

i) Functions of Geosynthetics in Civil Engineering and Construction Works

- Soil reinforcement structure.
- Separation of the in-situ soil and the imported soil to prevent mixing and reducing mechanical characteristics.
- Filtration behind all hydraulic structures and separation of lechate from ground water.
- Drainage control at the top to collect any seepage water coming from the other side of the embankment to avoid contamination on the structural fill.
- Erosion control blanket to protect the slope at the top and avoid erosion.

ii) Origin of geogrids and its manufacture

The geosynthetic materials, geogrids, are polymeric products which are formed by means of intersecting grids. The polymeric materials like polyester, high-density polyethylene and polypropylene are the main composition of geogrids. These grids are formed by material ribs that are intersected by their manufacture in two directions: one in the machine direction , which is conducted in the direction of the manufacturing process. The other direction will be perpendicular to the machine direction ribs, which are called as the cross-machine direction (CMD).

iii).Uses of Geogrids in Construction

- Ease of Construction: The Geogrid can be installed in any weather conditions. This makes it more demanding.
- Land Optimization: This method of Geogrid installation in soils makes an unsuitable area suitable for preparing it to meet desired properties for construction. Geogrid thus helps in proper land utilization.
- Geogrid promotes soil stabilization.
- A higher strength soil mass is obtained.
- Higher load bearing capacity.
- It is a good remedy to retain soil from erosion.
- Geogrids are flexible in nature. They are known for their versatility.
- Geogrids have high durability reducing maintenance cost. They are highly resistant against environmental influences.

- Materials are tested based on standard codes and regulations

iv). Literature review

Ambika Kuitya , Tapas Kumar Roy et.al : Utilization of geogrid mesh for improving the soft subgrade layer with waste material mix compositions(Soil Pond Ash & Soil-rice husk).
Sarika Dhule et.al: Improvement of Flexible Pavement With Use of Geogrid.
Olaniyan, O.S.L, Akolade et.al: Reinforcement of Subgrade soils with the use of Geogrids.

2. Objective:

In the light of literatures reviewed different authors have used different types of geosynthetics to increase the strength and reduce the pavement thickness.
In connection to this review, the present investigation aims to study the values of CBR and observing the pavement by adding geogrids at different depths with different layers.
The main objective is to study how much the thickness of road is going to be reduced. The objective of this study is to evaluate the effectiveness of geogrid in reducing the pavement thickness for roads.

3.Methodology

The methodology adopted in this study includes:

- Collection and characterization of materials
- Formulation of Scheme of Experiments
- Conducting Compaction and CBR tests as per scheme of experiments
- Analysis of results and formulation of conclusions.

COLLECTION AND CHARACTERIZATION OF MATERIALS: The material used in the present work is laterite soil.

Table 1 summarized properties of soil

S.No	Properties	Symbol	Value
1	Specific gravity	G	2.68
2	Soil Classification	SC	-
3	Liquid limit	WL	32%
4	Plastic limit	WP	16.05%
5	Plasticity index	IP	15.95%
6	Optimum moisture content	OMC	14.03%
7	Maximum dry density	MDD	1.96g/cc

4. Results for Omc And Mdd

For natural soils

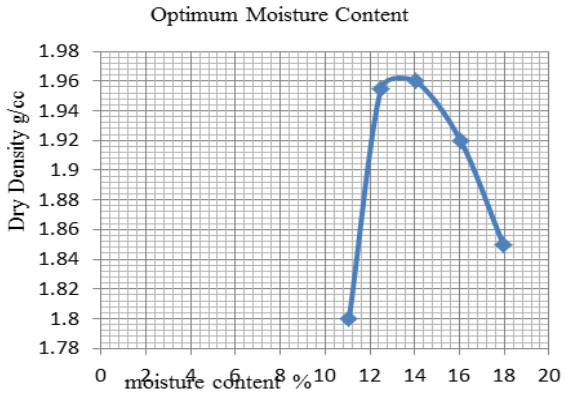

Fig I Standard Proctor test results for natural soil

CBR VALUES**:**

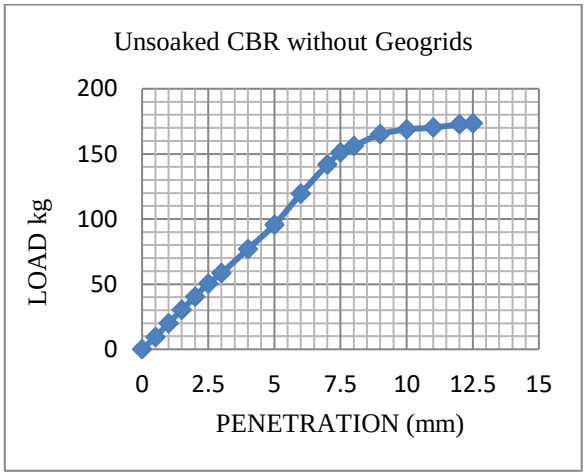

Fig II CBR values for Unsoked condition without geogrids

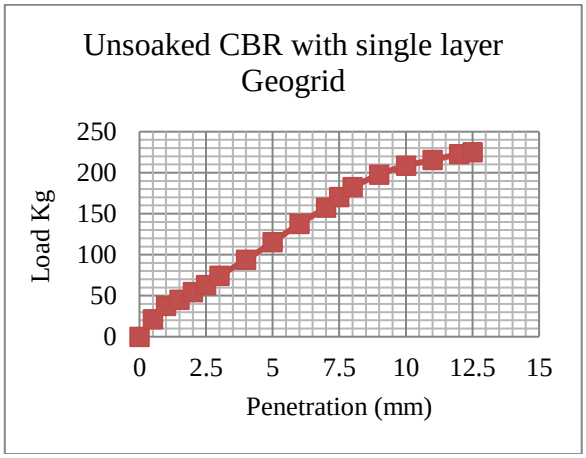

Fig IV CBR values for Unsoked condition with single layer geogrid

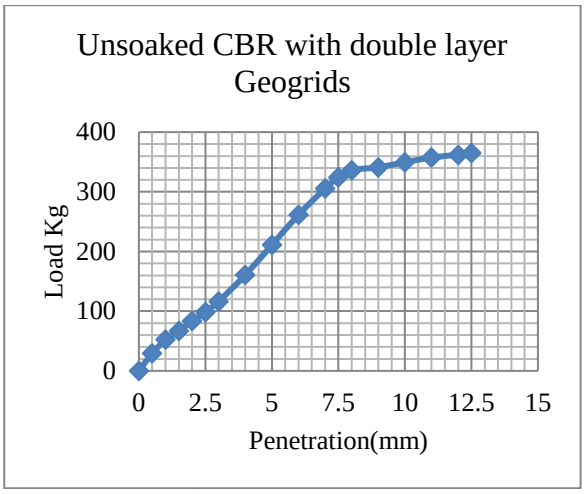

Fig IV CBR values for Unsoked condition with double layer geogrid.

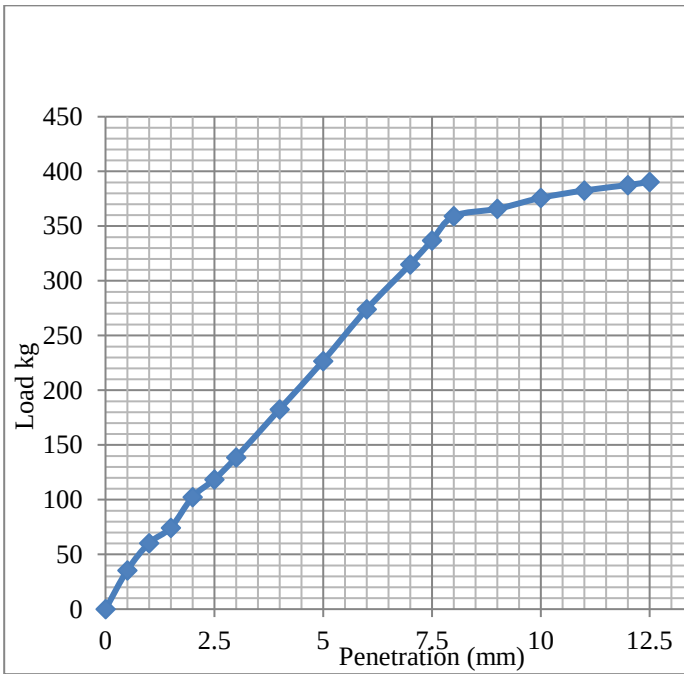

Fig V CBR values for Unsoked condition with three layers geogrid.

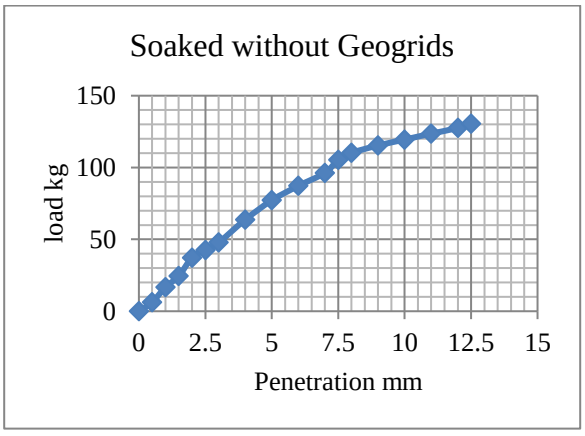

Fig VI CBR values for soaked condition without geogrid.

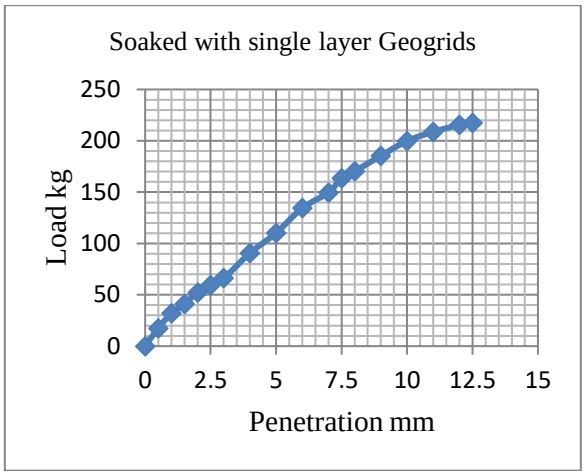

Fig VII CBR values for soaked condition with single layer geogrid

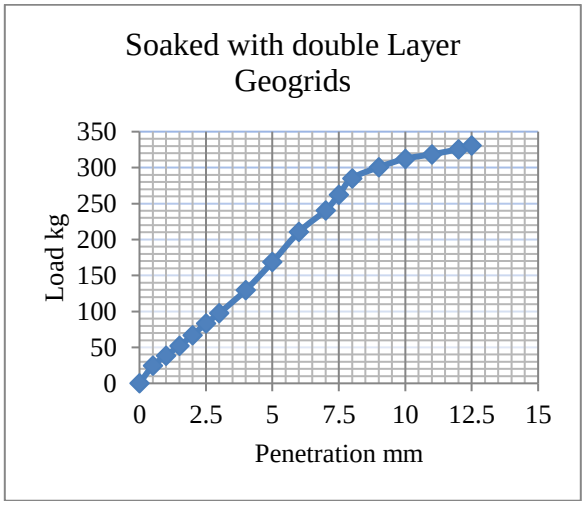

Fig VIII CBR values for soaked condition with double layer geogrid

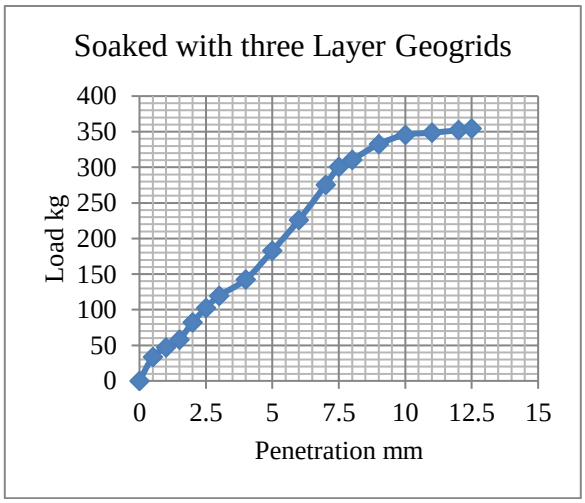

Fig IX CBR values for soaked condition with three layers geogrid

i. Summerized cbr valus

Unsoaked Condition**:**

Table 2 summarized CBR values for unsoaked condition for different layers.

LAYERS	Penetration of plunger (mm)	LOAD (Kg)	CBR VALUE %
Without Geogrids	2.5 5	50.5 95.5	3.68 4.64
Single Layer	2.5 5	63.1 115.1	4.60 5.62
Double Layer	2.5 5	98.5 211.05	7.18 10.28
Three Layer	2.5 5	118.5 226.8	8.64 11.03

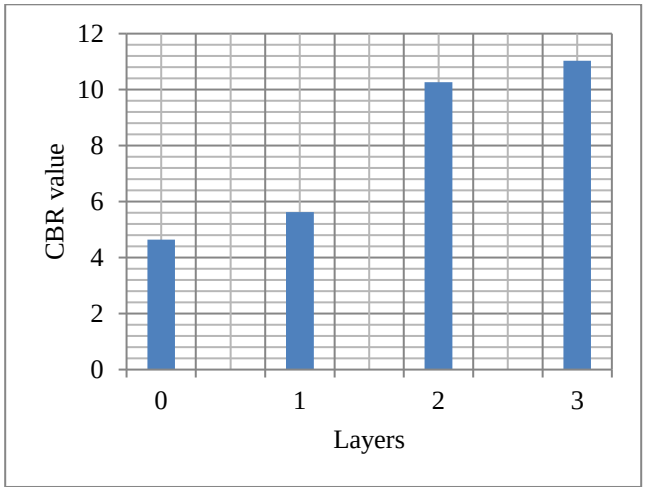

Fig X four layers vs CBR values for unsoaked CBR values

Soaked Condition:

Table 3 summarized CBR values for soaked condition for different layers.

LAYERS	PENETRATION OF PLUNGER (mm)	LOAD (Kg)	CBR VALUE %
Without Geogrids	2.5 5	42.6 77.2	3.10 3.75
Single Layer	2.5 5	59.5 110.3	4.34 5.36
Double Layer	2.5 5	83.5 168.7	6.09 8.20
Three Layer	2.5 5	102.5 182.7	7.48 8.89

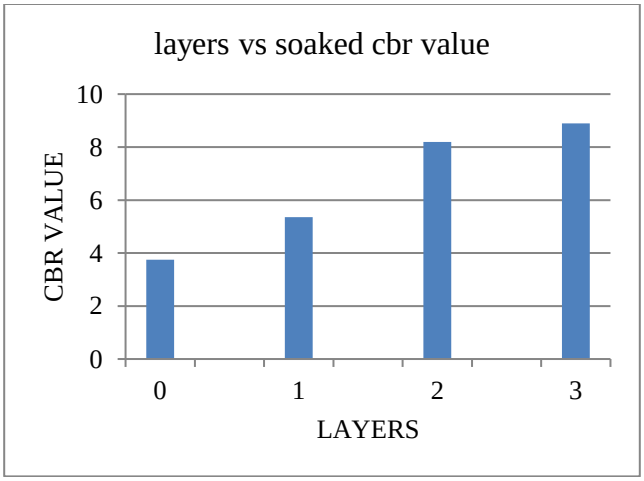

Fig X four layers vs CBR values for unsoaked CBR values

As Per IRC:37-2001:-The reduction of pavement thickness as follows

We considered the design traffic factor of cumulative standard axle as 150 msa(million standard axles).The value we got from Karimnagar.

UnSoaked condition	Thickness
Without Geogrids	788mm
Single Layer Geogrids	739mm
Double Layer Geogrids	650mm
Three Layer Geogrids	650mm

5. Conclusions

- In this test we got higher values at 5mm penetration for both soaked and unsoaked conditions and Observed that the CBR values got increased in soaked and unsoaked Conditions.
- Although the CBR value was higher for 3 layered geogrid sample but the thickness of the pavement is nearly equal for two layered and three layered sample. As per Calculations the pavement thickness is reduced by 17.5% in unsoaked condition by using double layer at a height of H/5 at top and bottom. As Per calculation the pavement thickness is reduced by 21.31% by using double layer geogrids in the soaked condition at a height of H/5 at top and bottom.
- So we consider double layer geogrid is suitable for this soil.

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