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"APPLICATION OF GEO SYNTHETIC IN FLEXIBLE PAVEMENT"

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Abstract: Roads in India have mostly the problems like the formation of potholes, ruts, cracks and localized depression and settlement, especially during rainy season. These are mainly due to the insufficient bearing capacity of the subgrade in water-saturated condition. The subgrade soil mostly yields low CBR value 2-5%. In the CBR method of pavement design (IRC:37-2012) the total thickness of pavement increases exponentially with a decrease in the CBR value of subgrade soil which in turn increases the cost of construction. So, it has been tried to use then geogrid material for increasing the bearing capacity of the subgrade. Laboratory CBR tests are conducted on soil samples with and without the inclusion of geogrid layer and also by varying the position of it in the mould use of geogrid increases the CBR value of the subgrade and there by reduces the pavement thickness considerably up to 40%. As on 31st march 2018, estimates the total road length in India 6,603,293km (4,103,096 mi) making the Indian road network, the second largest road network in the world after the united-states. But the roads are not giving the desired result due to poor CBR value. This study will have a positive impact on cost, as it will reduce the project as well as maintenance cost of the road. Our project will discuss in detail the process and its successful applications.

Index Terms - Geogrids, reinforcement, CBR value, flexible pavement, subgrade, expensive soil.

I. INTRODUCTION

One of the major problems faced by the engineers in highway construction in plains and coastal areas of India is the presence of soft/ loose soil at ground level. Roads constructed over this loose soil demands higher thickness of granular materials resulting in the high cost of construction. Alternately, attempts of reducing the thickness of pavement layer to make an economic construction will lead to early damage to the pavement, which in turn will make the road unserviceable within a short period after construction. This condition may be further worsened if supplemented with poor drainage or lack of it. Some states of India are situated in a region of high rainfall area suffers from poor drainage as well as weak subgrade condition. This is one of the major causes of deplorable road condition in those states. Looking at the poor road condition of some states of India use of geogrid is thought for road construction to improve the performance of roads. Geogrid a geosynthetic manufactured from polymers is selected for this purpose.

Geogrids used within a pavement system perform two of the primary functions of Geosynthetics: separation and reinforcements. Due to the large aperture size associated with most commercial geogrid products, geogrids are typically not used for achieving separation of dissimilar material. The ability of a geogrid to separate two materials is a function of the gradations of the two materials and is generally outside the specifications for typical pavement materials. However, geogrids can theoretically provide some measure of separation, albeit limited. For this reason, separation is a secondary function of geogrids

used in pavements. The primary function of geogrids used pavements in reinforcement, in which the geogrid mechanically improves the engineering properties of the pavement system. The reinforcement mechanisms associated with geogrids.

GEOSYNTHETICS, IT'S TYPES:

Geosynthetics have been defined by the American Society for Testing and Materials (ASTM) Committee D35 on geosynthetics as planar products manufactured from polymeric materials used with soil, rock, earth, or other geotechnical engineering related material as an integral part of a man-made project, structure or system. Geosynthetics is the term used to describe a range of polymeric products used for Civil Engineering construction works. Geosynthetics are synthetic products used to stabilize terrain. They are generally polymeric products used to solve engineering problems .This includes eight main product categories: geotextiles, geogrids, geonets, geomembranes, clay liners, geofoam, geocell and recomposites. The polymeric nature of the products makes them suitable for use in the ground where high levels of durability are required. They can also be used in exposed applications. Geosynthetics are available in a wide range of forms and materials. These products have a wide range of applications and are currently used in many civil, geotechnical, transportation, environmental, hydraulic and private development applications including roads, airfields, railroads, embankments, retaining structures, reservoirs, canals, dams, erosion control, sediment control, landfill liners, landfill covers, mining, aquaculture, and agriculture.

TYPES OF GEOSYNTHETICS:

a) Geotextiles b) Geogrids c) Geonets d) Geomembranes e) Geocells f) Geofoam g) Recomposites

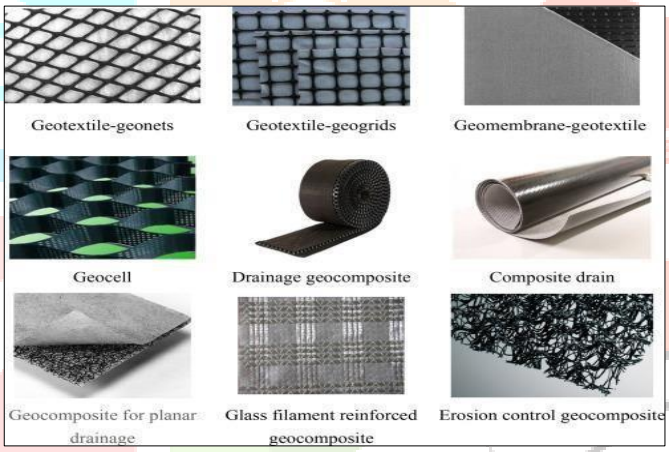


Fig 1. Types of Geosynthetics

II. OBJECTIVES OF THE PROJECT:

- To reduce the thickness of Pavement. So, as to reduce the cost of road construction.
- To Design Pavement thickness based on CBR and mass traffic as per IRC: 37-2012.
- To increase the load carrying capacity of the road (Strength of road). □ Increase the Service Life of Road

III. LITERATURE REVIEW:

Dr. Arno Hefer Consulting and Rubicon Solutions (October 2023) ,"Pavement Design with Geosynthetics" The primary objective of this research project was to evaluate geotextiles placed under or within a hot mix asphalt (HMA) overlay to reduce the severity or delay the appearance of reflection cracks. Researchers evaluated six geosynthetics, representing fabrics, grids, and composites in the laboratory using the TTI Overlay Tester.

V Vinay Kumar, Sireesh Saride, JG Zornberg Geosynthetics International 28 (6), (2021), "Fatigue performance of geosynthetic-reinforced asphalt layers" Pg.584-597. This study aims at understanding the influence of different geosynthetic reinforcements on the fatigue performance of asphalt layers and the

corresponding mechanisms involved. Three different types of geosynthetic reinforcement, namely a biaxial polypropylene geogrid (PP), a polyester geogrid coated with a polymer-modified binder (PET) and a glass geogrid composite (GGC)

3.1 Summary of Literature Review:

· The research papers discuss the properties of the geosynthetics used in the CBR test. This includes characteristics such as tensile strength, stiffness, thickness, aperture size, and opening size distribution.

· Geosynthetics are subjected to various environmental conditions, such as exposure to temperature variations, chemical exposure, and biological degradation.

· Research papers evaluate the durability and characteristics of geosynthetics to understand their long-term performance and service life.

· The CBR test is a laboratory test used to measure the load-bearing capacity of soils and geosynthetics. By incorporating geosynthetics into the test, engineers can assess their impact on soil strength and performance, enabling the design of more robust and durable infrastructure.

VI. METHODOLOGY:

Grain Size Distribution:

IS: 2720 (Part 4) – 1985 – Method of test for soil (Part 4-Grain size analysis)

The size of the individual grain is an important factor governing soil behaviour and therefore, the most common soil test is the grain size analysis. The result can be represented by the numerical values and indicate some characteristic grain size and degree of uniformity. Allen Hazen, after performing a number of tests with filter materials concluded that in the loose state the permeability of the soil depends on “effective size” and “uniformity coefficient”.

The effective size is defined as the size of material corresponding to 10% finer on the grain size distribution curve denoted by D10. This means 10% of the particles are fine and 90% are coarser than the effective size.

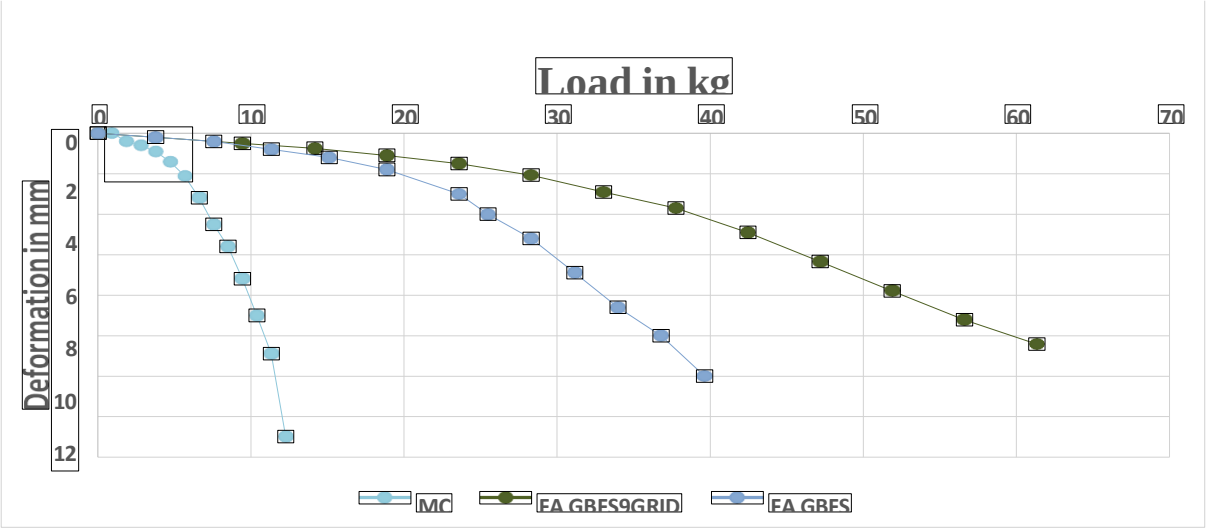
The uniformity coefficient is the ratio of D60 to D10. It gives the measure of grading of the soil. A high uniformity coefficient means a low degree of uniformity or well – graded material. If uniformity coefficient is less than 4, the soil is uniform or poorly graded. coefficient is between 5 and 9 the soil is medium graded. Uniformity coefficient is more than 10, the soil is well graded.

V. RESULT & DISCUSSION:

The result of a CBR test is pre sented in the form of a graph this graph shows the relationship between the applied load and the penetration depth of the plunger into the soil. The CBR value represents the ratio of the penetration load to a standard load, usually expressed as a percentage.

The CBR values are usually calculated for penetration of 2.5 mm and 5 mm. The CBR value is reported to correct to the first decimal place.

MC				FAGBFS				FAGBFS9Grid)			
Load	load in kg	Deformation	D*0.01	Load	load in kg	Deformation	d*0.01	Load	load in kg	deformation	d*0.01
1	0.9435	0	0	1	0.9435	0	0	0	0	0	0
2	1.887	40	0.4	2	1.887	11	0.11	10	9.435	50	0.5
3	2.8305	60	0.6	3	2.8305	13	0.13	15	14.1525	75	0.75
4	3.774	90	0.9	4	3.774	15	0.15	20	18.87	110	1.1
5	4.7175	140	1.4	5	4.7175	19	0.19	25	23.5875	150	1.5
6	5.661	210	2.1	6	5.661	21	0.21	30	28.305	207	2.07
7	6.6045	320	3.2	7	6.6045	23	0.23	35	33.0225	290	2.9
8	7.548	450	4.5	8	7.548	27	0.27	40	37.74	370	3.7
9	8.4915	560	5.6	9	8.4915	30	0.3	45	42.4575	490	4.9
10	9.435	720	7.2	10	9.435	35	0.35	50	47.175	635	6.35
11	10.3785	900	9	15	14.1525	70	0.7	55	51.8925	780	7.8
12	11.322	1090	10.9	20	18.87	90	0.9	60	56.61	922	9.22
13	12.2655	1500	15	25	23.5875	120	1.2	65	61.3275	1042	10.42



CBR calculation = PT/PS *100 Where,
PT= corrected test load corresponding to the choose penetration from the load penetration curve.

PS= standard loads for the same penetration taken from to table curve.

1. WITHOUT GEOGRID:

From graph, CBR @ 5.6 mm Penetration: 42.33%

2. WITH GEOGRID AT H/4 FROM THE BOTTOM (FA GBFS):

From graph,

CBR @ 5.2 mm Penetration: 141.10%

3. WITH GEOGRID AT H/2 DISTANCE FROM THE BOTTOM (FA GBFS9Grid):

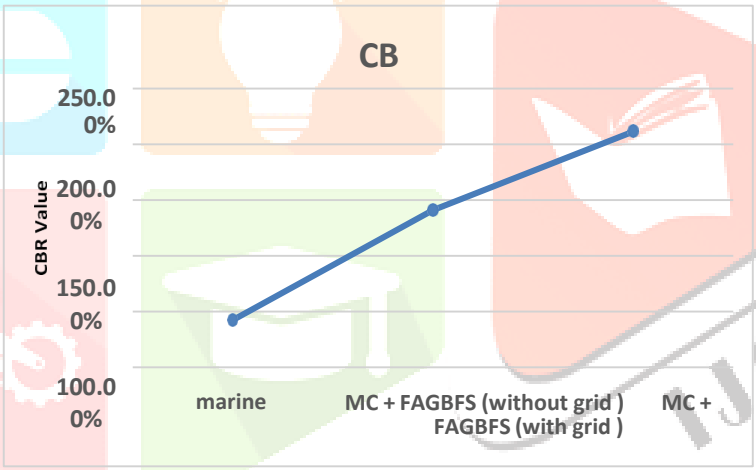
From graph, CBR @ 4.9 mm Penetration: 211.65%

5.1 COMPARISON:

The interpretation of CBR test results depends on the specific project requirements and standards. In general, higher CBR values indicate stronger and more stable soil, while lower values suggest weaker or less stable soil. The CBR values obtained from the test are often compared to design criteria or specifications to determine if the soil meets the required strength for a particular application, such as road construction.

COMPARISON OF CBR % VALUE:

- From the getting result of CBR % calculation, the CBR value % is more while using the MC+ FACBES with Grid as compared to the use of MC + FAGBFS (without geogrid).
- While using MC only the CBR value % is less as compared to the other.
- High % CBR content we will take for the design of the road pavement.



SAFETY & PRECAUTIONS:

- Clean the sieves with the help of a brush, after sieving.
- While weighing put the sieve with soil sample on the balance in a concentric position.
- Check the electric connection of the sieve shaker before conducting the test.

SAMPLE DESIGN OF PAVEMENT:

As per (IRC: 37-2012) Bituminous Surfacing with Granular Base and Granular Sub-base

a) WITHOUT GEOGRID: CBR: 1.67 %, N: 47.45 msa ≈ 50 msa
i.e., not fit for laying a road directly on the Subgrade soil; which needs Stabilization to it.
b) WITH GEOGRID AT 3H/4 FROM BOTTOM: CBR: 3.91 %, N: 47.45 msa ≈ 50 msa
i.e., the thickness of GSB: 300 mm, G. Base: 250, DBM: 115 mm, BC/SDBC:40mm The thickness of pavement required in MM:

Thickness	With grogrid	With geogrid @ H/4 from bottom
GSB	NA	300
DBM	NA	250
BC	NA	115
SDBC	NA	40
TOTAL	-	705 mm

(Where; GSB: Granular Sub-base, G. Base: Granular Base, DBM: Dense Bituminous Macadam, BC: Bituminous Concrete, SDBC: Semi-Dense Bituminous Concrete.)

VI. Future scope

The future scope of flexible pavement in geo-synthetics looks promising, as geo-synthetics offer various benefits such as improved drainage, reinforcement, and reduced maintenance costs. Integrating geo-synthetics with flexible pavements can enhance their performance, durability, and sustainability, making them increasingly attractive for infrastructure projects worldwide.

1. Gives additional support and good rideability in roads.
2. The benefits of using Geosynthetics to improve the performance of pavements.
3. Cost effective when good quality sub-base materials are not available economically.
4. The load carrying capacity increases.
5. Decreases the route depth.

VII. CONCLUSION:

The study investigated the application of geogrids to subgrade material as a form of reinforcement to road construction. The inclusion of the geo-grid considerably increases the strength of poor soils, which is reflected in the higher CBR values. The study shows that the strength of the subgrade is significantly altered positively by the positioning of the geo-grid at varying depth. It was observed that the highest subgrade strength is achieved when it is placed at 3H/4 for a single layer although has a satisfactory result at H/2 and H/4 respectively. On reinforcing the soil, there is a considerable increase in performance of the subgrade in the unsoaked condition. The use of geogrids as reinforcement to poor soils improves its strength. It is non-bio degradable and therefore durable; it also increases the ultimate service life of the pavement. The use of Geogrids should, therefore, be encouraged as an effective and modern form of improving road construction on poor sub-grade materials. Further research should be analysis in ascertaining the effect of geogrids on subgrade soils under the unsoaked condition.

1. The positive effects of geogrid reinforced subgrade courses can economically and ecologically be utilized to reduce aggregate thickness

2. To increase the life of the pavement and can also decrease the overall cost of the pavement construction with an increased lifetime

3. It is non-bio degradable and therefore durable; it also increases the ultimate service life of the pavement.

4. Geosynthetics with flexible pavements presents a promising avenue for improving

infrastructure performance and longevity.

VIII. REFERENCES:

- Dr. Arno Hefer Consulting and Rubicon Solutions (October 2023), "Pavement Design with Geosynthetics".
- V Vinay Kumar, Sireesh Saride, JG Zornberg Geosynthetics International 28 (6), (2021), "Fatigue performance of geo-synthetic-reinforced asphalt layers" Pg.584-597.
- Guangfan Zheng, Hossein Alimohammadi, Junxing Zheng, Vernon R Schaefer IFCEE (2021),"Effectiveness of geo-synthetics in the construction of roadways" Pg.223-232.
- Sanat K. Pokharel, Jie Han, Dov Leshchinsky, Robert L. Parsons (2017) ,"Experimental Evaluation of Geocell-Reinforced Bases under Repeated Loading".
- S. N. Moghaddas Tafreshi,o.Khalaj, A.R.Dawson, B. Masek.(2015) ,"Repeated load response of soil reinforced by two layers of geocell".