EXPERIMENTAL INVESTIGATION ON GEOGRID REINFORCED SUBBASE OVER A SOFT SOIL

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Abstract - *Geogrid reinforcement is gaining acceptance as an effective way of improving the properties of naturally occurring soils for road pavement construction. The quality and life of pavement is greatly affected by the type of subgrade, sub base and base course materials. Unpaved roads are a two-layer system consisting of a natural subgrade and a subbase course. There are many cases where the soil makes the existing subgrade too weak to support the traffic loads. Conventional measures used to address soft subgrade soils include excavation of the weak soil and replacement with good fill material. Geogrid reinforced soils are often treated as composite materials in which reinforcement resist tensile stress and interact with soil through friction. Geogrid reinforcement can improve the performance of the pavement by increasing the traffic load or by decreasing the pavement thickness. The clayey type of soil and one type of geogrid were selected for this study. From the study it is clear that there is considerable improvement in California Bearing Ratio(CBR) of sub-grade due to geogrid reinforcement. In case of without reinforcement (Geogrid) the soaked CBR value was lesser and when geogrid was placed at 0.2H from the top of the specimen the CBR was increased.*

Key Words: Geogrid, Soil subgrade, Pavement, reinforcement.

1. INTRODUCTION

Geosynthetics have been used for subgrade stabilization and base course reinforcement for construction of unpaved structures roads and areas since the 1970s. Geosynthetic is placed between the subgrade and base course, or within the base course. Geosynthetic improves the performance of unpaved roads carrying channelized traffic and random traffic. Geosynthetics with its improved performance increases the volume of the traffic and decreases the base course thickness. Use of lower quality base course material is another potential benefit provided by geosynthetics. Geosynthetics can provide separation between base and sub-grade materials and it also provide reinforcement of the base course and sub-grade. Separation of base and sub-grade material prevents the mixing of subgrade soil and granular base materials and the resulting deterioration of the base course. Reinforcement with goesynthtics increases the bearing capacity of the sub-grade, stiffens the base layer thereby reducing normal stresses and changing the magnitude and orientation of shear stresses on the subgrade in the loaded area, restricts lateral movement of the base course material and the subgrade soil, and can provide tensioned membrane support where deep rutting occurs.

1.1 Scope

An experimental investigation is carried out to study the pullout behaviour and tensile strength of the geogrid. The main objective of the project is twofold. The first is to understand the mode of geosynthetic reinforcement in the stability of unpaved roads. The second objective is to develop an improved design method that encompasses the contribution of reinforcement with allowance for degradation of the aggregate base course.

The scope includes experimental and theoretical studies. CBR test on geogrid-reinforced unpaved structure is conducted. Based on the test data, numerical and theoretical analyses have been performed to study the performance of unpaved section.

1.2 Site investigation

In site investigation initial field study, ground investigation, field study report and construction over soft soil should be monitored.

1.2 SELECTION OF SOIL SAMPLE AND GEOGRID

Soil: The soil is collected from Anna University campus. 3 samples are collected from a depth of 5m at an interval of 0.5Km

Geogrid: The geogrid is collected. The grade of the geogrid is G-150/60

2 EXPERIMENTAL ANALYSIS AND TEST RESULTS

2.1 TENSILE STRENGTH TEST

Test specimens must contain one rib with 3 junctions in the direction of concern. Use junctions at each end of the specimen for clamping; the center node represents the repeat unit. Test 3 specimens in each direction.

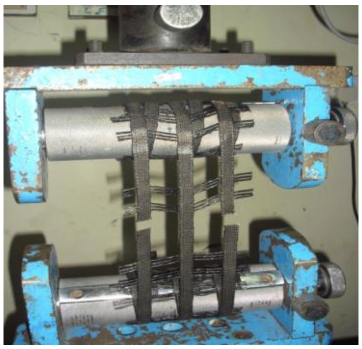

Fig 1 Tensile strength testing of the geogrid

2.2 PULLOUT TEST

Table 2.1 Peak load for geogrid

GRADE	VERTICAL LOAD	PEAK LOAD
G-160/50	50 kg/cm^2	64.95KN
	100 kg/cm^2	66.89KN
	200 kg/cm^2	69.28KN

2.3 TENSILE STRENGTH TEST

2.3.1 ALONG MACHINE DIRECTION

1. Grade of geogrid: G-160/50
2. For 1m length of geogrid **41 ribs** were present

Table 2.2 the peak tensile strength for geogrid along machine direction

TEST NO.	1	2	3
PEAK LOAD(KN)	1.6753	1.7676	1.7957

Thus the ultimate peak load of the geogrid is **1.7957KN** which is the maximum value from above test.

2.3.2 ALONG CROSS DIRECTION

1. Grade of geogrid: G-160/50
2. For 1m length of geogrid **36 ribs** were present

Table 2.3 the peak tensile strength for geogrid along cross direction

TEST NO.	1	2	3
PEAK LOAD(KN)	0.7425	0.7447	0.7735

Thus the ultimate peak load of the geogrid is **0.7735KN** which is the maximum value from above test.

2.4 CBR TEST

The laboratory CBR apparatus consist of a mould 150mm diameter with a base plate and a collar, a loading frame with a cylindrical plunger of 50mm diameter and a dial gauge for measuring the expansion on soaking and the penetration value.

Table 2.4 Load and penetration values for unsoaked soil sample

Penetration of plunger, mm	Load dial reading, division				
	No geogrid	0.2 H	0.4 H	0.6 H	0.8 H
0	0	0	0	0	0
0.5	8	12	9	7	4
1.0	16	26	24	21	18
1.5	28	43	35	29	24
2.0	35	62	54	47	39
2.5	43	81	73	68	51
3.0	51	85	77	73	57
4.0	64	89	81	78	58
5.0	68	91	85	80	68
7.5	72	93	89	83	73
10.0	78	95	91	87	75
12.5	80	97	93	89	79

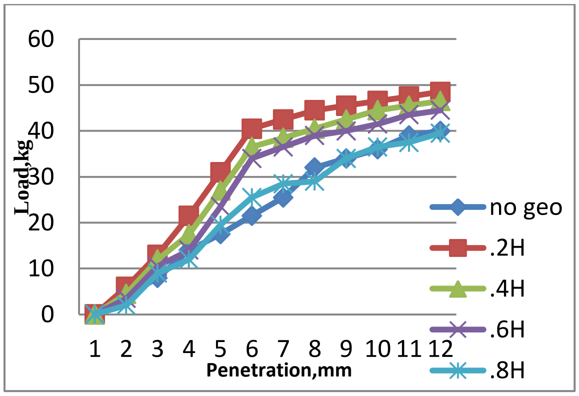

Chart 1 Load vs Penetration graph for unsoaked condition

Table 2.5 Load and penetration values for soaked soil sample

Penetration of plunger, mm	Load dial reading, divisions				
	No geogrid	0.2H	0.4H	0.6H	0.8H
0	0	0	0	0	0
0.5	1	10	11	5	3
1.0	2	22	23	12	8
1.5	10	38	35	17	15
2.0	17	43	47	25	19
2.5	21	66	52	39	22
3.0	26	69	57	43	28
4.0	35	73	59	48	37
5.0	40	78	63	51	39
7.5	50	81	68	59	45
10.0	58	83	72	62	49
12.5	63	89	75	66	53

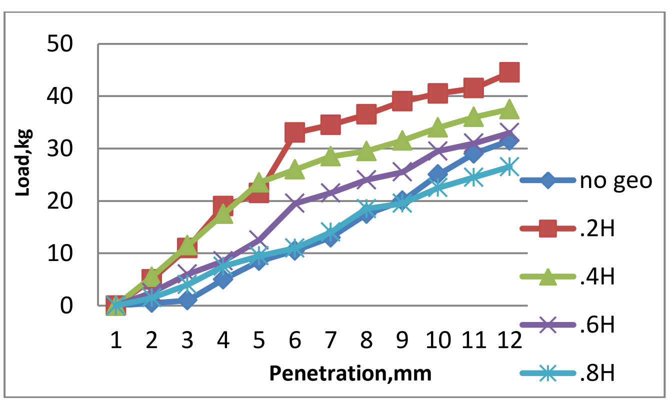

Chart 2 Load vs Penetration graph for soaked condition

Table 2.6 Unsoaked and soked CBR value for various position of geogrid

Position of geogrid from the top of the specimen	Unsoaked CBR value	Soaked CBR value
No geogrid	6.2	3
0.2H	11.59	9.5
0.4H	10.53	7.5
0.6H	9.7	5.6
0.8H	7.5	3.1

3. CONCLUSIONS

The results of field, laboratory and numerical studies have demonstrated the benefits of using geogrid to improve the performance of pavements. Tensile strength of the geogrid significantly affects the degree of improvement represented in terms of the reduction in the aggregate thickness. Based on the results of this study the following conclusions are drawn:

1. Interfacing soil with a geogrid material increases the penetration resistance and the CBR strength in both soaked and unsoaked conditions. Therefore the performance of a subgrade material in a pavement system is better with the inclusion of a geogrid. The CBR of a soil increases by 50-100% when it is reinforced with a single layer of geo-grid. The amount of improvement depends upon the type of soil and position of geo-grid.
2. CBR of sub-grade soil is 3.6% without reinforcement and when geo-grid was placed at 0.2H from the top, the CBR value increased to 8.7%. Placing one layer of geogrid at the top of layer 3 has more effective performance in penetration resistance in unsoaked condition than soaked conditions for geogrid.
3. Base course thickness is reduced as a result of geogrid reinforcement for a subgrade soil with increasing traffic volume. The present study illustrated the consideration of the strength parameters of the subgrade and geogrid which leads to more economical design. Overall geogrid reinforcement contributed to an improvement in the load bearing capacity of thin flexible pavement over soft subgrade soils. Geogrids have a good potential to reduce the cost of pavement layers if weak subgrades are encountered on the alignment. On unpaved roads, designers should consider the installation of geogrids to improve the California Bearing Ratio and to reduce layer thicknesses.

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