APPLICATION OF GEOTEXTILES IN RIGID PAVEMENT

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Abstract :

Pavement is the most severely, dynamically loaded structure under varied environmental conditions. Long lasting pavement with good riding surface has always been remained challenges to the pavement engineers. Most of the times vehicles are overloaded than the legal limits. Due to such overloading pavement life reduces drastically, particularly if the desired quality materials are not used. Geo-synthetics reinforcement has a potential in improving the engineering characteristics of the pavement materials as well as layers, which improves the pavement service life. The present study is to evaluate the cost-effectiveness of using geo-textiles at sub-grade-granular material interface. To improve the pavement system due to the use of geo-textiles is too investigated.

***Index Terms* – Geo- Synthetics reinforcement, geo-textiles, sub-grade-granular material interface.**

I. INTRODUCTION

Geo-textiles are a broad grouping, yet specific type, of fabric used in civil engineering and geotechnical applications. According to ASTM D4439, a geo textile is "A permeable geo-synthetic comprised of textiles. Geo-textiles are used with foundation, soil, rock, earth, or any other geotechnical engineering –related to material as an integral part of a human-man project, structure, or system"(ASTM standard D4439,2014). Geo-textiles are used with foundation, soil, rock, earth, or any other geotechnical engineering-related material as an integral part of a human-made project, structure, or system." (ASTM Standard D4439, 2014). Because the term geo-textile describes such a vast network of materials geo-textiles are commonly further classified by the function they serve the manufacturing process used to make them and their base material geo-textiles are commonly used in civil engineering applications and can be found above and below water, behind retaining wall under pavement surfaces and practically anywhere there I soil with material advances, the list of applications of geo-textiles continue to grow.

Geo-textiles can currently serve one or more of the following functions; separation, filtration, reinforcement ,protection ,and drainage. In India the main problems which the roads are facing the majority of them fail before their service life, due to the fact the load accounted during the design of road is far lower than ground reality the structural adequacy of the pavement system is based on the amount of stress that is acting on the sub grade layer. For the low value of sub grade stress, the life of the pavement system is longer. In a multi layered layer rigid pavement system sub-grade stress can be lowered by either increasing the thickness of the base course layer or by increasing the rigidity of the different layers by using good quality of natural materials

II.MATERIALS

1. *Geo-textiles*

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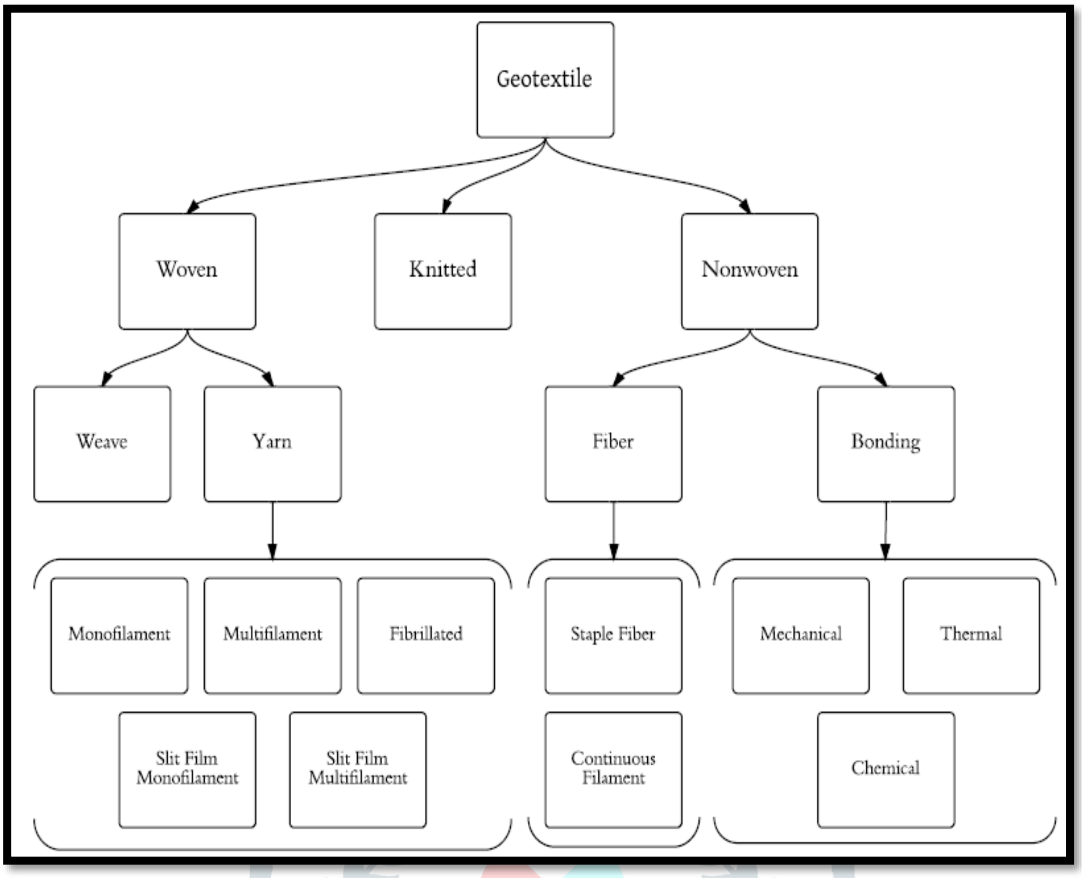
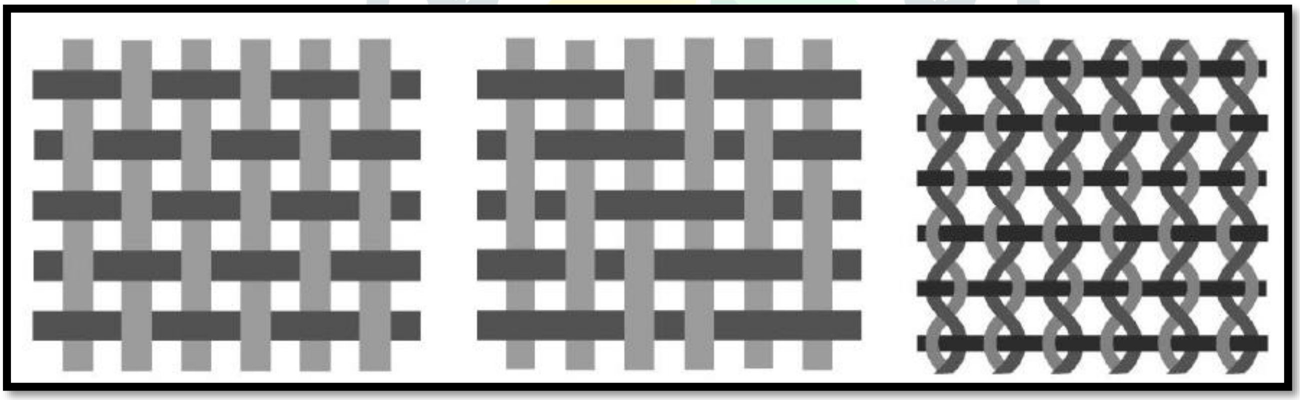


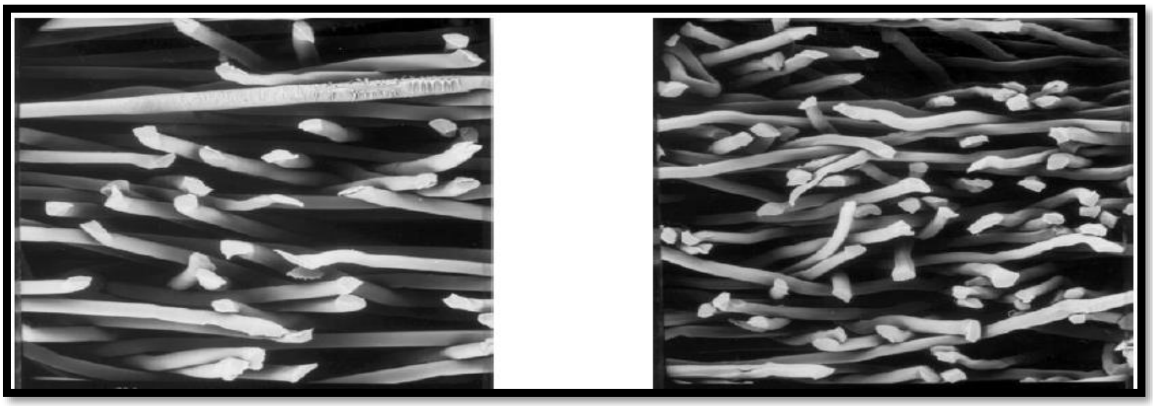
2. ***Woven Geo-textiles***

Woven geo-textiles can be sub-grouped based on both the weaving type and yarn type used. The most common weaves are plain, twill, and leno (Kumar 2008),



3. ***Non Woven Geo-textiles***

Nonwoven geotextiles are composed of either continuous filaments or staple fibers.



III. EXPERIMENTAL RESULTS

1. Soil:

Sub grade soil is an integral part of the road pavement structure as it provide the support to the pavement from the beneath. The sub grade soil and its properties are important in the design of pavement structure .The main function of the sub grade is to give adequate support to the pavement and for this the sub grade should posses sufficient stability under adverse climate and loading condition

2. Tests on soil sub grade:

The soil sugared is a layer of natural soil prepared to receive the layers of pavement materials placed over it the loads on the pavement are ultimately received by the soil sugared for dispersion to the earth mass. the soil sugared should not get overstressed at any time .Hence it is desirable that at least top 50 cm layer of the sugared is well compacted under controlled conditions of OMC and MDD

1. Grain size analysis, 2. Liquid limit, 3. Plastic limit, 4 .CBR method, 5. Compaction test –IS Light

1. Grain Size Analysis

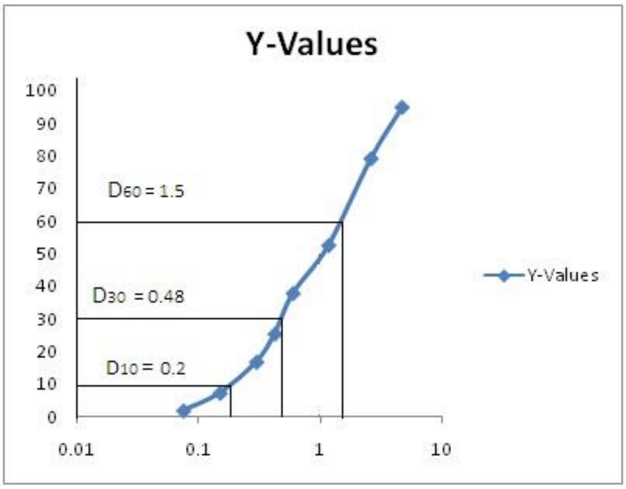
Grain size analysis of roadway sample

S.NO	Sieve No.	Aperture size in mm	Wt. of particles	% Wt. of retained	Cumulative % Wt. retained	% passing through (100-(6))
1	4.75mm	4.75	52	5.2	5.2	94.8
2	2.63mm	2.63	157	15.7	20.9	79.1
3	1.18mm	1.18	265	26.5	47.4	52.6
4	600µ	0.6	147	14.7	62.1	37.9
5	425µ	0.425	124	12.4	74.5	25.5
6	300µ	0.3	86	8.6	83.1	16.9
7	150µ	0.15	95	9.5	92.6	7.4
8	75µ	0.075	54	5.4	98	2.0

The weight of the particles in the pan= 20gm

% weight retained in the pan= 2.00

Cumulative percentage weight retained on pan=100



From graph:

D_{10}=0.2, D_{30}=0.48, D_{60}=1.5

Coefficient of uniformity Cu=D_{60}/D_{10}=7.5

Coefficient of curvature Cc=$D_{30}^2/(D_{60}*D_{10})$ = 0.8

1. U.C is less than 4, the soil is uniform.
2. U.C is between 5 and 9, the soil is graded.
3. U.C is more than 10, the soil is well graded.

   Since the coefficient of uniformity is between 5 and 9, the soil is graded.

2. ***Liquid limit:***

S. No	Observation and calculation	1	2	3	4
1	Weight of soil taken gm	120	120	120	120
2	Water added in cc	25%	27%	29%	31%
3	No of blows (N)	40	33	30	24
4	Weight of container W_1 gm	9	9	9	9

From Graph

At 25 blows the Liquid limit from graph = 29%.

3. *Plastic Limit*

1. Weight of the empty container W_1gm =22gm
2. Weight of container + Wet soil W_2gm =60gm
3. Weight of container + Dry soil W_3gm =56gm
4. Water content = $\{(W_2-W_3)/ (W_3-W_1)\}*100$

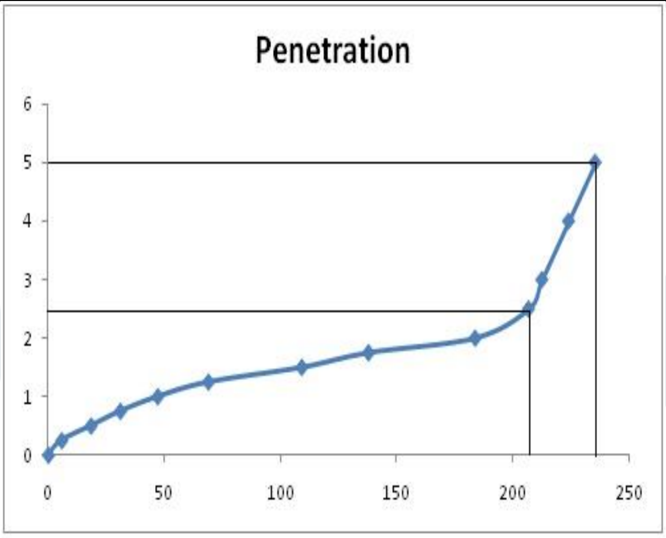
   = {(60-56)/ (56-22)}*100

   = 11.76%

Plastic limit of soil =11.76%

4. California Bearing Ratio Test:

S.No	Penetration dial gauge		Load dial gauge	
	Dial gauge reading	Penetration (mm) = reading* LC	Proving ring reading *LC(0.02)	Load in kg
1	0	0.00	0	0
2	25	0.25	5	5.75
3	50	0.50	16	18.4
4	75	0.75	27	31.05
5	100	1.00	41	47.15
6	125	1.25	60	69
7	150	1.50	95	109.25
8	175	1.75	120	138
9	200	2.00	160	184
10	250	2.50	180	207
11	300	3.00	185	212.75
12	400	4.00	195	224.25
13	500	5.00	205	235.75



Load at 2.5mm penetration = 207kg, Load at 5mm penetration = 235.75kg

CBR value at 2.5mm penetration = (penetration load/ standard load)*100

= (207/1370)*100 = 15.11%

CBR value at 5mm penetration = (penetration load/ standard load)*100

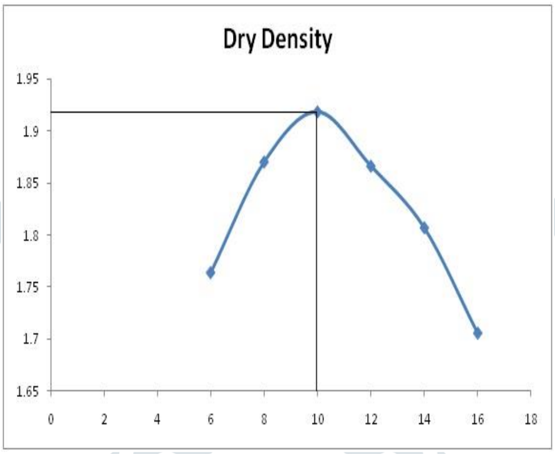
= (235.75/ 2055)*100 = 11.47%

CBR values of given sample = 15.11%

5. ***Compaction Test- Is Light***

S.No	Observations and Calculations	1	2	3	4	5	6
1	Amount of soil taken (gm)	3000	3000	3000	3000	3000	3000
2	Amount of water added (gm)	180	240	300	360	420	480
3	Weight of empty mould W_1 (gm)	4470	4470	4470	4470	4470	4470
4	Weight of mould + Compacted soil w_2 (gm)	6340	6490	6580	6560	6530	6449

5	Weight of compacted soil $W_3 = W_2 - W_1$(gm)	1870	2020	2110	2090	2060	1979
6	Bulk Density $\Upsilon = W_3/V$ g/cc	1.870	2.020	2.110	2.090	2.060	1.979
7	Dry Density $\Upsilon_d = \Upsilon/1+W$	1.764	1.870	1.918	1.866	1.807	1.706
8	Dry density at 100% saturation $\Upsilon d = (G*\Upsilon_W)/(1+WG)$	90.01	90.01	90.01	90.01	90.01	90.01



From Graph

1. Maximum dry density = 1.918g/cc
2. Optimum moisture content = 300ml (or) 10%

CONCLUSIONS

1. Only nonwoven geo-textiles are used at sub grade granular interphase, whereas both nonwoven and woven geo-textiles can be used for other application at highway.
2. Use of geo-synthetics materials in highway application extends the service life or reduce the base course thickness
3. There are significant environmental benefits associated with aggregate savings: less transportation of aggregate by trucks, hence less air pollution, energy consumption and less GHG emissions due to use of geo-textiles
4. Geo-textiles can be rolled above the old pavement and a new pavement can be placed over it, geo-textiles if used in this way can resist the cracks developed at old pavement to reach the new pavement.

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