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Application of Geosynthetic material on different soils used in the construction of pavement

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***Abstract**: The use of geosynthetics in geotechnical construction projects has gained tremendous popularity over the past 30 years. Ranging from the reinforcement and separation functions in roadway construction, to the filtration functions in earthen dams, geosynthetic applications are as varied as the types of geosynthetics available on today's market. The separation function is typically utilized in road construction where the sub grade condition is poor. A geosynthetic will act as a barrier preventing the roadway's base materialfrom being pushed into the weaker sub grade material, resulting in a smaller amount of base material required for the construction of the road. Geosynthetics may also aid in the construction of filters and drains.*

1. Introduction

Geotextiles have the widest range in properties in thegeosynthetics field, making them particularly well-suited for a range of potential applications.For many projects, inclusion of geotextiles in roadway design may prove advantageous whencompared to traditional materials and methods. This guide is presented first as a means ofunderstanding the various applications a geotextile may address in roadway design, anddetermining whether a geotextile presents an economic design alternative for a specific project. For the case in which a geotextile is appropriate, information regarding selection of an appropriate product and proper installation during construction is provided.

Geosynthetics may be divided into two distinct categories: geotextiles and geogrids. Geotextiles are typically made from petroleum products such as polypropylene, polyester, andpolyethylene; however, they may also be made from fiberglass. Geotextiles may be furtherdivided by the manner in which they were manufactured. For instance, woven geotextiles are made by weaving individual filaments together to create an interlocking structure. Conversely, nonwoven geotextiles are manufactured by bonding together randomly oriented short fibers orfilaments to form a planar structure. For nonwoven geotextiles, the bonding process may bechemical, thermal, or mechanical.

A. Survivability Requirements

For any of the design methods presented in this chapter to function properly, it is necessary that the geo-membrane survive the packaging, transportation, handling, and installation demands that are placed on it. This aspect of design cannot be taken lightly or assumed simply to take care of itself. Yet there is a decided problem in formulating a generalized survivability design for every application, since each situation is unique. Some of the major variables affecting a given situation are the following:

- Storage at the manufacturing facility.
- Handling at the manufacturing facility.
- Transportation from the factory to the construction site.
- Offloading at the site.
- Storage conditions at the site.
- Temperature extremes at the site.
- Subgrade conditions at the site.
- Deployment at the approximate location.

B. Objective

- To quantify the pavement performance benefits of geosynthetics in pavement base and sub-base layers, including improved ride quality and reduced cracking.
- To increase road performance, potentially leading to savings in maintenance costs.
- To study relative efficiency of geotextile as compared to use of conventional techniques.
- To evaluate the cost-effectiveness of using geotextiles at the sub grade-granular material interface. .

2. Methodology

- Collection of soil samples.
- To carry out the tests for virgin soil.
- To identify the lacking property soil.

3. Experimental Investigations

a. Properties of Black cotton soil

Sr.No.	Property	BC Soil
1	Specific gravity	2.58
2	Grain size distribution (%) Gravel Sand Silt Clay	 1.3 24.0 52.0 22.0
3	Consistency limits (%) Liquid limit Plastic limit Plasticity index	 52 23 30
4	IS soil classification	MH
5	CBR value (%) IS Heavy compaction a) OMC condition b) Soaked condition	 7.0 0.3
6	UCS for IS Heavy Compaction (kN/m^2) a. For OMC and MDD b. For 95% compaction on dry side c. For 95% compaction on wet side	 380 350 300

b. Basic Tests

The basic tests performed includes test for Specific Gravity, Atterberg's limits, Water content, Specific gravity, Proctor test, Optimum moisture content and MDD.

4. Experiments

Results of tests conducted on Black Cotton soil &Murum

4.1 Water content

Soil sample number	1	2	3
Mass of empty container (M_1) (gm)	24.20	23.15	23.00
Mass of container+ wet soil (M_2)(gm)	63.50	64.70	65.10
Mass of container+ dry soil + water (M_3) (gm)	61.40	63.49	62.75
Water content (%)	5.46	2.99	5.91
Avg. Water content (%) 4.84			

4.2 Specific gravity

Soil sample number	1	2	3
Mass of empty bottle (M_1) (gm)	642.59	634.45	619.20
Mass of bottle + wet soil (M_2) (gm)	1008.40	1007.45	1002.09
Mass of bottle + dry soil+ water (M_3) (gm)	1710.19	1690.40	1749.58
Mass of bottle + water (M_4) (gm)	1490	1466.20	1524.42
Specific gravity	4.27	2.50	2.42
Avg. specific gravity 3.05			

For Black Cotton Soil:

4.3 Liquid Limit

Soil sample No.	1	2	3
Mass of empty container (M_1) (gm)	20.20	22.17	20.65
Mass of container + wet soil (M_2) (gm)	33.7	34.17	32.12
Mass of container + dry soil (M_3) (gm)	29.47	31.24	28.45
Water content (%)	45.63	43.39	47.05
Number of blows	31	12	19

4.4 Plastic Limit

Soil sample number	1	2	3
Mass of empty container (M_1) (gm.)	20	19.46	23.38
Mass of container + wet soil (M_2) (gm.)	21.45	21.71	26.90
Mass of container + dry soil (M_3) (gm.)	21.24	21.26	26.20
Water content (%)	19.33	25	24.38
Avg. water content 22.90%			

4.5 Proctor test

Soil sample number	1	2	3
Weight of the empty mould (W_m) (gm)	7430	7430	7430
Internal diameter of mould (d) (cm)	10	10	10
Height of mould (h) (cm)	12.74	12.74	12.74
Volume of mould(V= π/4)d2*h	1000	1000	1000
Weight of mould+ base plate+ compacted soil (W_1) (gm)	8750	8940	8560
Weight of compacted soil(W_1-W_m)	1320	1510	1130

Weight density γw	1.32	1.51	1.13
Container number	C1	C2	C3
Weight of container (X_1)	20.30	22.85	21.45
Weight of container + wet soil (X_2)	84.7	124.30	115.34
Weight of container +dry soil (X_3)	79.63	115.15	104.50
Weight of dry soil (X_3-X_1)	59.33	92.3	83.05
Weight of water (X_2-X_3)	5.07	9.15	10.84
Water content (%)	8.54	9.19	13.05
Dry density (γd = γw/1+w/100)	1.21	1.37	1.17

4.6 CBR test on Black Cotton soil

Sr. No.	Deformation in dial Gauge reading(mm)	Division on dial gauge	Load in kg
1	0.5	8	10.928
2	1.0	12	16.392
3	1.5	17	23.222
4	2.0	21	28.687
5	2.5	26	35.514
6	4.0	32	43.711
7	5.0	37	50.543
8	7.5	49	66.930
9	10.0	61	81.494
10	12.5	77	102.865

5. Graph

Fig 1. Liquid limit

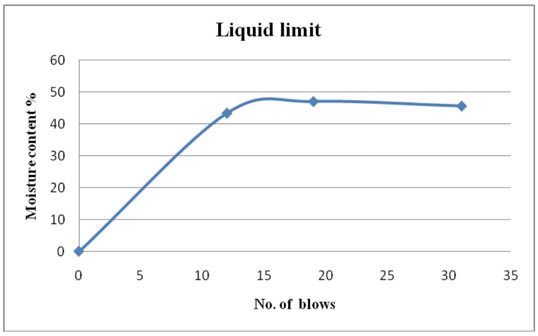
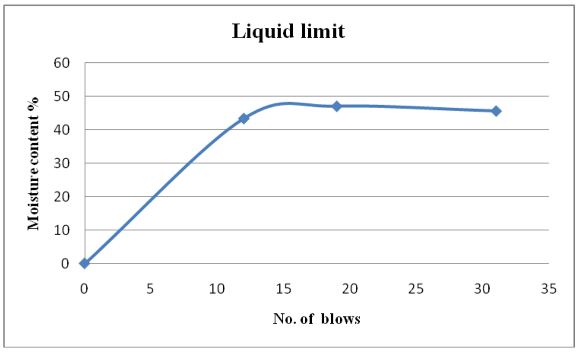


Fig 2. For OMC and MDD



6. Result and Discussions

The study of soil characteristics and the analysis is very important aspect in the design of the pavement which involves several complexities due to variable factors. This study is aimed at evaluating the strength properties of the given soils by stabilizing using the given stabilizers and the results are compared with the virgin soil sample.

- One important way to help achieve these goals is through the employment of a flexible pavement structure designed and built with geosynthetics (Jute).
- The CBR value of soil increases with the increase in length and diameter of fiber. Geosynthetic (Jute) Material is cheap, locally available, biodegradable and is a eco-friendly material.It provides improvement in the tensile strength of the pavement.
- A range of effective products and systems are available providing different levels of reinforcement, stress relief and sealing. Correct installation is of paramount importance to the effective performance of all these systems.
- Strength and Bearing capacity of Black cotton soil increases with the application of Jute, thickness decreases and thus cost reduces.
- We have tested it Black Cotton soil there is increase in CBR value. Black Cotton soil can be used for medium loading
- As stated in the paper, fibre is used in various percentages, but practically it is very difficult to add such percentage in huge amount of soil. Instead of that if we use thick woven jute, it may give better results.

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