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PAVEMENT STRENGTHENING ANALYSIS OF GEO TEXTILES AS SUB GRADE

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Abstract:

Geotextiles have been widely promoted for pavement structure. However, there is a lack of well-instrumented, full-scale experiments to investigate the effect of geotextile reinforcement on the pavement design. In this study, full–scale accelerated tests were conducted on eight lanes of pavement test sections. the lots of indoor and outdoor experiments, several key technical issues in construction of the Desert Highway have been solved satisfactorily, on the basis of great achievements of the studies in respects of dry compaction on sand base, design parameters, structure combination of subgrade and pavement, stabilization analysis of sand base strengthened with geotextile and a complete set of construction techniques. Using geotextiles in secondary roads to stabilize weak subgrades has been a well-accepted practice over the past thirty years. Two design methods were used to quantify the improvements of using geotextiles in pavements However, from an economical point of view, a complete life cycle cost analysis (LCCA), which includes not only costs to agencies but also costs to users, is urgently needed to assess the benefits of using geotextile in secondary road flexible pavement. Two design methods were used to quantify the improvements of using geotextiles in pavements. In this study, a comprehensive life cycle cost analysis framework was developed and used to quantify the initial and the future cost of 25 representative low volume road design alternatives. The sub grade must be stable, unyielding, properly drained and free from volume changes due to variation in moisture. If not, it leads to failure of pavement. Normally, pavement fails due to the reasons such as structural, functional, or materials failure, or a combination of these. But in the study area, it is observed that, the pavement failure is under the category of structural failure

1.0 Introduction

The economic development of a country is closely related to its road transport infrastructure facilities available. Especially in an under developing country, the rural roads connecting agricultural villages is vital in improving the rural economy. It is known that the option of unpaved roads are economical for low traffic volume in such areas, however, when unpaved roads laid on soft sub-grade undergoes large deformations, where the periodical maintenance of the rural road is limited due to cost considerations, which may disrupt the service and affect the function of the road. In such situations, comparing various other methods, geo-synthetics can be utilized to improve not only the performance of the unpaved road by increasing the life time, but also, minimizing the maintenance cost as well as reducing the thickness of the road. India has one of the largest road networks in the world, aggregating to about 33 lakh km at present.

Geotextiles:

Textiles were first applied to roadways in the days of the Pharaohs. Even they struggled with unstable soils which rutted or washed away. They found that natural fibers, fabrics, or vegetation improved road quality when mixed with soils, particularly unstable soils. During the past thirty years, geotextiles have been known to be good for improving the performance of paved or unpaved roads. Both woven and nonwoven geotextiles can be effectively used in the separation/stabilization of primary highway, secondary or low volume roads, unpaved and paved (access roads, forest roads, haul) roads, parking lots, and industrial yards.

Use of geotextiles

The use of geo textiles in ground improvement is too well known to be emphasized here. One of the most common uses of geo textiles has been in the construction and rehabilitation of both permanent and temporary roadways. Being produced from natural resources, jute geo textiles are eco-friendly. Since synthetic geo textiles are expensive in India, cheaper substitutes like jute have become more popular. The broad application and uses of geo textiles have been fairly identified have given analysis and design approach for an unpaved road reinforced with jute fabric.

Function of geotextiles

In a given application, a geotextile can perform one or several functions to improve the hydraulic and/or the mechanical behaviour of a structure in which it is incorporated. Every textile product applied under the soil is a geotextile. The products are used for reinforcement of streets, embankments, ponds, pipelines, and similar applications Depending on the required function, they are used in open-mesh versions, such as a woven or, rarely, warp-knitted structure, or with a closed fabric surface, such as a non-woven.

Problem statement:

Geotextiles have been used in pavements to either extend the service life of the pavement or to reduce the total thickness of the pavement system. The economic benefits of using this material are not well documented. Only initial cost is usually reported. A study considering the LCCA of geo synthetically stabilized pavements, including initial construction, future maintenance, rehabilitation, and user costs, is needed.

2.0 literature review

The roadway considered in this study is a secondary road system. It is hypothesized that geotextiles work as a cost effective separator between the granular base layer and the natural subgrade of the pavement. It is reported that geotextiles improve pavement performance by preventing the intermixture of subgrade fines and base layer. If, in the absence of a geotextile at the subgrade/base course interface, aggregate contamination by the subgrade fines occurs, the overall strength of the pavement system will be weakened.

Hans and Andrew (2001) investigated the reinforcement function of geo synthetics for a typical Minnesota low volume roadways. From the study it was observed that the addition of a geo synthetic does provide reinforcement to the roadway as long as the geo synthetic is stiffer than the subgrade material. The service life of a roadway may also be increased with the addition of geo synthetic reinforcement.

Schriver at al. (2002) conducted experimental study on geo-grid reinforced lightweight aggregate beds to determine their subgrade modulus and increase in the bearing capacity ratio. From study it was observed that the geo-grid reinforcement placed at sub base/aggregate interface effectively increases the service life of paved roads.

Ranadive (2003) investigated the performance of geotextiles reinforcement in soil other than sand. In this study, model strip footing load

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tests are conducted on soil with and without single and multi-layers of geotextile at different depths below the footing. Testing was carried out on Universal Testing Machine. From the study it was observed that bearing capacity improved considerably for reinforced soil over unreinforced soil.

Lyons, C.K. and J. Fannin (2006) conducted plate load test to study the variation of load carrying capacity for both reinforced and unreinforced pavements. It was observed that the bearing capacity improved by providing coir geotextiles as reinforcement. She reported an increase in bearing capacity by 1.83 times for reinforced pavement compared to unreinforced pavement.

3.0 Methodology

Design guidelines and procedures for using geotextiles in flexible pavement road construction can be found in the "Geotextile Engineering Manual" and "Geotextile Design and Construction Guidelines." Design examples for geotextiles used in flexible pavement for roads are also given in the "Geotextile Engineering Manual" and in "Geotextile Engineering Workshop Design In using geotextiles in the design of flexible pavement for roads no structural support is assumed to be provided by the geotextile, and therefore, no reduction is allowed in the aggregate thickness required for structural support Standard design methods are used for the overall pavement system.

Woven geotextiles:

Consist of monofilament, multifilament, slit-film and/or fibrillated slit-film yarns - often in combinations - that are woven into a geotextile on conventional textile weaving machinery using a wide variety of traditional, as well as proprietary, weaving patterns. The variations are many and most have a direct influence on the physical, mechanical and hydraulic properties of the fabric.

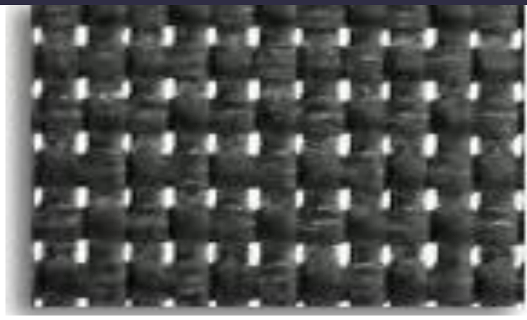


Figure:Woven geotextiles

Nonwoven geotextiles:

Consist of fibers that are continuous filament or short staple fibers. These fibers are then bonded together by various processes that can include a needling process that intertwines the fibers physically (needle punched), or a chemical / thermal bonding operation that fuses adjacent fibers together.

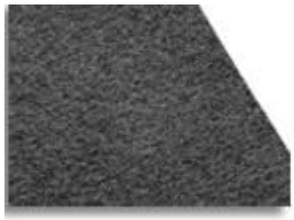


Figure: Nonwoven geotextiles

Woven Geotextile manufacturing:

We'll start with woven geotextile fabrics. As their name suggests, making these fabrics uses a process similar to how other traditional fabrics are made. Woven geotextile fabrics are created on large industrial looms that interlace horizontal and vertical threads to form a tight criss-cross or mesh.

Table: Comparison of predicted interface friction angles between geotextile and soil

tan δ/tan π for:	needle-punched nonwoven	thermally bonded nonwoven /woven
clay	~ 0.92	~ 0.84
fine sand	~ 0.92	~ 0.80
coarse sand	~ 0.95	~ 0.83

Geotextiles using Materials:

The soil sample used in this study is collected from Major area of bidhar, The area is largely covered with clayey soil. The soil is classified as clay of high compressibility (CH) as per Indian standard classification system. The soil is then air dried and is pulverized with a wooden mallet.

Modeling of Pavements:

Numerical analysis helps researcher predict performance of pavements via simulation. Finite element method (FEM), discrete element method (DEM), and finite difference method (FDM) are three types of numerical analysis commonly used by civil engineers. In FEM and DEM, the structure is divided into numerous cell/grid points. DEM is primarily used to analyze granular and discontinuous materials. Intense computational process of DEM limits method application for analysis of massive structures such as pavement.

Results

In this study two material models were considered for the HMA layer: elastic and creep model. Initially, the HMA layer was modeled based only on its elastic modulus. The elastic model, however, could not show permanent strain in this layer after unloading; the layer rebounded after removal of the load and the vertical plastic strain in this layer was zero. Therefore, the elastic model is not an appropriate model for HMA and other pavement layers. Plastic deformation of aggregate base and subgrade layer has a defining role in determining pavement performance. A majority of rutting in HMA pavements happens due to permanent deformation of the base and/or subgrade layer(s). Therefore, an accurate model should consider plastic behavior of the underlying layers

HMA Layer Properties:

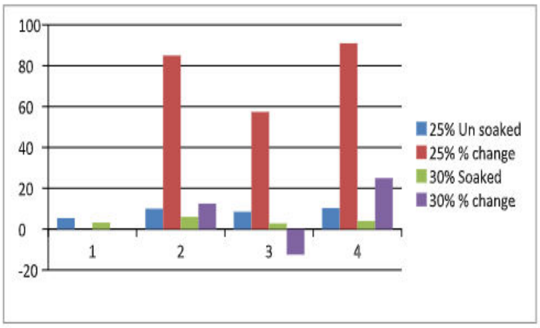
Plastic behavior of the HMA layer was modeled using creep properties. The elastic modulus and Poisson's ratio were used to model elastic behavior of the HMA layer. Elastic layer moduli for each section were back calculated from surface deflection data obtained in the FWD test. Poisson's ratios were estimated to be typical values because their effects on the back calculation 63 process were negligible. The creep model was defined by five material parameters which define time-dependent behavior of the HMA material: creep parameters, A, m, and n. In order to obtain these parameters, flow test was conducted on samples compacted by the Super paver Gyratory compactor with loose asphalt samples from CISL test sections

CBR test Results:

No anchorage provided to the geo textiles.The results of CBR test conducted on local soil by placing geo-textile at various depths anchorage was provided. can be observed that the CBR values for soil reinforced with geotextiles shows a lower CBR value than that obtained for reinforced case in case of soaked soil. This decrease may be attributed to the slippage of the geotextile that takes place between the soil layers. In the field layer slippage doesn't happen. Hence anchors were provided and the CBR test was repeated.

Table: Summary of CBR values Soil with Polypropylene

Soil with Polypropylene	Plain	GT top	GT 1/2	GT 1/3	GT top and ½
25%	Un soaked	5.4	10	8.5	10.3
	% change		+85	+57.4	+91
30%	Soaked	3.2	6	2.8	4
	% change		+12.5	-12.5	+25



Graph: Summary of CBR values Soil with Polypropylene

Table: Summary of CBR values Soil with Polyester

Soil with Polyester	Plain	GT top	GT 1/2	GT 1/3	GT top and ½
25%	Un soaked	5.4	3.2	6.5	8.4
	% change		+75	+80.4	+81
30%	Soaked	3.2	5	2.5	4
	% change		+11.10	- 10.4	+18

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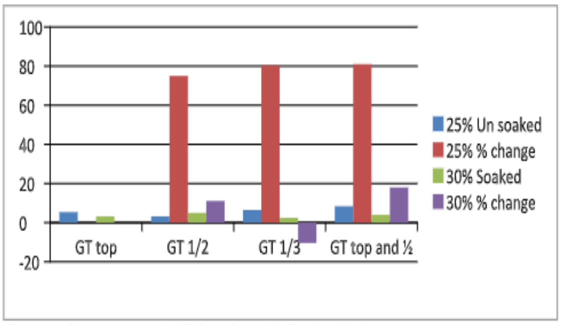
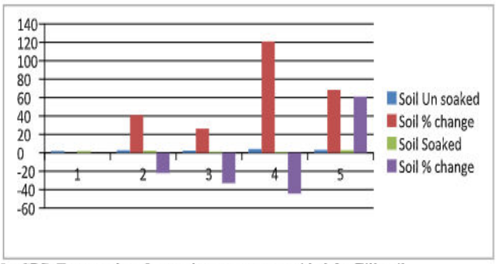


Graph: Summary of CBR values Soil with Polyester

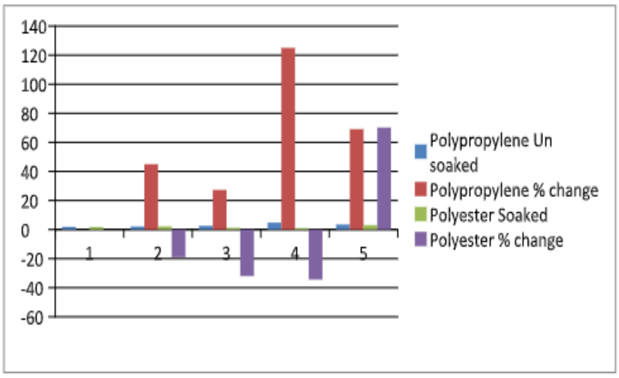
Soil	Plain	GT top	GT top	GT 1/2	GT 1/3	GT top and 1/2
Polypropylene	Un soaked	1.9	2.8	2.4	4.2	3.2
	% change		41	26.3	121	68.4
Polyester	Soaked	1.8	2.2	1.2	1	2.9
	% change		-22	-33	-44.4	61.1



Graph: CBR Test results after anchorage was provided for Fill soil

Table: Summary of CBR values for Fill soil 30 %

Soil	Plain	GT top	GT top	GT 1/2	GT 1/3	GT top and 1/2
Polypropylene	Un soaked	1.9	2.11	2.6	4.8	3.5
	% change		45	27.3	125	69.1
Polyester	Soaked	1.8	2.2	1.2	1	3.1
	% change		-19	-32	-34.4	70.2



A series of same test were conducted after proper anchorage of geo-textiles in soil layers using bamboo nails of 2.5 cm long. Figure shows the results of CBR tests conducted after providing proper anchorage to the geo textiles.

- The percentage reduction in the compression index at an elapsed time of 30 months after placing the jute geotextile at different locations is 30.8, 37.7 and 34.4 respectively.
- The CBR values obtained on the subgrade soil before laying the geotextile and 30 months after laying The CBR values were determined on the sample collected from location
- The increase in CBR is as high as three times that of the natural soil, which ensures that the thickness of the crust can be effectively reduced following improvement with the geotextile.

Conclusion:

Textiles are not only clothing the human body but also our motherland in order to protect it. The maximum dry density value is increasing with reduction in optimum moisture content with maximum value of 1.84g/cc at 16% OMC for 100mm depth from the top of mould, due to greater soil to soil interaction provided by polypropylene, as the space which was earlier occupied by air particles are now replaced with soil particle having greater density. The CBR value of soil increases by 3.43% and 6% for polyester placed at H/5 and 2H/5 depths from top of specimen. CBR value of soil decreases for 75mm (3H/5) and 100 mm (4H/5) depth of geotextile placement from top, which is even below the CBR value of unreinforced soil. The improvement in soil properties is seen in upper layers, this may be due to more resistance offered by geotextiles to penetration and there is improvement in load-penetration behaviour. The most optimum position of geotextile placement is at 2H/5 (50mm) depth from top of compacted specimen where maximum improvement in CBR value was seen. The use of polypropylene and polyester in soft subgrade causes reduction in thickness requirement of pavement, increases the service life and reduces the frequency of maintenance required, resulting in economical pavement design.

The CBR value for reinforced soil under soaked condition is found to be lower than the unreinforced soil for very soft soil.

1. There is considerable increase in the CBR value when the geotextile is anchored to the soil. There is an increase of more than 100% for geotextile placed at the surface and more than 25% increase when the geotextile is placed at the mid height of the subgrade to that of unreinforced soil.

2. The CBR value of soil with anchored geotextile is observed to vary from 17% to 100% for unsoaked condition and 4% to 75% for soaked condition with respect to that without anchorage.

References:

[1] Masad, E. A., and Little, D. N.(2012). "Comparing finite element and constitutive modeling techniques for predicting rutting of asphalt pavements" International Journal of Pavement Engineering, 13(4), 322-338.

[2] Abduljauwad, S. N. (1996)." Effect of geotextile on permanent deformation in salt-encrusted subgrade soils" Transportation Research Record: Journal of the Transportation Research Board, No. 1534, Transportation Research Board, Washington, D.C., pp. 40–49

[3] Qin, H., and Liu, X. (2010). "Unsaturated creep tests and empirical models for sliding zone soils of Qianjiangping landslide in the Three Gorges.", Journal of Rock Mechanics and Geotechnical Engineering 20(2), pp.49-54

[4] Bhosale, S.S. and B.R. Kambale (2008) "Laboratory Study on Evaluation of Membrane Effect of Geotextile in Unpaved Road," The 12th International Conference of International Association for Computer Methods and Advances in Geo mechanics, Goa, India, 4385-4391.

[5] Tan and K.W. Leong (2005) "Performance of Geotextiles Stabilized Unpaved Road Systems Subjected to Pretensioning," Geo-Frontiers-2005, Annual ASCE Conference Proceedings, Austin, Taxes, USA, Vol. 155, 405-412.