

A Study Review on Geosynthetics use on Flexible Pavement Design

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Abstract:- This study covers a literature search and review to obtain information on geotextile applications related to pavement construction. Applicable information from this study, if sufficient, would then be used to prepare guidelines on design application, material specifications, performance criteria, and construction procedures for improving subgrade support with geotextiles in general aviation airport pavements. The study revealed that there are numerous design procedures available for using geotextiles in aggregate surfaced pavements and flexible pavement road construction. However, there is no generally accepted procedure for either type construction. The state-of-the-art has not advanced to the point where design procedures for using geotextiles in paved airport construction are available. Construction/installation procedures are available for using geotextiles in aggregate surfaced pavements and flexible pavements for roads, and these may be used as an aid in recommending procedures for airport construction. Results of comprehensive tests by researchers indicate that geogrids have more potential than geotextiles for reinforcement of flexible pavements. Until design procedures for flexible pavements for airports incorporating geotextiles are developed, current standard airport pavement design procedures should continue to be used, and if geotextiles are included in the structure, no structural support should be attributed, to geotextiles. Further research on the use of geotextiles to improve subgrade support for general aviation airports should be delayed until the laboratory grid study and field grid tests are completed.

INTRODUCTION

Geosynthetics are an established family of geomaterials used in a wide variety of civil engineering applications. Many polymers (plastics) common to everyday life are found in geosynthetics. The most common are polyolefins and polyester; although rubber, fiberglass, and natural materials are sometimes used. Geosynthetics may be used to function as a separator, filter, planar drain, reinforcement, cushion/protection, and/or as a liquid and gas barrier. The various types of geosynthetics available, along with their specific applications, are discussed in subsequent sections.

OBJECTIVE OF THIS STUDY

The objective of this study is to extend a Pavement's life-span, and enables the construction of a pavement with a reduced quantity of base course material without sacrificing pavement performance. We will study the properties of Soil at different layers in a flexible pavement, i.e. subgrade, sub-base & base course. And analyze the

behavior of soil with & without geosynthetic material by finding out the CBR values. Also to prove the use of geosynthetic material in flexible pavements helps in enhancing the properties of pavements and provides various characteristics like: **filtration, drainage, separation, reinforcement, durability, service life & cost reduction.** The soil in which it is to be used is characterized on the basis of tests performed: liquid limit, plastic limit, optimum moisture content, minimum dry density, CBR tests, and specific gravity. Then the material is placed in the sub-grade layer at different heights and is tested to obtain best values of CBR. The combined results are then used to design pavements using design software.

LITERATURE REVIEW

J.G. Zorn Berg (2014)

In this study, he has conducted the several comparative study of geosynthetics in geotechnical projects. It updates the information provided by Zornberg (2012). For each type of geotechnical project, the following aspects are discussed: (i) some difficulties in their design, (ii) a creative approach to address the difficulties using geosynthetics, and (iii) a recent project illustrating the creative use of geosynthetics. Specifically, this paper addresses the creative use of geosynthetics in the design of earth dams, resistive barriers, unsaturated barriers, veneer slopes, coastal protection systems, foundations, bridge abutments, retaining walls, embankments, and pavements.

Pardeep Singh, K.S.Gill (2012)

They studied the quality and life of pavement is greatly affected by the type of sub-grade, sub base and base course materials. The most important of these are the type and quality of sub-grade soil. But in India most of the flexible pavements are need to be constructed over weak and problematic sub-grade. The California bearing ratio (CBR) of these sub-grade have very low, it needs to more thickness of pavement. Decrease in the availability of suitable sub base and base materials for pavement construction have leads to a search for economic method of converting locally available problematic soil to suitable construction materials. The present research have to study the effect of geo-grid reinforcement on maximum dry density (MDD), Optimum Moisture Content (OMC), California Bearing Ratio (CBR) and E-Value of sub-grade soil. The clayey type of soil and one type of geo--grid 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 geo-grid reinforcement. In case of without reinforcement (Geo-grid) the soaked CBR value was 2.9% and when geo-grid was placed at 0.2H from the top of the specimen the CBR increases to 9.4%.

Mayura M. Yeole, Twinkal P.Thakur, Yogita Gaurav, Yash Agarwal (2018)

They discussed the paper discusses the problem of the soft soil and solution to overcome it. The use of geotextile as a reinforcement in soil in the emphasizing point of research which is been reflected into the paper. The test California bearing ratio been performed to check the behaviors of soil when induced/combined with geotextile. They performed Modified Proctor Teston to the soil with and without geotextile for the reading of the OMC and MDD which are 14.35% for pure soil and 11.38 % for the soil with geotextile. Thus the reading obtained are been used in finalizing the CBR test methodology. The test that where performed where for soaked condition that has been taken at different depth with different layer of the geotextile material.

Taylor M. Goldman (2011)

He did research for three-year, project aimed at determining the benefits of using geosynthetic reinforcements to improve the performance of flexible pavements constructed over poor subgrade soils. The test site, known as the Marked Tree site, is an 850-ft (258-m) long segment of low-volume frontage road along Highway 63 in the town of Marked Tree, Arkansas. The site, constructed in 2005, consists of seventeen 50-ft (15.2-m) long flexible pavement test sections with various types of geosynthetic reinforcements (woven and nonwoven geotextiles, and geogrids), which were all positioned at the base-subgrade interface, and two different nominal base course thicknesses [6-in (15.2-cm) and 10-in (25.4-cm)]. One section in each nominal base course sector was left unreinforced to allow for monitoring of the relative performance between reinforced and unreinforced sections of like basal thicknesses. The different sections were evaluated in this study using deflection-based, surficial testing conducted between 2008 and 2011, as well as subsurface forensic investigations conducted in October 2010. Signs of serious pavement distress appeared in some of the test sections in the Spring of 2010. Distress surveys revealed that all of the “failed” sections [defined herein as sections with average rut depths > 0.5 in (1.3 cm)] had nominal base thicknesses of 6-in (15.2-cm) and were reinforced with various geosynthetics. None of the sections with 10-in (25.4-cm) nominal base thicknesses had “failed” despite receiving more than twice the number of ESALs as the 6-in (15.2-cm) sections.

P. B. Ullagaddi, T.K.Nagaraj (2010)

They did an investigation on “geosynthetic reinforced two layered soil system” which says that investigation has been carried out with different thickness configuration of the two soils and three types of woven and non-woven geotextiles, having different physical and mechanical properties. Based on experimental work it infers that there

is improvement in CBR Value and therefore increases bearing capacity. Due to increase in bearing capacity, thickness of soil layer can be reduced to serve the same functioning. Based on U.S .corps and IRC method, woven geotextile found to be more effective in increasing CBR value than non-woven geotextile.

Richard D. Barksdale (1989)

This study was primarily concerned with the geosynthetic reinforcement of an aggregate base of a surfaced, flexible pavement. Separation, filtration and durability were also considered. Specific methods of reinforcement evaluated included (1) reinforcement placed within the base, (2) pretensioning a geosynthetic placed within the base, and (3) prerutting the aggregate base with and without reinforcement. Both large-scale laboratory pavement tests and an analytical sensitivity study were conducted. A linear elastic finite element model having a cross-anisotropic aggregate base gave a slightly better prediction of response than a nonlinear finite element model having an isotropic base. The greatest benefit of reinforcement appears to be due to small changes in radial stress and strain in the base and upper 12 in. of the subgrade. Greatest improvement occurs when the material is near failure. A geogrid performed differently and considerably better than a much stiffer woven geotextile; geogrid stiffness should be at least 1500 lbs/in. compared to about 4000 lbs/in. for a woven geotextile. Reinforcement is effective for reducing rutting in light sections having Structural Numbers less than 2.5 to 3 placed on weak subgrades (CBR less than 3%). As the strength of the section increases, the potential benefits of reinforcement decrease. For somewhat stronger sections, whether reinforcement is effective in reducing rutting where low quality bases and/or weak subgrades are present needs to be established by field trials. Both precutting and prestressing the aggregate base were found, experimentally, to significantly reduce permanent deformations. Precutting without reinforcement gave performance equal to that of prestressing and significantly better than just reinforcement. Precutting is relatively inexpensive to perform and deserves further evaluation.

Rupinderpal Singh, Dr. Pardeep Kumar Gupta(2018)

In this study they presented the “Application of Geosynthetics in flexible pavement” which says the basic engineering and geotechnical properties of poor sub-grade soils can be improved using geosynthetics like Woven/Non-Woven Geotextile to improve its strength. Pavement thickness and Cost for Construction of Pavement reduces when Geotextile was placed at different depth of subgrade soil with minimum being when Geotextile placed closer to top of mould. CBR tests were carried out by placing the Woven Geotextile in single layer at depths 0.33H, 0.66H and 0.8H (H- height of mould in CBR test) from bottom of mould under soaked condition to determine the strength of the soil. Flexible pavement was designed for both fatigue and rutting life of 100MSA at 90% reliability, when the Woven Geotextile was placed at three different depth in subgrade soil The critical strain value for both fatigue and rutting life were analyzed by IITPAVE software and the allowable strain values were computed by IRC: 37-2012.

CONCLUSION

From the different studies, it was found that:

1. Geosynthetics is a well established technology within the portfolio of solutions available for geotechnical engineering projects.
2. Yet, ingenuity continues to be significant in geotechnical projects that involve their use.
3. This paper illustrates the merits of using geotextiles as filters in earth dams.
4. The use of exposed geomembranes as a promising approach for resistive covers the use of geotextiles as capillary barrier in unsaturated soil.
5. The use of integral geosynthetic reinforced bridge abutments to minimize the “bump at the end of the bridge.”
6. The use of geogrids in the design of the highest reinforced soil wall involving geosynthetics.
7. The use of reinforcements with in plane drainage capabilities in the design of steep slopes.
8. The use of geosynthetic reinforcements to mitigate the detrimental effect of expansive clays on pavements.
9. Overall, geosynthetics play an important role in all geotechnical applications because of their versatility, cost-effectiveness, ease of installation, and good characterization of their mechanical and hydraulic properties. The creative use of geosynthetics in geotechnical practice is likely to expand as manufacturers develop new and improved materials and as engineers/designers develop analysis routines for new applications.

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