USE OF GEOSYNTHETIC MATERIALS IN ROAD CONSTRUCTION

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***Abstract*: Geotextiles, which is now an effective engineering technology, has acquired wide spread applications in pavement construction. Geotextiles are most widely used under paved and unpaved road-ways, and this is referred to as the application of separation / stabilization. In addition, geotextiles used in paved and unpaved roads provide many advantages: separation, stabilization, strengthening and filtration. In many cases, geotextiles replace or decrease the need to use natural gate building materials which provide economic and environmental benefits. Typical pain issues that are overviewed in the present study arise in road construction due to various factors. The current scenario in India requires maximum transit facilities to build in the shortest feasible time at a low cost. Analysis done on most of the failed roads owes them to the founding soil on which those roads were constructed. Jute geo-textiles developed abundantly in this subcontinent can be used for the stabilization of such poor sub-grades in a beneficial and economic way with great efficacy. Although the construction of roads over soft soils using jute geo-textile has been extremely limited but effective in India, their systematic use has yet to be recourse to. Since the experience gained from their practical adoption and also from ongoing work certainly proves to be rewarding, maybe the geotechnical community should leverage this ability and promote such applications that result in improved highway efficiency at an optimized cost. It also introduces a preliminary concept approach that was thought to be adopted for this.**

***Keywords*: Geotextile, distress of pavement, filtration, separations and reinforcement geosynthetics, pavement, subgrades, pavement, separation, embedment soil.**

I. Introduction-

Geosynthetics have been widely used to serve a variety of roles that greatly lead to roadways performing well. These provide isolation, filtration, stabilization, stiffing, drainage, barrier, and safety functions. Any or more of these different features is used in at least six major roadway applications. The applications include migration of reflective cracking in asphalt overlays, isolation, road base stabilization, ground soft subgrade stabilization, and lateral drainage. The American Society for Testing and Materials (ASTM) Committee D35 on geosynthetics has described geosynthetics as planar products made from polymeric materials used with materials related to soil , rock, earth, or other geotechnical engineering as an integral part of a man-made project, structure, or system. Geosynthetics is the term used to describe a variety of polymeric materials used in construction of civil engineering works. The concept is commonly considered to cover eight major categories of goods. These include geotextiles, geogrids, geonets, geomembrane, liners of geosynthetic mud, geofoam, geocells, and geocomposite. The geotextiles and geomembrane are the most common geosynthetics employed. The ASTM (1994) describes geotextiles as permeable textile materials used as an integral part of a civil engineering project, structure, or device in contact with soil, rock, earth, or any other geotechnical substance. Geomembrane is an inherently impermeable membrane, in the shape of a sheet that is commonly used as cut-offs and liners. These are also used to landfill lineups. Geotextiles, as permeable textile materials, are used as an integral part of a civil engineering project, structure or system in contact with soil, rock, earth or any other associated geotechnical material.

A geogrid is a polymeric structure, unidirectional or bidirectional, in the form of a manufactured surface, consisting of a normal network of integrally connected elements which can be linked by extrusion, bonding, and whose openings are larger than the constituents and are used in geotechnical, environmental, hydraulic and transport engineering applications. A geonet is a polymeric structure in the form of a manufactured sheet which consists of a regular network of integrally connected overlapping ribs whose openings are typically larger than their constituents.

A geocomposite is an engineered polymeric material in the form of manufactured sheets or bars, consisting of at least one geosynthetic portion used in applications for geotechnical environmental and transport engineering.A geomat is a polymeric structure in the form of a manufactured sheet consisting of non-regular networks of fibres , yarns, filaments, tapes or other elements that may be linked thermally or mechanically, and whose openings are larger than their constituents.

A. Functions of Geo synthetics in road construction

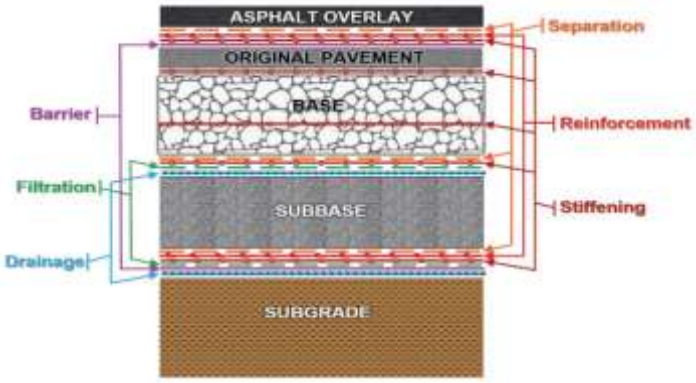


Figure 1. 1 Multiple functions of geosynthetics in roadway applications.

Although in roadway applications comparatively less common, additional geosynthetic functions include:
Hydraulic / Gas Barrier: Geosynthetic minimizes cross-plane leakage, ensuring liquid or gaseous containment. Core design properties to fulfill this role include the ones used to define the geosynthetic material's long-term durability.
Protection: The geosynthesis creates a barrier above or below other materials (e.g. a geomembrane) to mitigate damage during the placing of overlying materials. Core design properties for quantifying this role include the ones used to describe the geosynthetic material's puncture resistance.
Geosindics: A planar, polymeric (synthetic or natural) material used for filtration, drainage, isolation, stabilization, safety, sealing and packaging in contact with the soil / rock and/or any other geotechnical material.
Geosynthetics have proved to be among the most versatile, practical, and cost-effective materials for ground modification, adaptation. Their use has spread rapidly into almost every field of geotechnical, marine, coastal and hydraulic engineering of metropolitan cities.
Geosynthetics are an existing family of geo-materials used for a wide range of applications in civil engineering. Geosynthetics show a large number of polymers (plastics) essential to daily life. Possible the various forms of geosynthetics.

II. RESEARCH METHODOLOGY

The methodology used for this thesis work. It includes:

1. Selection of Site
2. Collection of materials
3. Set of Samples
4. Testing
5. Analysis of Test Results.

SELECTION OF SITE: As I want to use geo-textile in road construction in this thesis work, I have selected NH701, as construction of widening of this road is in progress, the available soil is taken for testing. This Highway extends from Sopore to Kupwara (J&K).

GEO-TEXTILE:

PP Woven Geo-textile has been purchased online from Global Protection Industries Ltd through Indiamart.com. Following were the properties of online purchased geo-textile:

Property	Value
Thickness	2-10mm
Width	10-30 inches
Colour	Black
Finsih	Coated
Material	PP

TESTING OF MATERIALS:

After collection of materials, I have done testing of all materials both individually and after mixing at Islamic University of Science and Technology, Awantipora, Kashmir.The various tests done are:

1. CBR Test
2. Atterbergs Limits
3. Specific Gravity
4. Moisture content
5. Compaction Test
6. Standard pavement test

III. RESULTS AND DISCUSSION

The laboratory experiments were conducted on the three samples obtained for the purpose of defining, classifying, and evaluating technical characteristics of the materials used. After that the samples in the pavement model were used as test subgrades.

A. Distribution Particle

This test was carried out on the natural soils and the result. They have been used to sort the samples.

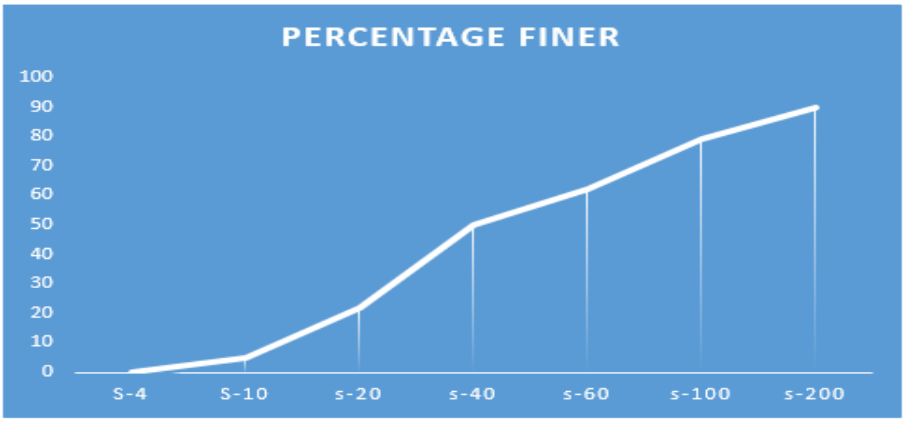


Figure 4. 1 Particle size distribution graph for Sample A

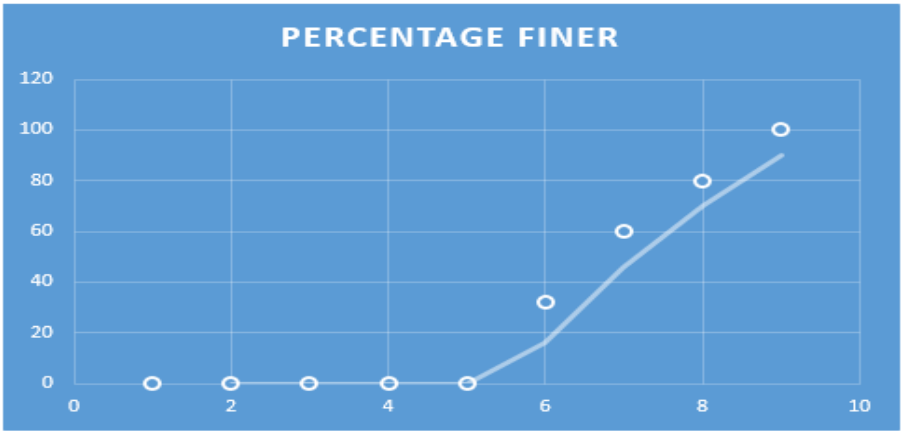


Figure 4. 2 Particle Size distribution graph for Sample B

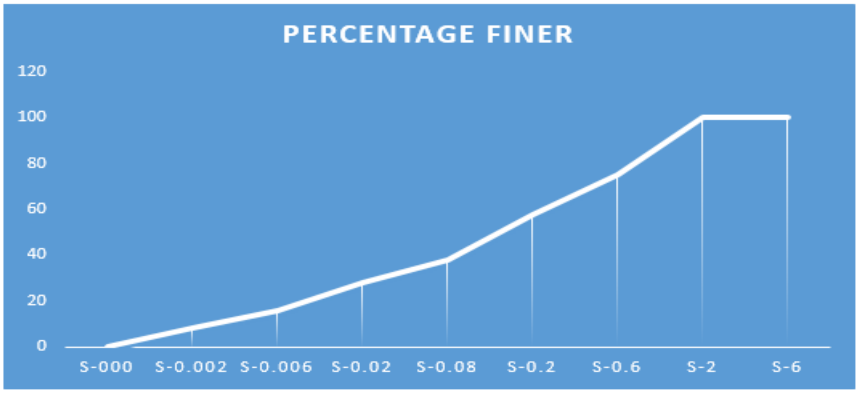


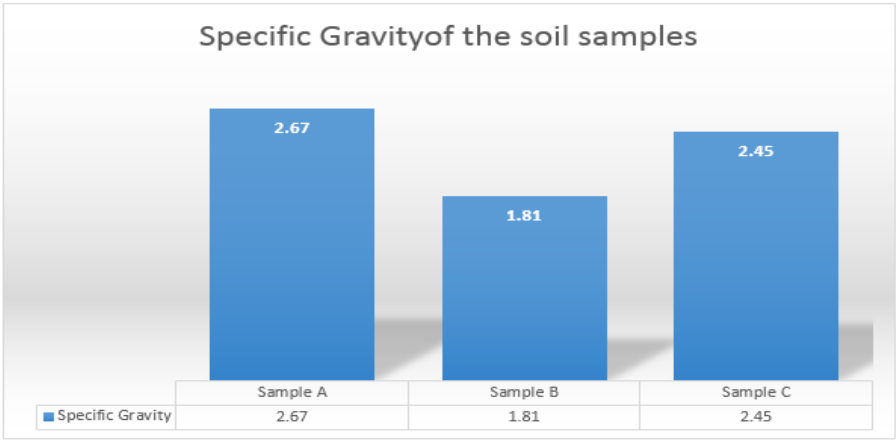
Figure 4. 3 Particle Size distribution for Sample C

Sample A, as shown above, varies between fine sand and fine gravel according to the AASHTO definition, is therefore an A-2-7 soil (silty or clayey gravel material), while sample B differs between the sand and gravel scales. The substance is gravely sand with percentages of 1.84 per cent clay, graded as A-2-4. A-6 soil (Clayey soil) is sample C that varies from mud to fine sands

B. Gravity Specific Report

The natural gravity of a soil is the measure of the weight of an equivalent amount of water to a given volume of matter. This is not appropriate for soil comprising more than 10 per cent of stones that are held in the 37.5 mm BS check sieve so these can be broken down to less than that.

The result of the specific gravity test conducted on the three samples A, B and C was 2.82, 1.79 and 2.56 respectively.



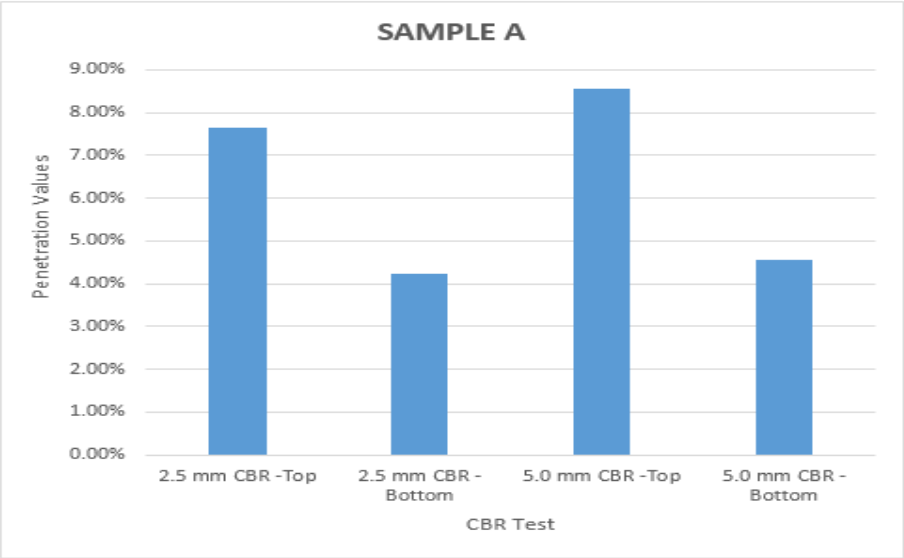
Moisture Content

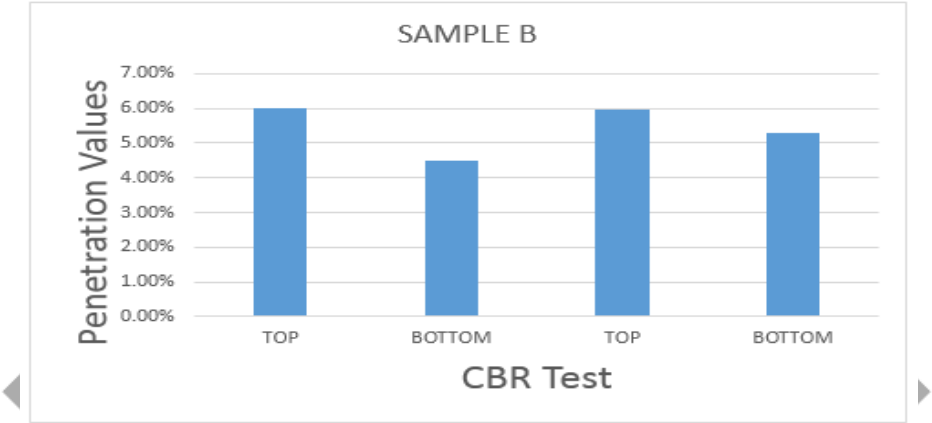
Table Showing natural moisture content of soil samples

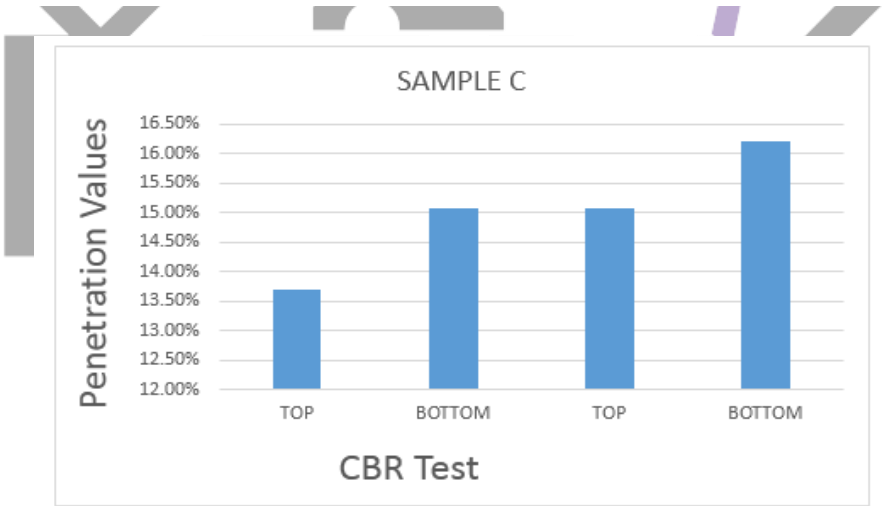
Samples	Sample A	Sample B	Sample C
MI = mass of empty clean can (g)	28.71	29.04	30.02
M2 = mass of can and moist soil (g)	96.03	93.09	90.02
M3 = mass of can and dry soil (g)	73.33	83.11	74.88
W = moisture content	0.27	0.23	0.26
W_0 = aggregate moisture content (%)	27.89	21.99	21.14

C. California Ratio Test

This research was carried out on the samples in order to readily recognize the soil 's true conduct and the shear tolerance to moisture. This shows the results with graphs showing the relationship between dry density and moisture content.





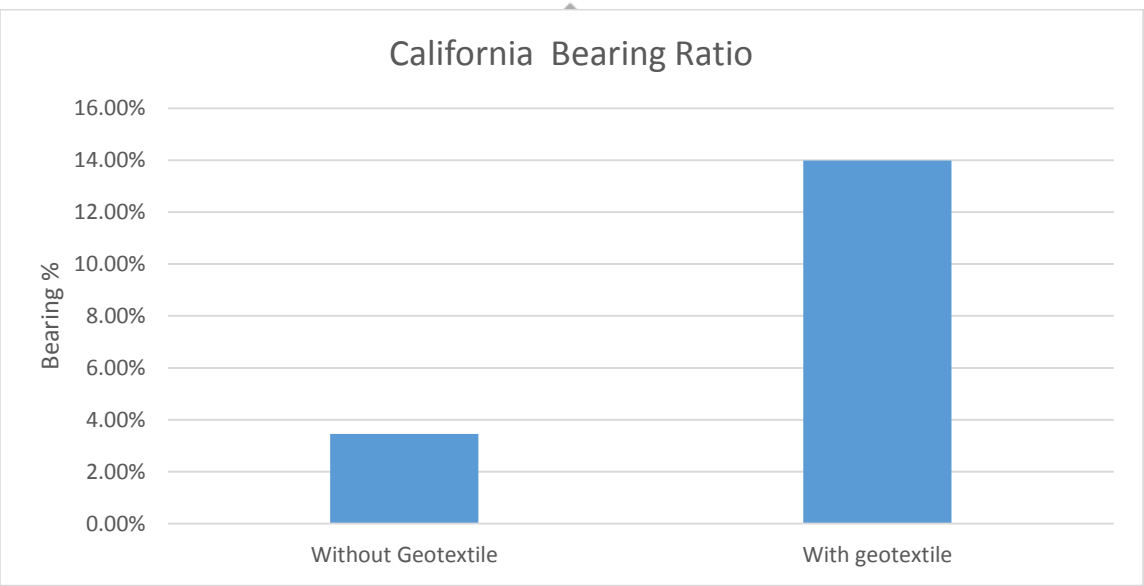


The poor CBR values shown by the A & B samples suggest that the sub-grade has a high bearing intensity and is vulnerable to degradation when subjected to moisture or surface rainfall, thereby promoting and exacerbating pavement rutting and deformation.

Test result of soil sample with geotextile and without geotextile

Table Observation

Sr. No.	Tests	Without Geotextile	With geotextile
1.	Water Content	25.9 %	27.89 %
2.	Specific gravity	2.67	2.99
3.	Direct Shear	C=0.490 kg/cm2, $\alpha = 33$	C=0.503 kg/cm2, $\alpha = 34$
4.	Core Cutter Method	ρs =1.67 gm/cm3, ρd =1.13gm/cm3	ρs =1.79 ,m/cm3,ρd =1.79gm/cm3
5.	Standard Proctor Test	MDD = 1.49 , OMC=13.11	MDD = 1.57, OMC=14.29
6.	California Bearing Ratio	3.45%	13.99 %



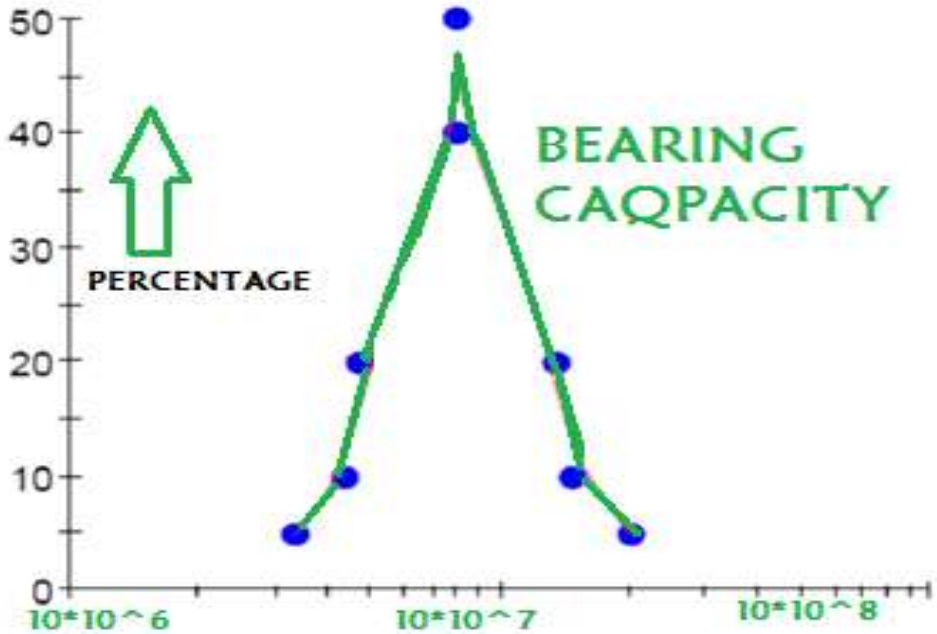


Figure Approximate Pavement Bearing Capacity Distribution (in terms of Standard Axles)

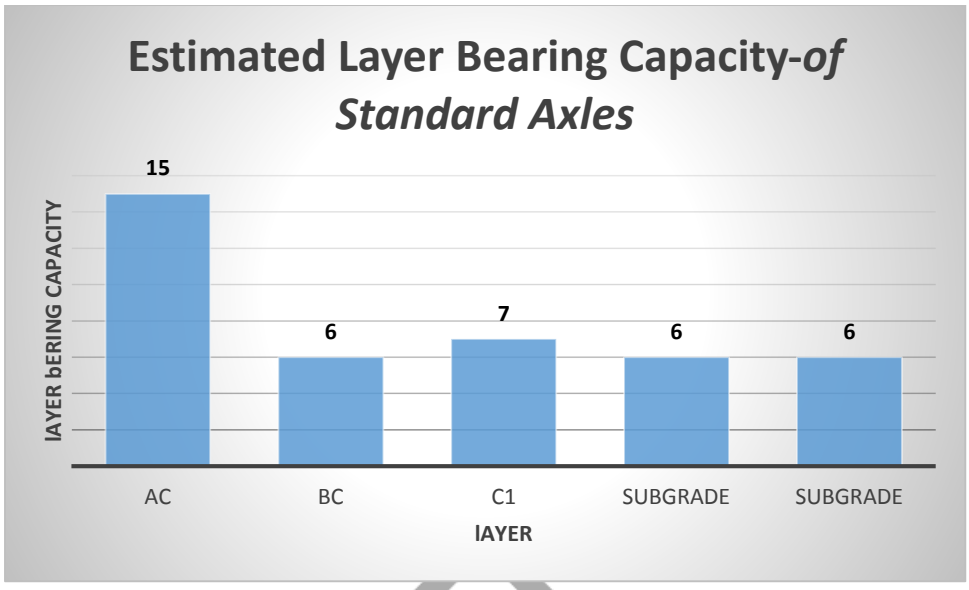


Figure Estimated Layer Bearing Capacity (in terms of Standard Axles) –

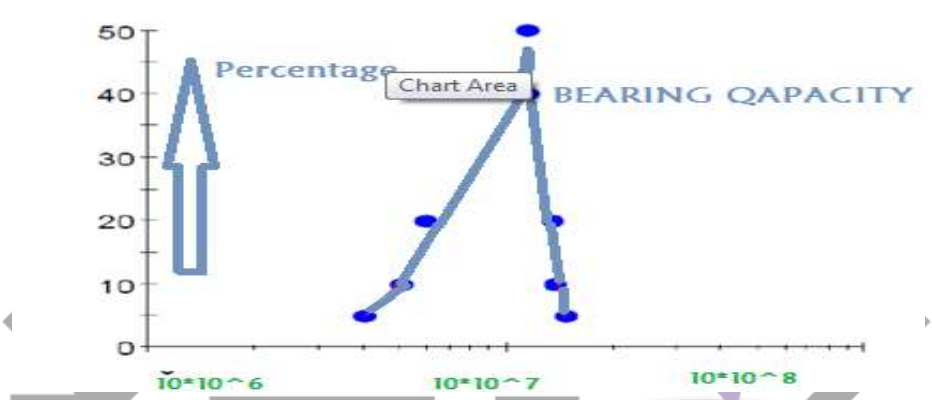


Figure Approximate Pavement Bearing Capacity Distribution (in terms of Standard *Axles)*

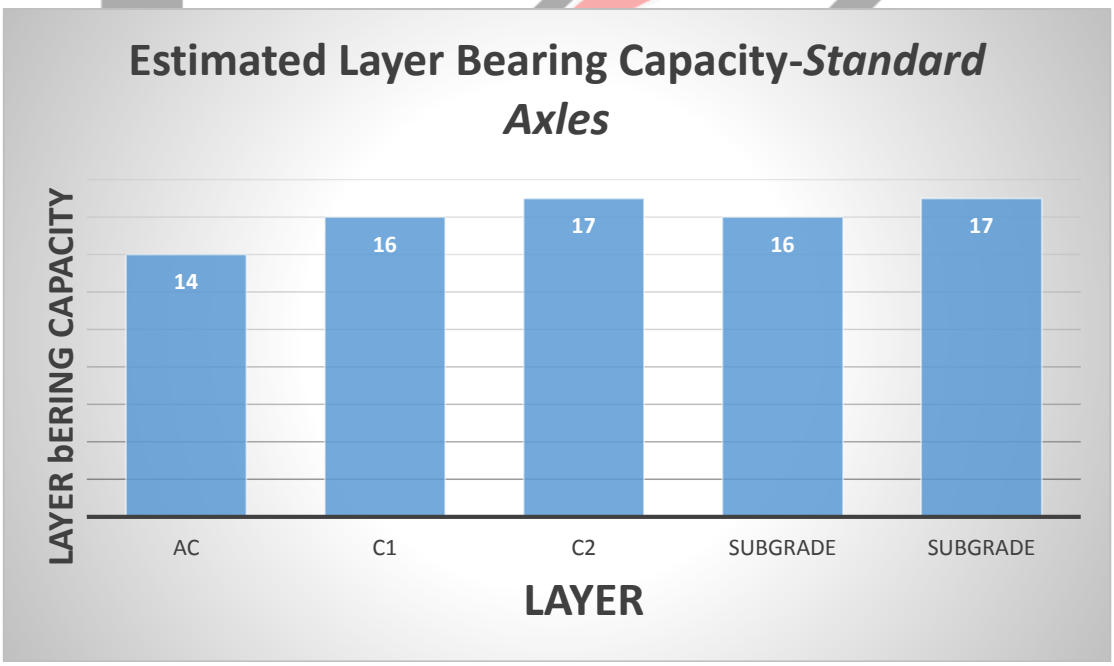


Figure Estimated Layer Bearing Capacity (in terms of Standard Axles)

IV. CONCLUSION AND RECOMMENDATION

A. Conclusion

Introducing the use of geotextiles in road building, since it eliminates the act of "borrowing to fill" because the in-situ soil can be conveniently improved by utilizing geosynthetics, is of economic gain from the above research taken on both soil sample and content.

The geotextiles perform a key function in the design of highways. They're used e ectively in almost all new building details. This significantly increases surface asset life, which e ectively reduces repair costs. It signi cantly sep-arate sub-base from sub-soil and have structural support due to its strong deformation resistance. It also decreases the thickness of the granular subbase path. This would be advantageous if geotextiles were used in the development of highways as their use would minimize initial construction costs and reduce regularly

Bridge rehabilitation and maintenance work.

Geotextiles are powerful instruments in the civil engineer 's hands and have proved to solve a variety of geotechnical issues. With the availability of a variety of products with different characteristics, the design engineer needs to be aware not only of the application possibilities but also more specifically the reason why he uses the geotextile and the functional properties of the governing geotextile to fulfill these functions. The creation and development of geotextiles focused on sound engineering concepts would benefit both consumer and business long-term purpose.

Effectiveness of geotextiles relies on the quality and proper installation of the cloth. Geotextiles are a cost-effective means of achieving proper irrigation and subgrade stabilisation. Thus it can be inferred that the geotextiles benefit from careful deployment, handling and maintenance in road building. In separation uses, also, permeability should always be considered to allow moisture to move freely through the system. This prevents excessive hydrostatic stresses that cause soil failure.

B. Recommendations

This Work has demonstrated the beneficial roles of geotextiles in road building when tested on the various forms of soil. From the data collected, incorporating the usage of geosynthetics as a whole into the engineering sector is very economical. The content can also be used to easily distinguish subgrade and sub-base courses in road building and other infrastructure constructions. Geosynthetics, such as geotextiles, geogrids and drainage geocomposites, are used for 'ltration, isolation, reinforcement and drainage by means of local labor (intensive labor technology) in South Africa and abroad with progress from subgrade reinforcement, sub-floor and foundation reinforcement to asphalt and overlay reinforcement.

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