

Use of Geo-synthetic Fiber for Strengthening of Sub Grade in Construction of Road

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ABSTRACT

Geo synthetic materials are used for so many purposes in civil engineering projects. Strengthening, filtration, drainage are the main purposes of the geo synthetic fiber. Geo synthetic reinforcing elements are used to strengthen the ground surface or sub grade in soft and weak soil. Geo synthetic fiber increases the performance and life of highways it also reduce the maintenance cost of the highways. Geo synthetic layer of the material is used below the granular sub base. Geo synthetic layer also reduce the maintenance of the sub grade. It is a light weight polymer based material and easy to use in sub grade soil. By mixing the geo textile with the soil we can achieve the required strength of the sub grade.

Keywords : Geo-synthetic, Geo-textile, Geo-grid, sub-grade, synthetic fiber, Separation

I. INTRODUCTION

Roads are an important mode of transportation in our country. In old days, animals are used for traveling from one place to other places. It can be seen in the form of bullock carts, Horse drawn cart (Ekka & Tonga) etc. Although travelling through air, water and rail is also available, but road transportation is very popular, convenient and easily available transportation. Connecting different cities and towns and villages, roads are a very important means. The first evidence of road development in the Indian subcontinent can be traced back to approximately

around 2800 BC in the ancient cities of Harrapa and Mohenjodaro of the Indus Valley civilization.

OBJECTIVE OF THE STUDY:

In past, when dealing with weak soil for the purpose of the road construction, there were two options to continue the work. Either replace all the weak soil by new soil or change the alignment of the road. Both options are very costly and sometimes it is impossible. By using geo-synthetic layer we can improve the strength of the sub grade. Geo synthetics have proven to be among the most versatile and cost-effective ground modification materials. Their use has

expanded rapidly into nearly all areas of civil, geotechnical, environmental, coastal, and hydraulic engineering.

NEED OF THE STUDY:

The objective of the dissertation is how it's work and how it is beneficial for construction of highway. Following are the main objectives of use of Geo synthetic.

1. The objective of the study is to improve the quality and strength of the sub grade.
2. By improving the strength of sub grade, the life of road can be increased.
3. With geo synthetic layer we can reduce the thickness of the sub grade and cost of the earth filling.

4. The maintenance cost of the road may be decreased by adding the geo synthetic mix.

GEOSYNTHETICS MATERIAL:

Geo synthetics are a type of geo materials used in civil engineering applications. Geo synthetics 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 geo synthetics are available. Geo textiles, geo- membranes, geo nets, geo grids, geo composites and geo synthetic clay liners are the difference type of Geo synthetics. These are often used in combination with conventional materials, for improving the strength of the soil. The four main applications for geo synthetics in roads are Sub grade separation and stabilization, Base reinforcement, Overlay stress absorption, and Overlay reinforcement.

Functions of geo synthetic materials

Type	Separation	Reinforcement	Filtration	Drainage	Containment
Geo Textile	y	y	y	y	
Geo Grid		y			
Geo Net				y	
Geo Membrane					y
Geo Clay Liner					y
Geo Foam	y				
Geo Cell	y	y			
Geo Composite	y	y	y	y	y

Geo synthetic fiber called polypropylene is used in my study. Geo synthetic fibers are mixed with the soil available at the site and check the CBR value of the mixed material. Natural and manmade, both types of fibers are available. We should try to use eco friendly materials to save the environment.

Palm fibers: Palm fiber obtained from palm trees and date after the decomposing of the palm trees. it is a low cost, regional abundance, durable, light weight and having low tensile strength and modulus Elasticity fiber.

Coconut fibers: Coconut fiber is also called coir fiber. Coconut fibre is a natural fiber and obtained from coconut shells. The fiber is removed from the coconut, after soaking the coconut in hot seawater the fiber is removed from the shell by combing and shredder.

Sisal Fiber: Sisal is a traditionally used lingo cellulosic fiber and used as a reinforcing material for gypsum board. It is obtained from the leaves. Generally these trees are found in Brazil, Indonesia and East African countries.

Flax Fiber: Flax is a plant grown for its fibers seeds in many parts of the world. Probably it is the oldest known fiber.

It has been used for the production of hemp textiles since ancient times.

Jute: Bangladesh, China, India and Thailand are the main producer of the jute. It is obtained from the fibrous bark of jute plants. Jute is an environmentally friendly fiber.

Barely straw: Barley straw is cultivated in many part of the world it is generally cultivated and harvested once or twice in the year.

Sugar Cane: Sugarcane belongs grows up to a height of 6 m and up to 6 cm in diameter, a fibrous residue left after the extraction of the sugar.

Bamboo: Bamboo fiber is a regenerated cellulose fiber. It is a common fact that bamboo can thrive naturally without using any pesticide. The fiber is seldom eaten by pests or infected by pathogens.

Synthetic fibers: synthetic fibers are generally manmade fibers

Polypropylene fibers: Polypropylene fiber is a manmade fiber. Polypropylene fiber increases the strength of soil and decrease shrinkage properties.

Polyethylene fibers: The use of polyethylene (PE) strips and fiber have been studied for reinforcing the floor. It has been reported that the presence of a High density polyethylene (HDPE) fiber can increase the fracture strength ground energy.

Polyester fibers: The strength of soil can be increased by mixing of polyester fiber. The strength of the soil depends on the content of fiber.

Polyester fibers: Fiberglass threads called "roving" can be used today reinforcing non-adhesive soil it improve peak intensity of the soil. Volume of fiberglass is generally depends upon the strength.

Steel fiber: Steel fiber reinforcement is found in concrete structures for reinforcement of soil cement composites in addition, steel fiber can improve the ground strength, but it cannot be compared with the case of using other fibers.

Nylon fiber: Strength behavior of nylon fiber Reinforced silty clay with various degrees of compression is stated to be upto 93%. The compression is much more Characteristics of fiber reinforced sand mud floor made from scrap of nylon carpet.

Polyvinyl alcohol (PVA) fibers: Polyvinyl alcohol (PVA) fiber is a synthetic fiber recently used in fiber reinforced concrete. Resistance, chemical resistance (especially alkali resistance), Tensile strength is superior to polypropylene fiber.

II. METHODOLOGY

- Study of Geo-synthetic materials and its use in road work.
- Selection of Geo-synthetic material for our site as per requirement.
- Design criteria and method used for site.
- Laboratory test of materials.

- Comparative Study of strength of the sub grade by using the geo synthetic and without geo synthetic materials

Materials are collected from the site for conducting the tests in laboratory. In laboratory both materials (soil and geo synthetic fibers) are tested on various parameters to calculate the properties of soil and geo synthetic fibers. Following tests are performed to complete the study.

Primarily Optimum Moisture Content (OMC) and Maximum Dry Density (MDD) of soil have been calculated from lab test. For achieving the required OMC and OMD, geo synthetic materials are mixed in the soil and again tested in laboratory. This test is performed again and again by increasing the quantity of geo synthetic material. When we achieved the required OMC and OMD the test will be stopped and this mix is used for the construction.

As above, California Bearing Ratio (CBR) of the soil has been calculated from lab test. For achieving the required CBR, geo synthetic materials are mixed in the soil and again tested in laboratory. This test is performed again and again by increasing the quantity of geo synthetic material. When we achieved the

required CBR the test will be stopped and this mix is used for the construction.

Following steps are adopted to perform the work:

1. Selection of site
2. Collection of soil sample which comes in the alignment of the road.
3. Procurement of materials used in the project that is polypropylene
4. Testing of the collected sample
5. Mixing of the fiber in collected soil
6. Testing of the composite material
7. Data analysis

III. Result and Conclusion

This study is based on the value of CBR, OMC and MDD. The test of soil and composite material is performed in laboratory. Composite material is the mixture of clean soil and geo fiber. Geo fiber has been mixed in the soil in different ratio for testing. Mixing of geo fiber increases the CBR value, but after a certain ratio if the quantity of geo fiber increases the value of CBR decreases. CBR value of composite material is as follows at different percentage of fiber.

penetration of plunger (mm)	CBR value of soil (%)	CBR Value of Composite material (%)			
		% age of Geo fiber mixed			
		0.25	0.50	0.75	1.0
25	3.55	4.06	5.61	4.24	3.81
50	3.97	4.95	7.38	5.16	4.60

From the above table it is found that when the geo fiber is mixed in soil the CBR value of composite material increases. The CBR value of soil is 3.55% and 3.97% at 25 mm and 50 mm penetration respectively but when 0.25% geo fiber is mixed the CBR value of composite material increases up to 4.06% and 4.95%

at same penetration. When geo fiber is added 0.50% CBR values again increases and it reaches 5.61% and 7.38% at 25 mm and 50 mm penetration.

After getting this result the amount of fiber further increases and test it on 0.75%, the result is decline and

it reduces up to 4.24% and 5.16%. After these once again increases the fiber quantity and test it on 1% of geo fiber, at this ratio we got the result further decline and it reaches up to 3.81% and 4.60% at 25 mm and 50 mm penetration respectively.

From above tests it has been seen that 0.50% of fiber mixed in soil gives the better result. If the quantity of fiber decreases from 0.50% the CBR value reduced and if we mix the quantity of fiber more than 0.50% the CBR value again reduces.

This study shows that by using the geo fiber we can increase the strength of the soil. The strengthening of the soil depends upon the quality of the soil and fiber. Better fiber gives us better result. Sub grade of the road is same as the foundation of the building. Planning of the building can be shifted from one place to other places if the soil of that place is weak but alignment of the road cannot be change easily. In the case of road the improvement of the strength of the soil is very important and using of geo fiber is a better option of that. Quantity of fiber is more important if it is less it reduces the strength and if it is more they can lose their properties. Other studies and large-scale experiments are needed to better understand the behavior of fiber-reinforced floors. Further research is needed to better understand the potential advantages and limitations and allows for more application of the yarn complex geotechnical structures. The study of sustainability for a long time of this composite material of soil and fiber is also required. If for a long time it is not useful then this type of composite material is not good for construction purpose.

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