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Improvement of Sub Grade Soil Using Nylon Fibers

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Abstract

Rapid population growth, increasing user demand of land for living, transportation, industry Initialization, educational institution and various types of power stations built on the sub-soil. For the construction of new infrastructures it is important to have a high strength (quality) of Soil and along with the possible effect of cost-effective and also fully save the environment. Nowadays, it is the major challenge for civil engineer to improve sub grade soil for construction work. Recent illustration about construction of highway or roadway is weak sub grade soil. Soil reinforcement is the method associated with the increase of strength and decreases the deformation properties of soil. This paper discussed regarding the effects of fiber on the CBR value of a clay soil reinforced with Nylon fibers. A series of CBR tests were conducted on samples of unreinforced and reinforced clay with different percentages of randomly distributed nylon fibers. The soil samples were prepared by its Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) as well as in this study, different percentage of fibers by dry weight of soil is used. The CBR values have been founded from present investigation are 3.55, 4.57, 7.70, and 7.83 by using 0.0%, 0.25%, 0.5% and 0.75% of Nylon fibers respectively for 30 mm length. Correspondingly, the CBR values have been founded from present investigation are 3.55, 5.31, 8.20 and 9.22 by using 0.0%, 0.25%, 0.5% and 0.75% of Nylon fibers respectively for 60 mm length. Also, the diameter of the nylon fiber was constant at 1 mm. This investigation exemplify that the CBR value increased significantly with the percentages and length of the nylon fibers. For the greater value of CBR thickness of the pavement will reduce.

Keywords: *CBR, Nylon fiber, Sub grade Soil*

INTRODUCTION

Nowadays a number of failures occur in several countries in the world due to dynamic and static load. Present world is drastically concerned with dynamic load pattern. Liquefaction, hill sliding, river bank erosion, and slipping and differential settlement are a more challenging issue. To investigate soil physics/behavior under different loading condition and identify the proper solution. Most of the cases soils have lacking of internal friction angle and cohesion property of soil. The frictional angle of a soil depends on the particles of soil how to interlock in a soils body or soil mass. And the cohesion is defined the soil particle how to bonding /adding to each-other in the soil body. Soil improvement is defining as a technique which increases the soil strength parameter. Soil index properties get transformed by adding additives. This leads to the alteration of the physical and chemical properties of the soil. Soil improvement, in the broadest sense, is the alteration of any property of a soil to improve its engineering

performance. It therefore became necessary to utilize the excellent properties of the common materials. There is a wide range of material available for the construction industries. The choice and sustainability of a particular material depends largely on its availability, nature of project individual preference, durability, proximity, and economic consideration. Md. Jan - E - Alam, Saddam Hossain, Prince Reza, Rafiqul Islam (2017) Improvement CBR values observed with the rapid increment in the percentages of cement, fly ash content also with different fibers amount such as jute fibers, nylon fibers etc. It also found that the strength and CBR values improve with the increasing of curing period. The suitability of the stabilization technique has been studied with respect to the cost and strength [1].

Barnali Ghosh, Dr V Ramesh, Rajarajeswari B Vibhuti (2014) conducted a study on two different clayey soils (peat and black cotton soil) with and without reinforcement. Jute geotextile (grade-TD-5) was used as a reinforcing material. The result show the increment of soil properties like shear strength, dry density, CBR while permeability and settlement decreases on introduction of jute geotextile [2]. Aberdeen. Md. Akhtar Hossain, Md. Shakhawat Hossain, Md. Kamrul Hasan (2015) conducted a study on locally available soil reinforced with jute fiber .It was observed that the optimum moisture content and CBR value increases and the maximum dry density decreases with the increase in jute fiber content for each length and diameter of jute fiber [3]. Dharmendra Kumar, Sudhir Nigam, Abhinav Nangia, and Shailendra Tiwari (2015) conducted a study on five soil samples on the improvement in CBR values of soil reinforced with Jute fibers. It was observed that the CBR value of soil increases with the increase in length and diameter of fiber [4].

MATERIALS AND METHODOLOGY

Soil

A soft clay soil with natural water content of 17.77% was brought from a site of Deshipara, Gazipur district. Several trial tests have been carried out to prepare soft clay with a water content of 14% from optimum moisture content. The soil sample was collected from a depth of 5 ft after removing the top surface soil from natural ground surface. The materials used for the present study are soil, nylon fiber. Index properties of the soil were determined (Table 1) and classification of soil was done as per Textural Classification. The soil is classified as Clay Loam.

Table: 1. *Index Properties of Soil*

Natural Water Content (%)	17.77
Liquid Limit (%)	33.1
Plastic Limit (%)	19.89
Plasticity Index (%)	13.21
Maximum dry density (gm/cc)	1.67
Optimum moisture content (%)	14
Specific Gravity (Gs)	2.7
CBR value, at 2.5 mm (%)	3.55

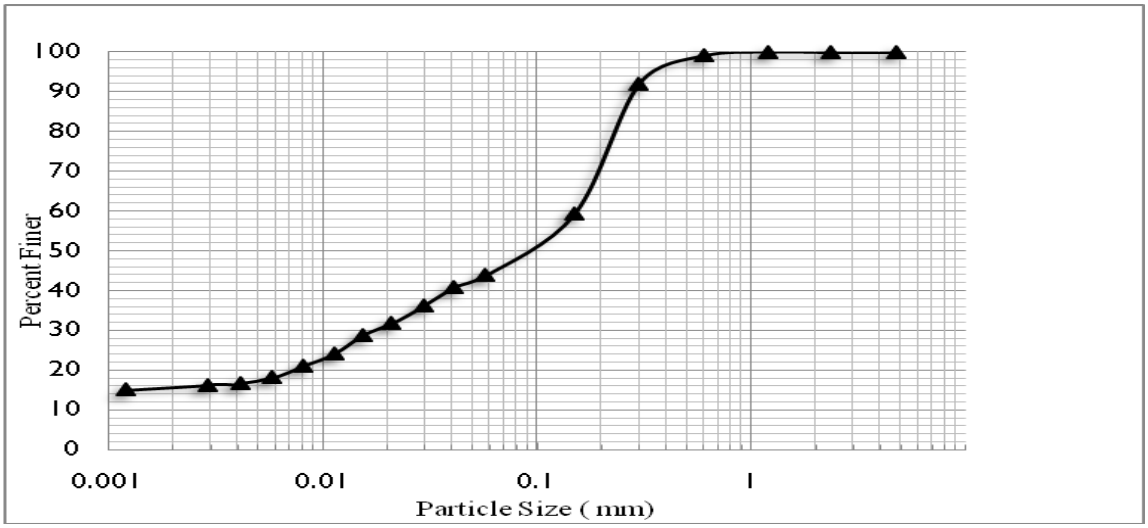

Fig: 1. *Particle size distribution curve of soil.*

Reinforcement Material

The reinforcing material used in this study is Nylon Fiber. These fibers are generally available in the threaded form. The nylon fibers used in this study was purchased from the market in the diameter of 1 mm and in the length of 30 mm and 60 mm.

EXPERIMENTAL PROGRAM

A series of proctor compaction tests and California Bearing Ratio tests have been carried out on soil mixed with nylon fiber. The detailed procedure and results are as under

Proctor Compaction Test

To assess maximum dry density (MDD) and optimum moisture content (OMC) Modified Proctor test is performed as per ASTMD-1557. A series of modified proctor tests were carried out on the soil sample with 0.25% to 0.75% by weight of nylon. From the result of modified proctor test it was observed that inclusion of nylon fiber reduces the maximum dry density and increases the optimum moisture content for each length and diameter of nylon fiber.

California Bearing Ratio Test

A series of California Bearing Ratio (CBR) tests were performed on the soil without nylon fiber reinforcement and with different proportion of nylon fiber based on the modified proctor test results. The test was performed for all the combination of the lengths and diameters of nylon fiber and percentage.

RESULTS AND DISCUSSIONS

Results of nylon fiber reinforced soil are compared with that of unreinforced soil in the following sections.

Table: 2. *CBR value of soil (soaked) reinforced with nylon fiber*

Fiber Length (mm)	Percentages of fiber by dry weight of soil	Fiber Diameter 1 mm	
		CBR Value (%)	% increase in CBR Value
30	0.00	3.55	-
	0.25	4.57	28.73
	0.50	7.70	116.90
	0.75	7.83	120.56
60	0.00	3.55	-
	0.25	5.31	49.57
	0.50	8.20	130.98
	0.75	9.22	159.71

Based on the results accessible in table 2, it observed that the CBR value of soil in initial condition was 3.55 and was maximum 9.22 when the percentage of nylon fiber reached to 0.75%. The maximum increase in CBR value was found to be more than 159.71% over the plain soil under soaked conditions at the fiber content of 0.75% for the fiber having length 60mm and diameter 1mm.

CONCLUSIONS

From above discussion it can conclude that with the increase of percentage of nylon fiber CBR value increased significantly. Also, there has an effect of length of the fiber therefore, so different percentage with various lengths must be considered for enhanced scope. In future it is recommended that soaked and unsoaked condition need to be observed for better clarification. Moreover, effect on optimum moisture content and maximum dry density need to study very carefully.

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