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STUDY ON STABILIZATION OF BLACK COTTON SOIL USING COCONUT FIBRE

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Abstract:

The soil bed should bear all the stresses transmitted by the structure. If the soil is weak and has not enough stability to resist heavy loading, the soil should be reinforced and stabilized. As the quality of the soil is increased, the ability of the soil to distribute the load over a greater area is generally increased. Stabilization using natural fibre is a cost effective and eco-friendly approach to improve properties of soil. The use of natural fibre is an initiative to maintain balance in nature. This study reveals around the reinforcement of soil by coir fibre, jute fibre, sisal fibre stabilization. The comparison between engineering properties before and after stabilization is made. The study is carried out to evaluate effects of fibre on engineering properties of a soil by carrying out unconfined compression test, permeability test, compaction test, consolidation test on soil sample. In laboratory testing of liquid limit, specific gravity along with grain size distribution is carried out for the classification ofsoil. The fibre is added by 0.25%, 0.5%, 0.75% and 1%. The experimental result with and without fibre reinforcement is compared to find optimum quantity of fibre reinforcement required to stabilize a weak soil along with the inference about effect on bearing capacity and shear strength.

INTRODUCTION:

A developing country like India which has a large geographical area and population, demands vast infrastructure i.e., network of roads and buildings. Everywhere land is being utilized for various structures from ordinary house to sky scrapers, bridges to airports and fromrural roads to expressways. Almost all the civil engineering structures are located on various soil strata. Soil can be defined as a material consisting of rock particles, sand, silt, and clay. It is formed by the gradual disintegration or decomposition of rocks due to natural processes thatincludes disintegration of rock due to stresses arising from expansion or contraction with temperature changes. Weathering and decomposition from chemical changes that occur when water, oxygen and carbon dioxide gradually combine with minerals within the rock formation, thus it is breaking down to sand, silt and clay. Transportation of soil materials by wind, water and ice forms different soil formations such as those found in river deltas, sand dunes and glacial deposits. Temperature, rainfall and drainage play important roles in the formation of soils as in the different climatic regions. Under different drainage regimes, different soils will be formed from the same original rock formation. In India, soils are classified into six groups namely alluvial soil, marine soil, laterite and lateritic deposits, expansive soils, sand dunes and boulder deposits. On an average 1 lakh sq.km area is covered by lateritic soil deposits, 3 lakhs sq.km area is covered by black cotton soil, and 5 lakhs

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sq.km area is covered by sand dunes. Encountering land having soft soil for construction leads to an attention towards adopting ground improvement techniques such as soil stabilization. Stabilization is a method of processing of locally available materials for the construction of low-cost road in the view of design and construction. A study was conducted to investigate the influence of randomly oriented natural fibre reinforcement on soil strength parameter. The construction cost can be considerably decreased by selecting local materials including local soils for the construction of the lower layers of the pavement such as the sub-base course. Soil stabilization is defined as the modification of native soil or aggregate in an effort to improve its engineering properties. 2 The present investigation focuses on use of naturally available Coir and Jute fibre in providing soil-reinforcement for soil, they are expected to accelerate the process of improving stability and increase the strength of the soil. Fibre is a thread of filament from which a vegetable tissue, mineral substance or textile is formed. The soil bed should bear all the stresses transmitted by the structure If the soil is weak and has not enough stability to resist heavy loading, so it can cause settlement of soil therefore, the soil should be reinforced and stabilized. As the quality of the soil is increased, the ability of the soil to distribute the load over a greater area is generally increased. This study reveals around the reinforcement of soil by coir fibre, jute fibre, sisal fibre and the comparison between engineering properties before and after stabilization.

Advantages of soil stabilizations are as follows:

1.If during the construction phase weak soil strata is encountered, the usual practice followed is replacing the weak soil with some other good quality soil. With the application of soil stabilization technique, the properties of the locally available soil (soil available at the site) can be enhanced and can be used effectively as the subgrade material without replacing it.

2.The cost of preparing the subgrade by replacing the weak soil with a good quality soil is higher than that of preparing the subgrade by stabilizing the locally available soil using different stabilization techniques.

3.The strength giving parameters of the soil can be effectively increased to a required amount by stabilization.

4.It improves the strength of the soil, thus, increasing the soil bearing capacity. ϖ It is more economical both in terms of cost and energy to increase the bearing capacity of the soil rather than going for deep foundation or raft foundation.

5.It is also used to provide more stability to the soil in slopes or other such places. ϖ Sometimes soil stabilization is also used to prevent soil erosion or formation of dust, which is very useful especially in dry and arid weather.

6.Stabilization is also done for soil water-proofing; this prevents water from entering into the soil and hence helps the soil from losing its strength.

OBJECTIVES OF THE PROJECT WORK:

1.To study the engineering properties of black cotton soil.

2.To obtain the optimum dosage of fibre (coir fibre).

3.To determine the increase in strength characteristics and stabilization property of soil

4.To make a comparative study stabilized soil.

5.To evaluate maximum dry density, permeability, unconfined compressive strength (UCS) and compaction test of fibre soil with various dosage of fibre.

MATERIALS AND METHODOLOGY :

Materials

Black Cotton Soil In India, extensive soils are called as Black cotton soil. The name Black cotton as and farming origin. Greatest part of these soils is black in colour and good for growing cotton and occurring in Maharashtra, Gujarat, Madhya Pradesh, Karnataka, parts of Andhra Pradesh and Tamil Nadu. These are expansive in nature. On expenses of more swelling and reduction potential these are hard soils to deal with in foundation design. All the black soils are not expansive soils and all the expansive soils are not black in colour. The behaviour of the expansive soils is very uncertain when it is subjected to moisture changes. These changes pose considerable challenge for the civil engineers during construction activities specially while constructing foundations. The strength of soil changes when water occupies large space in the voids of soil. The general recognisable character of this effect is extreme compression of soil, collapsing behaviour, high compressibility, high swelling capacity and low shear strength. The adverse descriptions made the black-cotton soils out of condition for construction purpose; hence they need to be stabilizing before they can be put to use. Though black-cotton has unfavourable characteristics for infrastructural- developments, they are useful as agents of environmental protection and waste disposal.

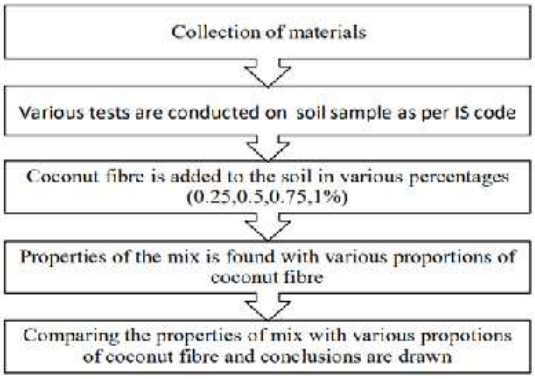
Fig - 1Black Cotton soil

Properties of black cotton soils Rich proportion of montmorillonite is found in Black cotton soil from mineralogical analysis, High percentage of montmorillonite renders high degree of expansiveness. These property results cracks in soil without any warning. So, building to be founded on this soil may suffer severe damage with the change of atmospheric conditions

Table - 1 Properties of black cotton soil

SI.NO	Properties	Standard Values
1	Specific Gravity	2.65
2	Liquid Limit	26.5%
3	Plastic Limit	21%
4	Classification of soil	CL-ML
5	Optimum Moisture Content	10.25%
6	Maximum Dry Content	1.785gm/ml
7	Plastic Index	5.5%
8	Unconfined Compressive Strength	0.335kg/cm^2
9	CBR Value	1.16%

METHODOLOGY:



In this work, different engineering and index properties of the soil were studied and then the synthetic fibre is contributed in the soil as per the aspect ratio (L/B) i.e., 0.25, 0.5, 0.75 and 1 from 2%,4%, 6% to 8% by doubling the initial percentage of aspect ratio of fibre to the soil.

Liquid Limit:

Liquid limit is the minimum water content corresponding to the arbitrary limit between liquid and plastic states of consistency of soil. It is the minimum water content at which the soil in the liquid state but has a small shearing strength against flowing, which can be measured by available means. Soil passing through 425-microns IS sieve and distilled water is added to form a uniform paste is placed in the cup ofstandard liquid limit device. The paste is levelled at uniform depth. Then using grooving tool pick up out the paste from middle of the device perpendicular to the cup. After that the handle is rotated up to the paste in the cup combines in the middle.

Fig - 2 Liquid limit test

Then number of blows should be noted and a sample is taken to calculate the moisture content after dried in oven. This is repeated for five sets of blows are obtained. The graph is plotted between number of blows and water content. Water content corresponding to 25 blows liquid limit value.

RESULTS:

1.Free Swell Index: Free swell index = (Vd-Vk /Vk) *100 = ((16 - 10)/10) *100 FREE SWELL INDEX - 60%

2.Table – 4.1: Sieve analysis observation values

Sieve size	Mass of soil retained(gm)	% of weight retained	Cumulative % of soil retained in %	% Finer with respect to 4.75 passing
4.75	210	21.6	21.6	78.4
2.36	214	24.1	45.7	54.3
1.18	316	31.6	77.3	22.7
0.6	108	10.8	88.1	11.9
0.3	118	11.8	99.9	0.1
0.15	0.8	0.08	99.98	0.02
0.075	0.2	0.02	100	0
Pan	0	0	100	0

Table - 2 Sieve analysis observation values

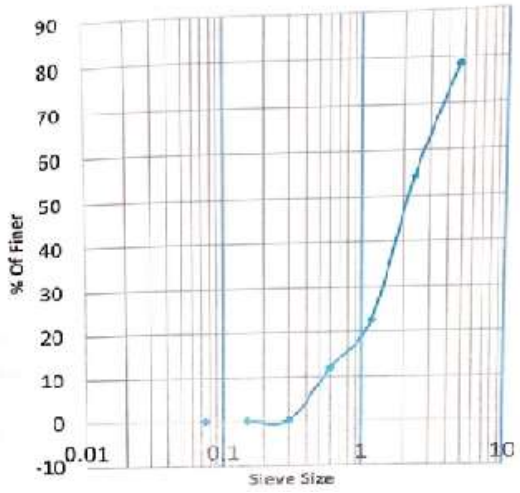


Fig - 3 Sieve analysis graph

CONCLUSIONS:

On the basis of the experimentalstudy, the following conclusions are made:

1.The CBR vales are increased for 0.25%, 0.5%, 0.75% and 1% (by weight of soil) of coconut fibre. 2. By adding 0.25%, 0.5%, 0.75% and 1% of the coconut fibre to black cotton soil we found that the OMC value are decreased and MMD values are increased.

3.Addition of 0.25%, 0.5%,0.75% and 1% of coir fiber to the black cotton soil the CBR values are increased by 5.65% ,7.02%, 17.11%,14.28% respectively. The higher the CBR value, harder will be the surface.

4.The California bearing ratio (CBR) of the soil alone is obtained as 3.59% and it increased to 17.11% after stabilizing it with optimum percentage of coir fibers (0.75%).

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