AN EXPERIMENTAL STUDY ON EFFECT OF REINFORCEMENT IN POLYMER AND FIBER FORMS ON CBR VALUE

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ABSTRACT

Dark cotton garden soil is usually accumulated near KSRM college or university regarding KADAPA is usually stabilized along with arbitrarily sent out Polypropylene fibers’ in addition to Nonwoven geo-textile along with unique u/d rate in addition to yellow sand content material regarding 5, 10 in addition to 15 per cent through excess weight. The actual CBR testing have been carried out inside the laboratory work for unique combination size regarding fibers in addition to geo-textile along with dark-colored silk cotton garden soil. Substantial enhancement can be found in this CBR benefit regarding dark-colored silk cotton garden soil.

Key words: CBR, Polymer and HDPE

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1. INTRODUCTION

The technique of strengthened earth will be based upon the actual basic principle regarding Vidal, in line with which often, introduction regarding reinforcing factors in a dirt large improves the shear amount of resistance in the moderate. In software regarding strengthened dirt, there is certainly continual argument about the impact regarding sort of the actual encouragement. Further, effectiveness regarding
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encouragement operate throughout immersed ailments will be a different place, which often calls for detailed brought on.

Lately the actual uses regarding fibers in several career fields include gained much importance. Many studies on dirt strengthened fibers are already described. Fiber-reinforced soil demonstrated this material could be some sort of useful as well as less expensive way of encouragement regarding bass speaker class soil throughout versatile streets [1]. Which have a practical systematically strengthened soil, at random distributed dietary fiber strengthened soil display many advantages. At random, distributed fibers provide strength isotropy as well as limited possible plane regarding weak point that could acquire parallel for you to driven encouragement [2]. The means of reinforcing the actual dirt improves the firmness as well as heap hauling ability in the dirt by way of frictional discussion relating to the dirt and the encouragement [3]. Material is utilized to gauge some sort of technique pertaining to blocking fracture innovations throughout dirt as a result of desiccation by means of quick polymeric fibers. The add-on regarding at random distributed, discrete tensile encouragement factors throughout dirt gives a possible treatment for the situation regarding sloughing instability regarding levees [4]. This sort of factors can be found as polypropylene fibers. There is risk of the use of dietary fiber reinforcing throughout dirt because it will be growing the effectiveness of the actual dirt by reducing desiccation great.

2. OBJECTIVES OF THE PRESENT STUDY
The objectives of the present experimental study are;
- To evaluate the effectiveness of form of reinforcement with specific reference to planar and randomly distributed forms.
- To assess the role of soaking on reinforcement mechanism in terms of CBR value.
- It further includes the optimum fiber content and that is yielding maximum CBR for the materials used in this dissertation.
- To know the optimum depth of reinforced zone/Position of reinforcement.

3. LITERATURE REVIEW
A review of the literature revealed that various laboratory investigations have been conducted on fiber-reinforced materials. The followings are the summaries of past experimental research on the behavior of reinforced sand and clay.

Choudhary et al., (2010): carried out compilation of CBR tests on at random sturdy soil through numerous portion associated with Large Solidity Polyethylene (HDPE) pieces along with different program plans and ratios. Connection between CBR tests proven which inclusion associated with HDPE pieces inside soil along with correct volumes much better durability and deformation habits associated with subgrade garden soil drastically. The actual tests were carried out on numerous strip material associated with 0. 0%, 0. 25%, 0. 50%, 1. 0%, a couple of. 0% and 4. 0%.

Amin and Hamid., (2012): looked into the effects associated with soluble fiber inclusion on CBR proportion. Some CBR tests were carried out to evaluate side effects associated with reinforcing the subgrade soil inside sidewalk method along with at random distributed cheap fibres. In this study, just one style of soil (i. e. silty sand) and two forms of soluble fiber were used.
Naeini and Mirzakhanlari., (2008): carried out CBR tests to analyze the stress sexual penetration behavior involving reinforced granular soil together with geo-textile. Setting geo-textile in a number of interesting depth within just sample height and a couple of tiers, the consequences involving the amount of geo-fabric around the raise throughout bearing potential involving reinforced granular soil and grading with efficiency involving geo-textile is actually discussed.

Bijayananda et 's., (2011): performed series of laboratory work drenched and unsoaked CBR tests with aimlessly driven dietary fiber reinforced and unreinforced garden soil examples compressed in OMC and MDD. A couple forms of aimlessly spread under the radar fabric, polypropylene (synthetic) and coir (natural) were employed to enhance your picked subgrade garden soil.

Senthil Kumar and Pandiammal Devi., (2011): performed CBR tests utilizing coir and jute geo-textile. Your CBR support rate is used for the pattern involving unpaved road, your CBR support rate value with the subgrade reinforced together with geo-textile is actually obtained through conducting CBR check, to analyze the consequence with the healthy geo-textiles around the delicate subgrade.

Writeup on novels offered earlier mentioned have usually demonstrated which, energy with the garden soil has been enhanced through addition involving geo-textile, geo-grid and healthy, manmade, Palm, LDPE and HDPE fabric. A lot of the work has been carried out with remote and silty soil regarding increasing it's energy by employing man made and healthy taken care of or perhaps unattended fabric. Your swelling and shrinking behaviour involving delicate subgrades (Black natural cotton soil) would be the major bring about for the destruction of pavement structure.

Preserving because each of these earlier work, laboratory work investigation is actually set up with Dark-colored natural cotton garden soil together with polypropylene and nonwoven geo-textile support in the present study. The purpose of that survey is usually to assess involving CBR beliefs involving crushed stone caused through dietary fiber and geo-textile addition.

MATERIALS AND EXPERIMENTAL METHODOLOGY
The effectiveness of using reinforced soil for improving the CBR value has studied, CBR tests will conduct on samples reinforced with fibers and geo-textiles. This paper provides in detail the physical and engineering properties of the materials used in the present work and also the testing procedure for performing the experiment investigations.

MATERIALS USED IN LABORATORY TESTING
The properties of the materials used for the experimental investigation are discussed below. The type of material used in the investigation was black cotton soil. The properties of the black cotton soil are presented below.

Black Cotton Soil
Expansive soils are commonly found in arid and semi arid regions. In India, about 20% of the soil cover is comprises of expansive soils also commonly known as black cotton soil. Principally such soils contain montmorillonite as main clay mineral and they exhibit high swelling and shrinkage with the seasonal moisture fluctuations. The B.C soils are also varying in their clay content and activity from region to region.
In the present study black cotton soil is collected near KSRM College at KADAPA.

**Sand**
The Sand used in the present study is collected locally.

**Polypropylene Fiber**
Polypropylene fiber is a chemically inactive additive.

**Nonwoven Geo-textile**
Nonwoven geo-textiles are manufactured from high quality polypropylene staple fibers. The fibers are mechanically bonded through needle-punching to form a strong, flexible and dimensionally stable fabric structure with optimum pore sizes and high permeability. The geo-textile is resistant to chemicals and biological organisms normally found in soils and are stabilized against degradation due to short-term exposure to ultraviolet radiation. Nonwoven geo-textiles confirm to the following property values.

**EXPERIMENTAL STUDY**
The objective of this study was to find out the increase in strength mobilization in terms of CBR values, by conducting CBR tests on the subgrade soil when reinforced with polypropylene fiber with varying contents and Nonwoven geo-textile placed at different positions.

**Preparation of Specimen**
In this method, a known quantity of air-dried soil passing 20mm sieve was taken and mixed with requisite water to get OMC and percentage of sand i.e.5%, 10% and 15% placed in layers with polypropylene fiber contents of 0.5, 1.0, 1.5, 2.0 and 2.5% and nonwoven geo-textile is placed with u/d ratio of 0.6, 0.8 and 1.0.

The samples were prepared by dynamic compaction method. The CBR cylindrical mould having 150 mm inner diameter and 175mm height and, a cylindrical plunger of 50mm diameter is used for testing. Calculated quantity of wet soil was transferred to mould and compacted with a light weight hammer of 2.6kg having drop of 310mm, each layer being given 56 blows. Top surface was scratched and polypropylene fiber reinforced sand is poured uniformly. Soil was put in the next layer and compacted as in the previous case and fiber reinforced sand is poured in second layer. Finally soil was put in third layer and compacted. After compacting another filter paper is kept on the specimen and then placed the surcharge disc over it.

A second group of CBR tests were conducted on geo-textile reinforced sand specimens under same soil and loading conditions. Instead of fiber inclusions, a second sheet of the geo-textile was employed for reinforced sand systems in these tests. Geo-textile reinforced sand is placed in two layers with u/d ratios of 0.6, 0.8 and 1.0. Where ‘u’ is the depth of geo-textile reinforcement from the surface, ‘d’ is diameter of plunger. Schematic representations of the test specimens are shown in Fig.1

In order to obtain the soaked CBR values, the specimens were soaked for 96 hours before loading the specimen. To soak the specimen, the specimen in the mould and surcharge weight was wrapped in a gunny bag and kept immersed in water. The mould, after four days of soaking is taken out and water is allowed to drain off. The
sample, along with the surcharge, is then subjected to loading. Photographic shows the preparation of sample and $CBR$ specimen in Fig.2 (a) and (b).

![Figure 1 Cross section of test setup](image)

**Figure 1** Cross section of test setup

Photographic shows a) CBR specimen  b) Preparation of sample

**CBR Testing**

The Fig 3 shows photograph of California bearing ratio test setup. The methodology includes characterization of the materials used, the $CBR$ values as per IS: 2720(Part-16) - (1987) [28].

The mould containing the specimen, with the base plate in position shall be placed on the lower plate of the testing machine. Annular surcharge weight equal intensity of
base material and the pavement is placed to prevent upheaval of soil. Penetration plunger is inserted in between the annular weight then adjusted to make contact with the specimen. Specimens were tested in a load frame, which gives the display of loads and penetrations. A standard plunger of 50mm diameter was penetrated into the soil at the rate of 0.625mm/minute. The load values corresponding to penetrations of 0.5mm, 1.0mm, 1.5mm, 2.0mm, 2.5mm, 3.0mm, 4.0mm, 5.0mm, 7.5mm, 10mm and 12.5mm were noted. CBR value is expressed as a percentage of the actual load causing the penetrations of 2.5 mm or 5.0 mm to the standard loads. The greatest value calculated for penetrations at 2.5mm and 5.0mm will be recorded as the CBR value. From the load - penetration graphs, CBR value was calculated as the highest value obtained from the ratio of test load divided by the standard load and expressed in percentage. The California bearing ratio is calculated as follows:

$$CBR (\%) = \frac{\text{Test Load}}{\text{Standard Load}} \times 100$$

**Figure 3** California Bearing Ratio test setup

### 4. RESULTS AND DISCUSSION

Laboratory tests were conducted on black cotton soil with different 5%, 10% and 15% sand content. The CBR values were studied with 0.5, 1.0, 1.5, 2.0 and 2.5% polypropylene fiber content and nonwoven geo-textile with u/d ratio 0.6, 0.8 and 1.0. CBR values expressed in percentage for different cases are summarized, in which the initial CBR refers to percentage CBR obtained for soil alone without any reinforced material. The experimental results give a clear indication that the presence of fiber and nonwoven geo-textile influences the CBR of the soil. The improvement in strength of soil due to the addition of fiber and placement of geo-textile is a function of interaction of fiber and geo-textile with the sand. It was observed that there exists interaction between sands reinforced systematically with fiber and geo-textile in soaked and unsoaked condition.

### 5. CONCLUSIONS

Laboratory test results for polypropylene fiber and nonwoven geo-textile with different sand content of 5% , 10% and 15% have been presented in the paper. Based on the investigations carried out in this project work the following conclusions were made:

- The California bearing ratio (CBR) value can be improved phenomenally by reinforcing the material in both planar and in randomly distributed fiber forms.
- The CBR increases with the increase in sand content at an optimum fiber content of 2.0% and geo-textile at u/d =0.8.
- The improvement in CBR of randomly distributed fiber form has increased from 1.05% to 2.75% with a percentage increase of 55% in soaked condition and 2.99% to 4.77% with a percentage increase of 30% in unsoaked condition is achieved when 2.0% fiber content is used.
- For the materials used in this study, The maximum improvement in CBR of geo-textile has increased from 1.05% to 2.67% with a percentage increase of 50% in soaked condition and 2.99% to 4.37% with a percentage increase of 20% in unsoaked condition is achieved when the layer of geo-textile is placed at u/d=0.8.
- The investigations showed that, reinforcement effect is present even under soaked conditions.
REFERENCES


