LABORATORY STUDY ON IMPROVEMENT OF SOFT SOILS BY COMBINED BAMBOO STRIP AND FLAX FIBER REINFORCEMENT.

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ABSTRACT

Construction of building on weak clayey soil is highly risky, on geotechnical grounds due to poor strength of the clayey soil. Soil is to improve the engineering properties of soil by soil stabilization. Soil stabilization is the process which includes the physical properties of the soil in order to increase its strength, durability etc. by mixing with additives. The mixtures used for soil stabilization are bamboo strips and flax fibre. It also decreases the intensity of stress on subgrade. Bamboo fiber and flax fibers are such a geosynthetic material which is easily available, eco-friendly and also low cost. With the application of soil stabilization method in construction the overall cost gets reduced when compared to the ordinary method of construction. In this study, we make use of bamboo and flax materials as reinforcements to increase the soil conditions for better construction.

Keywords: Bamboo reinforcement, Geonets, Grids, Coir, Bearing Capacity.

I.INTRODUCTION

Soil is one of the cheapest and easily available material for construction reasons but on the other hand its behavior is quite complicate. The soil plays a very crucial role. So, we need to have proper knowledge about their characteristics and factors which affect their behavior.The Soft soils such as clayey or silty soil do not have enough strength to carry heavy loads. Replacing weak soil with good quality soils are nowadays not possible due to the high cost.

The method of treating soft soils at the field itself using additives is called soil stabilization. Soil Stabilization has been always an curious topic in research field. From many years, materials have been utilised for stabilization of weak soils such as clays. A recent trend is to utilize natural materials for modifying soft soils. The advantage of utilising natural materials in construction consists its low cost and a new conclusion for the soil stabilization.It is the process in which engineering characteristics of soils are improved to make them more stable.We always not get the essential type of soil for any structure construction. The soil may not have enough strength and stability to carry the structure. In such a case we want to reinforce the soil. To improve different characteristics of soil, sometimes we may also change the additive mixture of the soil. For this we may add a organic matter to the soil. The main intention of soil stabilization is to reduce permeability and compressibility of soil and to improve the shear strength.The soil testing is the main reason for success of soil stabilization. The process of soil stabilization helps to reach the needed characteristics in a soil required for the construction work.

In present days environmental sustainability increases in construction field and so utilisation of natural resources in soil is more normal.Bamboo and flax fibres are continuously growing resources which gets on the earth. Bamboo is powerfull resources and very strong in tension. So also say as natural renewable material and biodegradable,so bamboo can be utilized as tension reinforcement in soil. Strength of bamboo and flax fiber are prime debate in soil implementation. It is best for low-cost implementation in developing countries due to its requirement of low prices compared to its synthetic materials. Strength and ability to withstand the natural soil are often tough to meet the engineering properties. The addition of bamboo strip and flax fiber can rise the strength of soil.

The fiber and bamboo has the nature of tensile and crack resistance and the dispersion degree.which can effectively make up for the deficiency of the traditional reinforced soil.

Thus, fiber reinforcement technology has been a curious topic in the research field of soil reinforcement. The strength and adaptable characteristics of soil improvement are alternatively better when bamboo pieces and flax fibers are mixed

II. METHODOLOGY

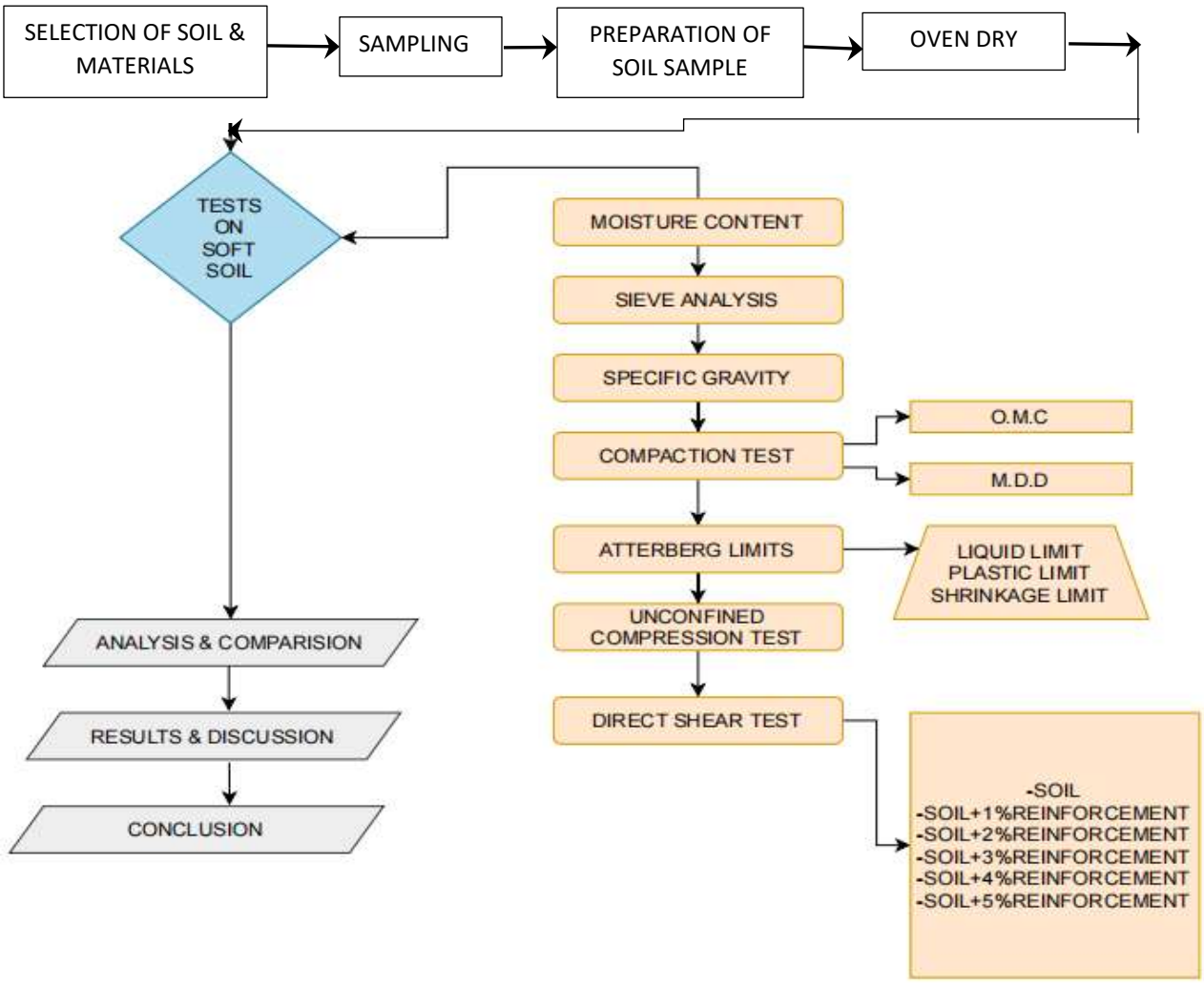


Fig 2.1 Flow chart of Methodology

Fig 2.2 Bamboo Strips

Fig 2.3 Flax fiber

III. OBJECTIVES

- To increase - Bearing capacity Of Soft Soil.
  - Cohesion Of Soft Soil.
  - Angle of internal friction Of Soft Soil.
- To reduce- Settlement Of Soft Soil
- To perform and analyse tests of soil along with natural reinforcements.

IV. LITERATURE REVIEW

- *The Potential Use of Bamboo as Green Material for Soft Clay Reinforcement System;*

Marto A, Othman.B.A 2011

Bamboo being used as reinforcement for soil in this case was put between embankment and soil, which lead to increase in stability and reduce deformation of embankment. Hydrostatic profiler along with Inclinometer was used. And comparison between unreinforced and reinforced were made. Unreinforced had settled 744mm and had moved 13.66mm, while reinforced had settled 588mm and had moved 9.4mm.

- *Soil Improvement By Using Bamboo Reinforcement;*

Md Asaduzzaman, Muhammad Iftiarul Islam 2014

In this paper it was seen that the load bearing capacity of weak soil was enhanced when the reinforcement was placed at depth in failure envelope region. Single layered reinforcement had a load bearing capacity of 1.77 while two layered had 2.02 compared to soil with no reinforcement.

- *Shear Strength Behaviour of Bamboo Fiber Reinforced Soil*

Dipika Devi, BokenJempen 2016

Here it was observed that the increase in fiber length increased the overall shear strength of the soil. And hence direct shear tests were conducted on1, 2, 3, 4, 5 percentages of mixed natural fibres and 4% was found to be optimum.

- *Bamboo-Geotextile Buoyant system for Hefty Construction over Deep Soft Subgrade*

Low Kaw Sai, Tioh Ngee Heng 2016

In this paper it was found that there was huge problem in supporting heavy buildings on tall structures and hence research was carried out. And the research observed that stress distribution in bamboo fibres surface area had good bending strength and buoyancy would help better and equal distribution of forces.

- *Characteristics of Bamboo Fiber as Environmentally Friendly Material for Soil Strengthening*

KhoiriyaLatifah, BambangSupriyadi, Abdul Rochim 2018

After many lab tests on different types of bamboo, Gombong type was found to be best in terms of fiber content, its length and also fibers within. It was then seen that higher quantity of lignin and larger the diameter,

the bamboo would be strong. So, Gombong being the highest in terms of lignin content had high adhesiveness and therefore with most tensile strength

- *Evaluation of Properties and Behavior of Bamboo Fiber Geotextile.*

Laika G. Canseko, Creeselle DJ. Dadivas, Adriel Samuel R.. Ersando and Engr. AnjerickTopacio 2018

In this research paper, soil was given reinforcements which were at an angle of 45 degrees and 30 degrees. The bamboo used here was pf DPWH standards. The results of this test showed that there was almost 95% reduction of erosion in 30 degree soils and 45 degree soils.

- *Studying Shear Perfomance of Flax Fiber- Reinforced Clay by Tri axial Test.*

Qiang Ma, Yicong Yang, Henglin Xiao and Wenwen Xing 2018

In the following paper, flax fiber was used as reinforcements as it naturally available product and would reduce construction costs drastically. Lab tests were performed on different ratios of fibre to clay with 0.2, 0.4, 0.6, 0.8 and 1 percentages with triaxial confining pressure ranging from 100, 200 and 300kPa and hence the triaxial test found that 0.8% was the best ratio.

- *Effect of Bamboo Grid and Geonet on Clay*

AnujaVijayan, Tanuja Christopher D'cruz 2019

In this research paper, it was observed that bamboo grid type showed better performance compared to geonet types. In both of the types either geonet or bamboo grid it was seen from experiments that best performance was seen in 3 layers.

- *Improvement of Clayey Soils by Combined Bamboo Strip and Flax Fiber Reinforcement.*

Fang Tong, Qiang Ma and Wenwen Xing 2019

In this research paper, unlike others it was seen that bamboo fibres even increased the cohesion and internal angle of friction of weak soils, which would help in maximizing the strength performance. In tests it was seen that for flax fibre cohesion had increased by 17% and for bamboo it had increased by 25%. On the other hand for angle of internal friction flax fibre had increased by 0.4% and bamboo by 11%.

- *Performance Evaluation on CBR values of Soft Soil using Coir and Bamboo for Flexible Pavement*

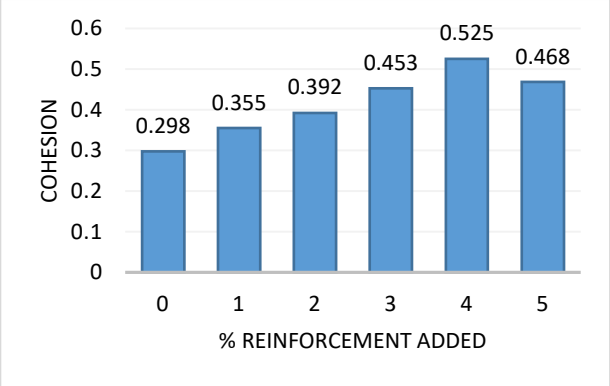
VarshaSahu, Anil Suman 2020

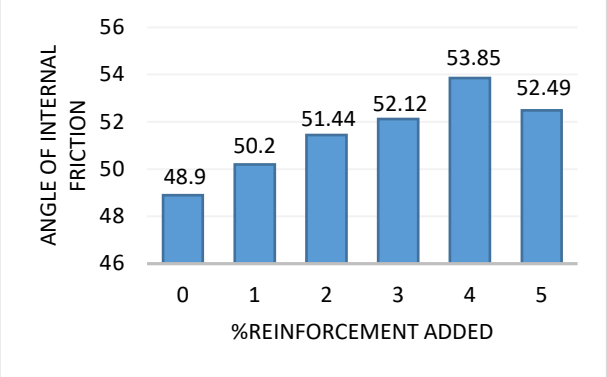
In this research paper, many types of natural fibres which can be used for natural reinforcements were taken for experimentation some which are coir, jute, sisal, bamboo, etc. Geotextiles was found to be useful even in control in erosion, filtration of drainage, etc. CBR tests were conducted according to IRC-37-2001. The arrangement was done in such a manner where in it was in square form which included coirs and bamboo strips strategically placed at 3/4 th from the base. And the results showed that CBR values increased by 6% compared to usual ones.

V. RESULTS AND DISCUSSION

SPECIFIC GRAVITY	2.17	**STANDARD PROCTOR TEST**	OMC=16% ; MDD= 1.79g/cc	
SIEVE ANALYSIS				
C_U	6.944	**UNCONFINED COMPRESSION TEST**	0.0426	
C_C	0.676			
ATTERBERG LIMITS		**DIRECT SHEAR TEST**	**C**	**F**
LIQUID LIMIT	32.34%	**SOIL**	0.298	48.9°
PLASTIC LIMIT	27.18%	**SOIL+1% REINFORCEMENT**	0.355	50.2°
PLASTICITY INDEX	1.57	**SOIL+2% REINFORCEMENT**	0.392	51.4°
CONSISTENCY INDEX	2.57	**SOIL+3% REINFORCEMENT**	0.453	52.12°
TOUGHNESS INDEX	0.22	**SOIL+4% REINFORCEMENT**	0.525	53.85°

FLOW INDEX	22.47	SOIL+5% REINFORCEMENT	0.468	52.49°
SHRINKAGE LIMIT	19.08%	MOISTURE CONTENT	19.04%	





The procured flax fiber was cut into average of 20 and 30mm strips. The flax fiber diameter was measured with caliper to be about 1-2mm. Soil samples were mixed with dosages of different proportions of bamboo and flux fiber together. So, six dosages containing bamboo and flax fiber 0%, 1%, 2%, 3%, 4%,5% were mixed to the six equal quantities of soil portions. Direct shear test was executed on all dosages of bamboo-flax fiber. The direct shear value is measure of soil strength which is controlled by existing bonds among particle and internal particle friction. There is a increase in Direct shear value at a dosage of 1,2,3 and 4% and reduction at 5%. Hence, 4% was the optimum content as shown in below calculations.

All results given in terms of Cohesion and Internal Angle of friction. It was noticed that the potential tensile use of strength, including bending properties of local vegetation which include materials like bamboo and flax fiber shall be used to enhance the stability of weak soils and decrease the deformations.

As seen above cases both Cohesion and Angle of Internal Friction continuously increase till 4% of reinforcements added, and later starts decreasing from **5%.**

Hence,…. 4% is concluded as optimum dosage of reinforcement to be added.

VI. CONCLUSION

The shear strength of a local soil with and without bamboo strip and flax fiber reinforcement are studied and compared.The study on the bamboo strips and flax fiber-reinforced clay can not only give recommendation to make full utilization of natural reinforced resources to increase the presentation of clay but also accelerate the value of resources by complete usage of various resources and decreases the engineering cost by taking locally available resources as well. Bamboo strips and flax fiber can be utilised as reinforcement resources to increase the strength and deformation resistance of clay, and the reinforcement outcome is more clear when the axial strain is large. The cohesion and internal friction angle of the clay are increased, and the increase of this strength is primarily considered in the impact on the cohesion. The impact of bamboo strips on the flax fiber reinforced clay is mainly considered in the improvement of the vertical strength of the reinforcement and the enhancement of its restriction to deformation. Bamboo strips and flax fiber can successfully use the reinforcement effect of the resources, improve the strength of the reinforced clay, play a vertical and horizontal reinforcement role, and enhance the overall strength of the reinforced clay.

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