Improvement in Shear Strength of Soil Reinforced with Pineapple Fibre

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Abstract - *In a land based structure, soil plays an important role in making the foundation strong. So, before working in soils, we should know about different characteristics and factors affecting their behaviour. The soil stabilization improves the properties of a soil needed for the construction . Soil stabilization is the method of improving soil characteristics by different methods to make a soil which have all the required engineering properties. Soil stabilization increases the durability and strength of soil and to prevent dust formation and erosion in soils..In this study, pineapple fibres were mixed with soil to find out strength gain in terms of direct shear strength. The results obtained are compared and reached certain inferences and checked whether fiber reinforcement is an effective and economic approach.*

Key Words: **Soil Stabilization, Reinforcement, Pineapple fibre, direct shear strength, Foundation**

1. INTRODUCTION

Pineapple leaf fibre (PALF) is one of the mostly available wastes materials of Malaysia and has not been studied yet as it is required. In a socioeconomic approach, PALF can be a new source of raw material to the industries. It can be an effective replacement of the synthetic fibre, which is non renewable and expensive. PALF has high specific stiffness and strength. Due to large amount of cellulose content in PALF, it is hydrophilic in nature. Retting method and mechanical method are used for the extraction of pineapple fibres. The form of fibrous cell of PALF is vascular bundle system and After harvesting entire upper layer is mechanically removed. It is a multicellular lignocellulosic fibre. It contains polysaccharides, lignin , and chemicals like pectin , wax, fat, uronic acid, anhydride, pentosan, colour pigment, and some inorganic substance.

A pineapple leaf fibre reinforced with polyethylene gives high performance composites. In comparison to other natural fibres, pineapple leaf fibre (PALF) shows excellent physical and mechanical properties. The utilization of pineapple leaf fibre in composite material is a new source of economic, recyclable and ecofriendly materials.

Soil stabilization indicates a general term for any chemical, physical, biological or method of changing a natural soil to a new one to meet an engineering purpose. Improvements include increasing the tensile strength, weight bearing capacity and overall performance of subsoil and sands, in order to strengthen road surfaces. The various renewable technologies include enzymes, surfactants, synthetic polymers, biopolymers, co-polymer based products, cross-linking styrene acrylic polymers, tree resins, ionic stabilizers, fiber reinforcement, , calcite, calcium chloride ,sodium chloride, magnesium chloride and more. However, recent technology has increased the number of traditional additives used for soil stabilization purposes. Such non-traditional stabilizers include: Polymer based products (e.g. cross-linking water-based styrene acrylic polymers that significantly improves the tensile strength and bearing capacity of treated soils), Copolymer Based Products, fiber reinforcement, Sodium Chloride and calcium chloride.

Fig -1: Pineapple Leaf Fiber

2. SCOPE OF THE PROJECT

Natural fibre based composites are ecofriendly nature and also show peculiar properties.So, they are under intensive study since their discovery. The natural fibre has an advantage of continuous supply, easy and safe handling, and biodegradable nature.The source of petroleum based products are believed as limited and uncertain.As a result an alternative with cheap sustainable and easily available raw material is required.Most of the countries growing plant and fruit are not for only agricultural purpose but also to generate raw materials for industries.

Even though tonnes of pineapples are being producing every year, very small portions are being used in the field of energy production and feedstock. The expansion of biocomposites will accelerate industrial usage that would release the possibilities to reduce the wastage of renewable materials. It may promote a non-food-based market for agricultural industry. According to journals, Pineapple leaf fibre (PALF) is a vital natural fibre, which have high specific strength, rigidity, and flexural and torsional rigidity as much as jute fibres. Considering these exclusive properties of PALF, industries can use it as an outstanding alternative raw material in the case of reinforcing composite matrixes. Pineapple leaf fibre is very common in tropical regions and it is very simple to extract fibres from its leaves. The utilization of pineapple leaf fibre in composite material is a new source of materials which can be economic, ecofriendly, and recyclable.

3. METHODOLOGY

3.1 Soil

Soil was selected from paddy fields in Ernakulam in kerala. Based on IS:1498-1970 ,It is a sandy soil contain clay content. Soil belong coarse grained soil and it belong to SP category. But the soil is poorly graded.

3.2 Pineapple Leaf Fiber (PALF)

Pineapple fibre is a material which have a good export quality. It should be collected from Kochi. There a lot of people cultivating pineapple fibre. It is of diameter in range 0.6-0.8 mm. It is of approximately 1 feet length. It should be divided into small pieces for testing.For the test we have cutted each 1feet long fiber hair into 1.5 cm long pieces.

3.3 Determination of index properties

At first determination of index properties of soil was done which include specific gravity, Atterberg limits, Optimum moisture content, maximum dry density, natural moisture content etc. Index properties thus obtained are illustrated in Table-1.Here the soil is sandy. So direct shear is the experiment we have taken for the test for reinforcement as the soil is sandy. Direct shear test was done by taking soil both with and without reinforcement.Thus the index properties are more important

Table -1: Index properties of soil

Specific gravity	2.43
Liquid limit	23.07%
Plastic limit	28.57%
Optimum moisture content	25%
Maximum dry density	1.44g/cc
Clay fraction	3.8%

3.4 Direct shear test

Based on ASTM D 3080 - Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions, Direct shear test is conducted.This test is performed to determine the consolidated-drained shear strength of sandy to silty soil. The shear strength is an important property of a soil. It's importance lies on a structure subjected to shearing resistance of soil. It's application include determining the stability of slopes or cuts, finding bearing capacity for foundations, and calculating the pressure exerted by a soil on a retaining wall. In this test , a direct shear device is used to determine the shear strength of a soil. From the plot of the shear stress versus the horizontal displacement, the maximum shear stress is obtained for a specific vertical confining stress. After running the experiment for several times for various vertical-confining stresses, a plot of the maximum shear stresses versus the vertical (normal) confining stresses for each of the tests is produced. From the plot, a straight-line approximation of the Mohr-Coulomb failure envelope curve can be drawn and thus f may be determined. Here change in the value of cohesion c and angle of internal friction f denotes the change in shear strength of soil .

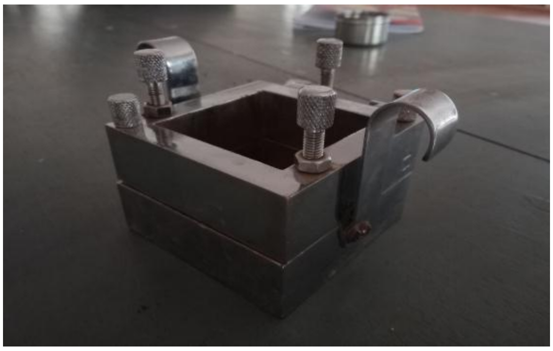

Fig -2: Direct shear mould

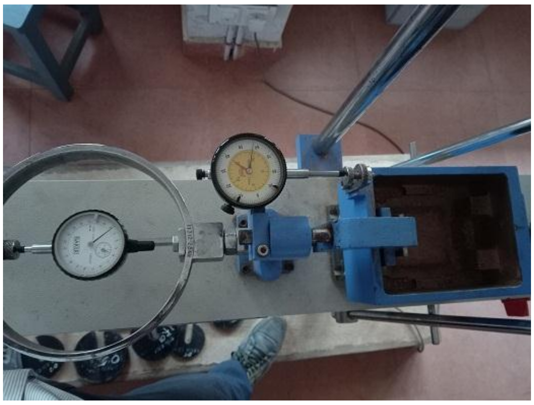

Fig -3: Direct shear apparatus

Change in value of shear strength of soil on addition of different percentage of fibre content is illustrated in Table-2.

Tabe -2: change in shear strength of soil corresponding to fibre content

Fibre content	Cohesion ,C	Angle of internal friction ,f
0%	0.06	36.86
0.25%	0.08	37.23
0.5%	0.1	37.95
0.75%	0.14	41.02
1%	0.08	40.36

3.5 Test conclusions

Here we can see that at 0% fiber content cohesion is 0.06 and angle of internal friction is 36.86. .After adding 0.25% fiber content cohesion increases to 0.08 and angle of internal friction slightly increases to 37.23. At 0.5% fibre content also cohesion and angle of internal friction slightly increases to 0.1 and 37.95.At 0.75% of fibre content cohesion slightly increases to 0.14and angle of internal friction shows a greater increases to 41.02.When 1% fibre is added value of cohesion shows a greater decrease to 0.08 and angle of internal friction slightly decreases to 40.36.Based on mohr-coloumb failure criterion, shear strength can be represented as a relation between cohesion and angle of internal friction. So the change in value cohesion and angle of internal friction can be actually considered as the change in shear strength of soil. Variation of cohesion with fibre content illustrated in chart-1 and Variation of angle of internal friction with fibre content is illustrated in chart-2.In both graphs it can be observed that there is a gradual increase in cohesion and angle of internal friction upto a point followed by a decrease.

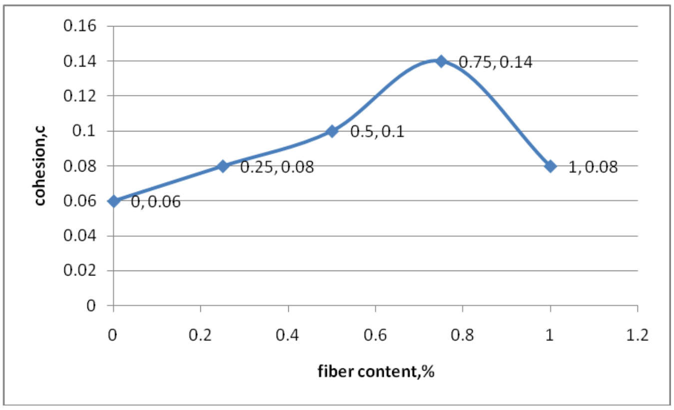

Chart-1: Variation of cohesion

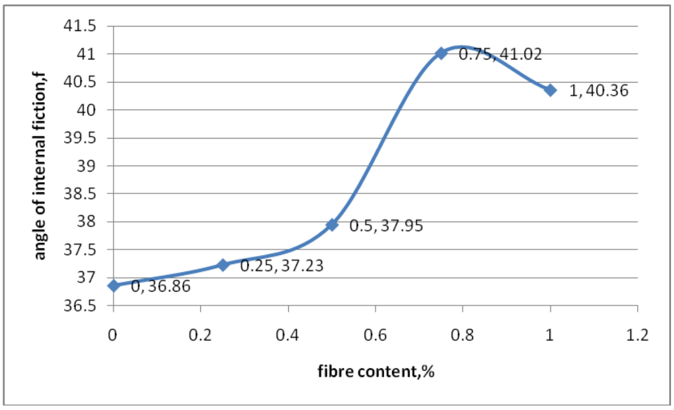

Chart-2:Variation of Internal Friction

4. CONCLUSION

From the direct shear test it was observed that value of cohesion and internal friction increases till fibre content of 0.75% had taken .At 0.75% internal friction attained a greater increase and cohesion showed slighter increase. At 1% fiber content both cohesion and internal friction decreased. So, it was concluded that the shear strength attained it's maximum value at 0.75% fibre content. After that shear strength decreased. So, at this point bearing capacity of soil for foundation will improved. Here the fibre reinforcement affects engineering properties of soil positively.

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