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COMPARATIVE STUDY ON FIBRE AMENDED SOIL

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Abstract - *Transportation fulfils the basic need of humanity. For the time immemorial everyone travels either for food or leisure. There is a strong correlation between the quality of transportation facilities and development of country, because of which everyone places a great expectation from transportation facilities. Major challenges among civil engineers today is that transportation system must be analytically based, economically sound, eco-friendly, socially credible, sustainable and practically acceptable. In current scenario, conventional construction methods are unsuitable and driving interest in technologies like ground improvement.*

Among all transportation modes, economical road network plays a vital role for advancement in the economy of developing countries like India. In case of a highway, if the subgrade layer of the pavement is weak then they require greater thickness of pavement that results in increase of pavement construction cost. In order to strengthen the sub grade soil, jute fibre is used because they are economically sound, locally available, biodegradable, environment sensitive and practically acceptable. On the basis of CBR value of the subgrade and traffic on the proposed road, flexible pavements design being done.In this study a series of Proctor Compaction tests and California Bearing Ratio (CBR) tests were carried out on locally available soil reinforced with jute fibre and basalt. The percentage of Jute fibre and basalt by dry weight of soil was taken as 0.4%, 0.8%, 1.2% and 1.4%. In the present investigation the lengths of fibre was taken as 6mm and 12mm for each fibre length to find out the optimal quantity.

Keywords— *Jute Fibber, basalt fibre, Subgrade, California Bearing Ratio, Length, Diameter*.

1.INTRODUCTION

The network of roadways of a country is as essential as the arterial system to the human body and the roads in a big way make possible advancement in the economy of a country and they simultaneously facilitate communication. But at the same time road network should be economically sound, eco-friendly and sustainable too. Economy in road network can be achieved through economical pavement design. The quality of sub grade available in pavement design is most valuable parameter in pavement design. In case of a highway, if the sub grade layer of the pavement is weak then they require greater thickness of pavement that the properties of the subgrade, one of the innovative ground improvement techniques practiced all over the world is the use of geosynthetic, which include geotextile, geomembranes, geogrids, etc.

In such cases engineering properties of natural soil are improved by reinforcing the soils with different kinds of materials. The inclusion of reinforcement enables the use of poorer quality of soils to be used and at the same time they are environment friendly, easily available and economical too. The technique of soil reinforcement by jute fibre material is not a new concept. Using natural fibre to reinforce soil is an old and ancient idea like Great Wall of China is one of the earliest examples of reinforced earth using branches of trees as tensile materials. In USA & Europe, the erosion control & highway slopes stability is controlled using reinforced soil. [1].Strength and stiffness response of soil reinforced with coir-fibre studied by Sivakumar and Vasudevan (2008) .To improve the laboratory CBR value of soil coir fibre was used by Singh (2012) [4].The strength characteristics of soil reinforced with coir fibre was also studied by Sharma et al. (2011) . Singh (2011) studied the strength characteristics of soil by using Geosynthetics. Jute processing is done by local people that utilizes local skills and thus result in the monetary benefits of local community by providing employment opportunities. Of all the natural fibre Jute has highest tensile strength and withstand rotting and heat (Sen. and Reddy, 2011). Studies have also shown that durability of natural fibre can be improved using coating of fibre with Phenol and Bitumen which is easily available in these areasThe principle of soil reinforcement by fibre material is to improve the tensile strength characteristic of the soil reinforcement matrix. The technique of soil reinforcement by jute fibreand basalt material is not a new concept.basalt fibre is a high performance non-metallicfibre made from basalt rock melted at high temperature. The main objective of this research is to focus on improving the engineering properties of the subgrade, so that for particular traffic intensity required pavement thickness may be reduced. A series of Proctor Compaction tests and California Bearing Ratio (CBR) tests were performed on jute and basalt reinforced soil samples with various fibrelengths and the improvements in the subgrade are studied.

2. PREVIOUS REASEARCH

H.P.Singh,and MBagra (2013); Based on the present investigation it is concluded that CBR value of soil increases with the inclusion of jute fibre. When the jute fibre content is increases, the CBR value of soil is further increases and this increase is substantial at fibre content of 1%. It was also found that preparation of identical soil sample for CBR test beyond 1% of fibre content is not possible and optimum fibre content was found to be 1% by dry weight of soil. It is also concluded that there is significant effects of length and diameter of fibre on CBR value of soil. The CBR value of soil increases with the increasing length and diameter of fibre. The maximum increase in CBR value was found to be more than 200% over that of plain soil at fibre content of 1% for fibre having diameter 2mm and length 90mm.

Sudir Nigam,AbhinavAngina and Shiledra Tiwari (2015); Based on the present investigation it is concluded that CBR value of soil is included with the inclusion of jute fibre. When the jute fibre content is increase, the CBR value of soil is further increases and this increase is substantial up to fibre content of 5%. It was also found that preparation of identical soil samples for CBR test beyond 5% of content is not possible and optimum fibre content expected to be between 4 to 5% by dry weight of soil. The optimum length of fibre is somewhere between 60 to 80 mm. it is also concluded that there is significant effects of length and diameter of fibre on CBR value of soil. The CBR value of soil increases with the increase in length and diameter of fibre.

M N Sandeep, T C Reshma (2014); the index properties of Cochin marine clay were found out and are classified as CH. The results of incremental loading(IL) consolidation tests and constant rate of strain(CRS) consolidation tests for the soil sample in cochin have been presented compared and discussed based on the test and analysis result.

RamanadanAyothiraman (2017); it is noticed that the inclusion of basalt fibre does not affect the compressibility characteristics of soil significantly, which is due to fact that basalt fibre consist of natural minerals having specific gravity similar to soil. However, this conclusion largely depend on applied vertical level pressure level and application types. For applications involving low vertical stresses, both types of fibres can be used to improve the strength properties of clay soil, without bothering about issues of compressibility. The permeability of soil increases with an increase of fibre content this may be due to flow of water along the interface of fibres and soil, and fibres helping enhancing the flow path for the water.

Amit kumarsingh (2016); the jute reinforcement is found to be very much effective for stabilizing the expansive soil as the CBR values of the soil were improved. The changes observed in the soil after reinforcement is remarkable. The OMC of the soil was decreased from 19.54% to 15.98%. The MDD was increased at two layer reinforcement from 1.698 g/cc to 1.74 g/cc and after the four layer reinforcement of jute layer, the MDD was seen to be reduced to 1.72 g/cc. the CBR values were enhanced as the CBR value of the natural sample was 2.67% and after two layer reinforcement of jute layer the improvement in CBR improved to 6.07% and when the jute layer reinforcement was increased to 4 layers the tremendous CBR value of 11.85% was obtained thus it can be concluded that maximum improvement was seen in 4 layer reinforcement of jute layer in soil.

3. MATERIALS AND METHODOLOGY

3.1 MATERIALS

3.1.1 Cochin marine clay

The soil used for the study is clayey soil collected from Cochin vytila. These marine clays are characterised by high atterberg limits and natural water contents. Then they are moderately sensitive with liquidity indices ranging over 0.46 to 0.87. The clay have very low shear strength. They were initially air dried in open atmosphere prior to testing.

Table 3.1 Marine clay properties

Colour	Black
Odour	Odour of decaying vegetation
Texture	Fine grained

Fig 3.1 Cochin Marine Clay

3.1.2 Jute fibre

The jute fibres used as reinforcement was collected from home. Which are in the form of geotextile and cut into thread form. The fibre cut in the length of 6mm and 12mm, Jute fibre are generally available in threaded form. thus are mechanically woven fibres with very fine thread. The jute fibres are abundantly available, superior durability. It can perfectly shaped itself to ground contours. It have high moisture absorbing capacity it can absorb moisture up to about 5 times its dry weight. They have high initial strength.

Fig 3.2 Jute Fibre

3.2.3 Basalt

The different length 6mm, and 12mm basalt fibre will be used in the test.Before being dispersed in the soil specimen, the basalt fibre is evenly in corporate in the clay soil. The basalt fibre is filamentous. Purchased from Chennai (online)

Table 3.2 properties of basalt [RamanathanAyothiraman 2017]

Density	2.65g/cm^3
Elastic modulus	85.9Gpa
Elongation at break	3.12%
Tensile at strength	2611Mpa
Length	6mm and 12mm

Fig 3.3 Basalt Fiber

3.2 Methodology

The properties of soil selected for this study was determined in the laboratory according to the relevant IS code (IS 2720).Fibres were added to soil in 0.4%,0.8%,1.2% and 1.4% of dry weight of soil and geotechnical properties were determined.

4. RESULT AND DISCUSSION

4.1 Atterberg limits (IS 2720: Part v &vi)

4.1.1 Liquid limit (LL)

The result shows the effect of varying percentages of fibre on the liquid limit of selected soil sample. The liquid limit decreases with increasing the percentage of fibre.

4.1.2 Plastic limit (PL)

The results show variation of plastic limit with addition of fibre. There is an increase in plastic limit with increase in percentage of fibre.

4.1.3 Plasticity index (PI)

The result show variation of plastic limit with the addition of fibre. There is a decresse in plasticity index with increase in percentage of fibre .

4.2 Addition of fibres in marine clay

The addition of different fibres content in soil in different length (6mm, 12mm) and different percentage (0%, 0.4%, 0.8%, 1.2%, 1.4%) and to find the CBR value and its compared also Finding the optimum fibre content.

4.2.1 Variation in CBR of jute fibre added in marine clay

The CBR value of soil determined for added in jute fibre in the length of 6mm and 12 mm in different percentage of 0%, 0.4%, 0.8%, 1.2%, and 1.4%. The fibres was added to soil and was thoroughly mixed. The results of CBR values are shown in the given Table 5.1

Percentage	Length	
	6mm	12mm
0%	0.89	0.89
0.4%	2.41	2.83
0.8%	4.96	5.26
1.2%	5.12	5.21
1.4%	4.87	4.71

Table5.2 CBR value of marine clay added in jute fiber

The CBR value will be varying in jute fibre added for marine clay. In 0% the CBR value is 0.89, and they added fibre percentage will increases also increases the value of CBR. In 1.2% will be get the optimum value of jute added in marine clay is get in to 6 mm will be 5.12. also we have

added jute in marine clay 12mm length the CBR value will be get in to 5.21 they are the optimum value.Beacuse the values of CBR will deceases in 1.4%.For different fibre lengths and fibre diameters CBR tests carried out at different fibre content varying from 0 % to 1.4% by dry weight of soil and results are revealed. Tests outcome shows that the CBR value of soil increases as the fibre content increases till particular point. This phenomenon can be observed for all the fibre lengths (6 mm and 12mm).

4.2.2 Variation in CBR of Basalt fibre added in marine clay.

The CBR value of soil determined for added in Basalt fibre in the length of 6mm and 12 mm in different percentage of 0%, 0.4%, 0.8%, 1.2%, and 1.4%. The fibres was added to soil and was thoroughly mixed. The results of CBR values are shown in the given Table 5.2

Percentage	Length	
	6mm	12mm
0%	0.89	0.89
0.4%	2.49	2.97
0.8%	5.38	5.57
1.2%	5.71	5.18
1.4%	4.92	4.34

Table 5.2 CBR value of marine clay added in Basalt fibre

The CBR value will be varying in Basalt fibre added for marine clay. In 0% the CBR value is 0.89, and they added fibre percentage will increases also increases the value of CBR. In 1.2% will be get the optimum value of basalt added in marine clay is get in to 6 mm will be 5.71.the length change in 12mm we get the optimum value will be in 0.8% fibre added. In For different fibre lengths and different percentage CBR tests carried out at different fibre content varying from 0 % to 1.4% by dry weight of soil and results are revealed. Tests outcome shows that the CBR value of soil increases as the fibre content increases till particular point. This phenomenon can be observed for all the fibre lengths (6 mm and 12mm).

The graph will be shown in fig 5.1 and 5.2 is the CBR value Variation

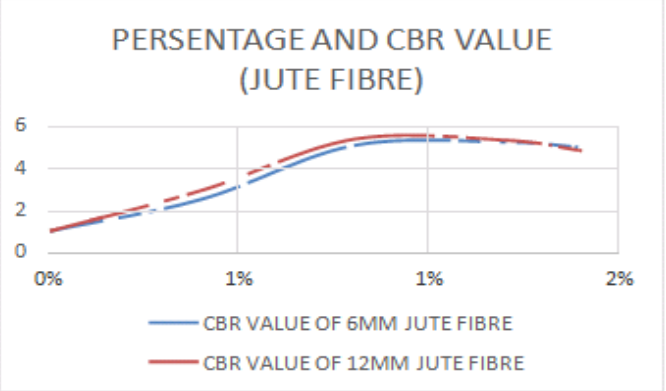

Fig 4.1 percentage and CBR value of jute fibre added in marine clay

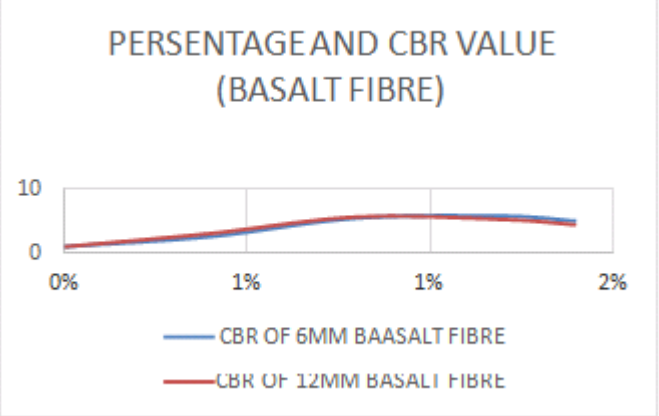

Fig 4.2 percentage and CBR value of basalt fibre added in marine clay

5. CONCLUSIONS

Marine clay is common type of clay and normally exist in soft consistency. The marine clay was found to be blackish, less sluggish, highly plastic, silty clay. The marine clay was due to swelling and shrinkage properties. It is not applicable for many of civil engineering works. So a method of stabilization is adopted here in the project to improve its proportion. Being transportation.so here we found the improvement in marine clay for subgrade stabilization. Fibre reinforced pavement than high tensile strength compared to other methods. Both natural and synthetic fibre can be utilized for reinforcement. The study uses natural fibre jute and synthetic basalt of different length. The soil has an initial CBR value of .89 addition of jute and basalt fibre. Improve the CBR value in different percentage

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