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KUTTANAD SOIL STABILIZATION USING SMOOTH CORD GRASS FIBRES

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Abstract - *Soil Stabilization is the process by which there is improvement in properties of soil for the intended purpose. This study concentrates on the Kuttanad soil stabilization using smooth cord grass fibres from Akkulam (Thiruvananthapuram) which is not yet used for this purpose. This is a perennial grass which is deciduous in nature and usually found in salt marshes. It has the capacity to act as an environmental engineer as it provides habitat for many marsh species. So the study utilizes this cheaply available material for soil stabilization purposes. This study mainly aims on enhancing the improvement in strength of soil with addition of fibres through compaction test and Unconfined Compressive Strength test. The index properties of soil are also studied. For the purpose fibres of length 30mm with average diameter of 0.7mm at 0%, 0.25%, 0.5% 0.75% and 1% by weight of dry soil is used. The optimum fibre content was obtained as 0.75% for 30mm.*

Key Words: *Kuttanad Soil, Smooth Cord Grass Fibres, Standard Proctor Test, Unconfined Compressive Strength Test*

1. INTRODUCTION

The substructure is very important in the construction field and construction of substructure is very risky in the case of very weak soils like Kuttanad soil. This is because Kuttanad soil is prone to differential settlement and it has low shear strength and high compressibility. Conventional methods are usually adopted to mitigate these problems are neither economic nor environment friendly except the use of tree trunks which are used locally to reinforce the soil. By introduction of randomly oriented fibres, there is no enhancement in tensile resistance of soil but also these fibres act as crack preventors. Apart from using synthetic fibres, the use of natural fibres are advantageous as these are eco-friendly, available locally and are very cheap. As these are degraded by bacteria, it does not create any waste disposal problem. The extraction of these natural fibres manually is a source of employement generation in rural areas. In this study, effect of smooth cord grass fibres as a reinforcement material is evaluated. The significance of this study is that utilization of cheaply available environmental waste is made.

2. PREVIOUS RESEARCH

Brahmachary T.K. et.al. (2018) [1] conducted a experimental study on the effectiveness of bamboo fibre as a subgrade material. Both soaked as well as un soaked CBR values were found out. Soil was classified as highly compressible organic soil. The length of fibre used was 10mm and 20mm and the diameter adopted was 3mm and 6mm. The fibres were used at percentages of 0.2%, 0.4%, 0.6%, 1%, 1.2% and 1.4% by waterless weight of normal soil. Optimum fibre content was obtained as 1.2%. There is enhancement in un soaked as well as soaked CBR value with rise in length and for similar fibre content and same fibre diameter and rises with rise in diameter of fibre. The percentage increase in soaked CBR value was 131.89% for 10mm length and 3mm diameter, 143.52% for same length and 6mm diameter, 161.13% for 20mm length and 3mm diameter, 196.35% for same length and 6mm diameter respectively. The percentage increase in un soaked CBR value was 172.59% for 10mm length and 3mm diameter, 183.36% for same length and 6mm diameter, 193.14% for 20mm length and 3mm diameter, 216.97% for same length and 6mm diameter respectively.

Faseela M. et.al. (2018) [2] conducted a comparative study on stabilization of Marine clay collected from Cochin using Jute and Basalt fibres. Fibre of length 6mm and 12mm were used for the purpose. CBR test was conducted. Fibres were used at percentages of 0.4%, 0.8%, 1.2% and 1.4% respectively. In case of jute fibre and basalt fibre, optimum fibre content obtained was 1.2% for 6mm and 0.8% for 12mm. The percentage increase in CBR value when compared to control sample for 6mm and 12mm were 475.28% and 491% in case of jute fibre and 541.5% and 525.84% in case of basalt fibre respectively.

Sathya Priya C.M. et.al. (2017) [3] conducted experiments on clay soil with polypropylene fibre. The soil was classified as CH according to Unified Soil classification system. The average length of fibre adopted was 12mm and the average diameter of fibre adopted was 0.048mm. The fibre dosage adopted were 0%, 0.5%, 1% and 1.5%. It was found that swell index decreased with increase in fibre content and liquid limit increased with increase in fibre content. The optimum fibre content for MDD was

obtained as 1%, 0.5% for OMC and 1% for UCS. The percentage increase in UCS with respect to control sample (0%) for optimum fibre content was 91.47%.

Chinnu A.S. and Sudha A.R. (2016) [4] conducted a study on strength enhancement of Kuttanad soil using untreated (U) cocunut fibres. The soil was classified as MH. The length and diameter of fibre used was 15mm and 0.2mm respectively. Fibre were used at percentages of 0.4%, 0.8%, 1.2% and 1.6% respectively. Fibres were treated using sodium hydroxide (S) and Calcium tetrachloride (C) solutions respectively. MDD decreased as fibres were added an for OMC in all cases optimum was obtained at 0.8%. Similarly in case of UCS optimum was obtained at 1.2%. The percentage increase in strength when compared to control samples were 160% (U), 200% (S) and 275% (C) respectively.

Prajisha J.P. and Ajitha A.R. (2016) [5] conducted experiments on strength behavior and durability of banana fibres on Kuttanad soil stabilized using lime. Untreated and rubber treated fibres were used. Length of fibres adopted were 10mm, 20mm and 30mm. and diameter adopted was 0.5mm for untreated fibres and 0.6mm for rubber treated fibres. The percentage fibres adopted were 0.25%, 0.5%, 0.75% and 1%. The optimum fibre content was obtained as 0.5% and optimum lime content obtained was 6%. Untreated and treated fibres shows decrease in tensile strength when immersed in alkaline solution. For untreated fibres, the percentage increase in UCS was obtained as 34.93% for 1cm fibres, 40.54% for 2cm fibres and 48.66% for 3cm fibres. In case of treated ones, fibres were used at random length and the percentage increase in UCS was 186%. In case of lime stabilized soil, the percentage increase in UCS were 263% in case of untreated fibres and 361% in case of treated fibres.

Patel S.K. and Singh B. (2014) [6] conducted a study on the UCS behaviour of glass fibre reinforced laterite soil. The length of fibres adopted were 10mm, 20mm and 30mm and the average diameter adopted was 0.15mm. The percentages of fibre adopted were 0.25%, 0.5%, 0.75%, 1% and 1.25% by dry weight of soil. For 10mm fibre, the UCS improved for all fibre contents where as for 20mm fibre, the optimum fibre content was obtained as 1% and for 30mm fibre, the optimum fibre content was obtained as 0.75%. The optimum fibre length was obtained as 20mm up to 1% fibre content and 10mm for 1.25% fibre content.

3. MATERIALS AND METHODOLOGY

3.1 MATERIALS

3.1.1 Kuttanad Soil

Soil in paddy field collected from Kavalam, Kuttanad (Fig. 1.) from a depth of 1.22m were used for the project purpose. It was obtained in a slurry form due to its high water content and it was black in colour, fine grained, very soft and contains large amount of organic matter. The index properties of soil are given in Table 1.

Fig. 1. Kuttanad Soil

Table 1. Soil Index Properties

Index Properties	Values
Specific Gravity	1.42
Percentage silt (%)	75.9
Percentage clay (%)	24.1
Plasticity Index (%)	24.84%
Soil Classification	OH
Unconfined Compressive Strength (kPa)	11.86

3.1.2 SMOOTH CORD GRASS FIBRES

The fibres of smooth cord grass were used for the project purpose. So many varieties are there out of which *Spartina alterniflora* from Akkulam (Thiruvananthapuram) was adopted. It is also called as salt marsh cord grass or salt water cord grass. (Figure 2.) It is called as an environmental engineer because it provides habitat for many mussels and also it is a food for snow geese. Monofilament fibres were used for the purpose. Fibres were used at percentages of 0.25%, 0.5%, 0.75% and 1% by weight of dry soil. Length of fibres used was 30mm respectively and average diameter adopted was 0.7mm. The tensile strength of a single thread of fibre was obtained as 2.1kg by weight suspension method and water absorption capacity after 24hours was obtained as 249.69%.

Fig. 2. Processed Fibre

3.2 METHODOLOGY

After completing the literature survey and materials procurement, soil classification properties were studied. The tests conducted include specific gravity of soil using pycnometer method, hydrometer analysis, liquid limit test, plastic limit test and Standard Proctor tests (compaction test) for gettimg optimum moisture content (OMC) and maximum dry density (MDD) and Unconfined Compressive Strength (UCS) tests for shear strength were carried out in soil not reinforced with fibre (0%) and in soil reinforced with 3cm fibres at fibre percentages of 0.25%, 0.5%, 0.75% and 1% by dry weight of soil.

4. RESULT AND DISCUSSION

4.1 Reinforcement with 3cm Fibres

The results of 3cm fibre reinforced samples are given in Table 2. Variation of OMC, MDD and UCS with different fibre content is given in Figures 3, 4 and 5 respectively. OMC decreases at 0.25% and there after increases whereas MDD increases at 0.25% and there after decreases. Optimum dosage of fibre was 0.75%. In 0%, the UCS value was obtained as 11.86kPa. It increases with increase in fibre content. The optimum value is obtained as 36.44kPa and the corresponding percentage increase was obtained as 207.25%.

Table 2: Results of 3cm Fibre reinforced samples

Fibre Dosage(%)	OMC (%)	MDD (g/cc)	UCS (kPa)	% increase
0.25	30	1.47	17.27	45.6
0.5	34.37	1.39	21.9	83.64
0.75	41.82	1.29	36.44	207.25
1	52	1.27	19.96	68.28

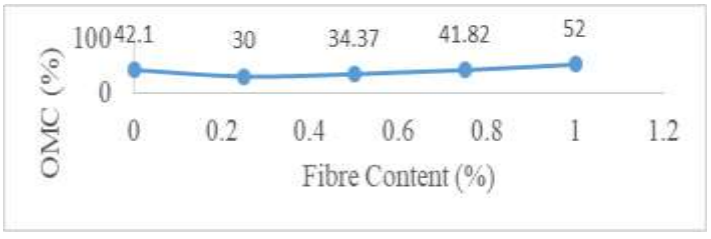

Fig. 3. Variation of OMC with Fibre Content

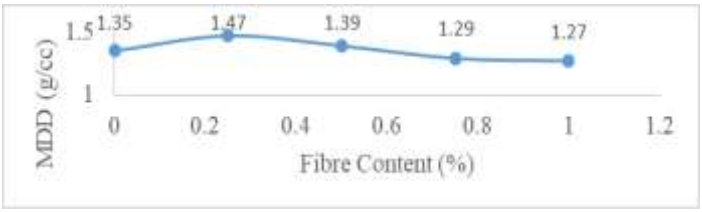

Fig. 4. Variation of MDD with Fibre Content

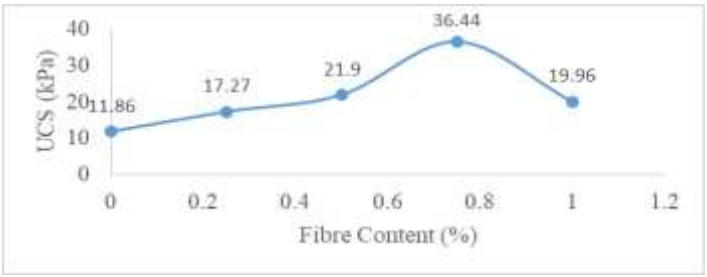

Fig. 5. Variation of UCS with Fibre Content

5. CONCLUSION

These are the conclusions drawn from following investigation. The addition of fibres in Kuttanad soil showed enhancement in its strength. The optimum fibre content for OMC and MDD is 0.25% for 3cm fibres. The optimum fibre content of UCS for 3cm fibres was obtained as 0.75%. The percentage improvement in strength with respect to control sample was obtained as 207.25% for 3cm fibres. There is increase in UCS up to optimum fibre content due to interaction of soil with fibre. There is decrease in UCS after optimum fibre content due to fibre fibre interaction.

REFERENCES

1. Brahmachary T.K. & Md. Rokonuzzaman (2018), "Investigation of random inclusions of bamboo fibre as ordinary soil and its effect on CBR value ", International Journal of Geo Engineering, Vol. 9, pp.1-11.

2. Faseela M., Sherin K.C.J., Nafla C.H., Rahib P., Sahna J. & Anitha P.M. (2018) , " Comparative Study on fibre amended Soil", International Research Journal of Engineering and Technology, 5 (5), pp.871- 875.

3. Sathya Priya C.M., Archana S., Albert A.B. & Deeraj A.D. (2017) , " Stabilization of Clayey Soil Using Polypropylene Fibre", International Research Journal of Engineering & Technology , 4(4), pp.1252- 1255.

4. Chinnu A.S. & Mrs. Sudha A.R. (2016), " Exprimental Study on Strength behavior of Kuttanadu Soil using Treated Coir Fibre ", International Journal of Engineering, Research & Technology, 5(5), pp.649- 655.

5. Prajisha J.P. & Ajitha A.R. (2016) , " Strength and Durability Study on Banana fibre Reinforced Lime stabilized Kuttanad Soil ", International Advanced Research Journal in Science, Engineering & Technology , 3(3), pp.158- 163.

6. Patel S.K. & Singh B. (2014) , " Unconfined Compressive Strength Behaviour of Fibre Reinforced Lateritic Soil", Journal of Civil Engineering and Environmental Technology , Vol. 1, No. 4, pp.93- 98.