EFFECT OF BAMBOO GRID REINFORCEMENT USING SOIL BAGASSE ASH MIXURE

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ABSTRACT

Soil is very important in civil engineering constructions. The poor engineering properties of the local soils may present many difficulties for construction and therefore need to improve their engineering properties. Stabilization techniques can be used to improve the properties of soil. The bamboo and bagasse ash can be obtained easily, and easy to use. The use of bamboo reinforcement of the grid layer on the soil will increase the CBR by 51% for one layer of bamboo reinforcement, 48%for two-layer of bamboo reinforcement and 47 % for 3 layers of bamboo reinforcement. According to CBR results, when we mix bagasse ash with CBR in different proportions we found that the maximum strength gain is done when we mix soil with 20% bagasse Ash at the depth 2/3 in aperture size 2x2.

Keyword : - *Soil , CBR, Ash, Bamboo, Depth, Reinforcement etc.*

1. INTRODUCTION

Soil stabilization improves various engineering properties e.g. bearing capacity, compressibility, strength, and various other properties of soil. Soils are complex mixtures of minerals, water, air, organic matter, and countless organisms. Various types of soil available in India like alluvial soils, black cotton soils, laterites soils, mountain soils, desert soils, red soils. Soil is the upper most part of earth and it is cheapest and readily available construction material. Soil is generally categorizes into four basic types (such as): Gravel, Sand, Clay and Silt. Out of them, few possess montmorillonite in high amount resulting in sudden swelling and shrinkage upon contact with water. Such soils are not useful in construction directly but can be made useful after their stabilisation. Soil is defined as an unconsolidated material, composed of soil particles, produced by the disintegration of rocks and chemical decomposition. On the basis of shear strength, soil can be divided into three types: cohesion less soils, purely cohesive soils and cohesive soils. In case of road construction the aim of stabilization of soil is to increase the stability by increasing its bearing capacity and hence increasing its strength and reduction in pavement thickness. In recent years, various waste are generated in the society which is not good for us and leads to harmful effect on human as well as any other creature of the society. So in this research we utilized the two waste i.e. bagasse and bamboo with the soil at different layers.(1/3,2/3 and mid) and different Apurture Size. India is the second biggest in significant sugar delivering nations after Brazil. Because of that there is expansion in bagasse ash as a by item from the sugar factory. Uttar Pradesh alone produces 38.77% of the gross production of sugarcane. Uttar Pradesh produces 130 million tonnes of the sugarcane. 40 % of sugarcane is used for gur and khandsari and 60% sugarcane used for crystalline sugar. As it is known that approximately 30% is the bagasse ash by weight in sugarcane. Bagasse ash is the sinewy build-up of sugar stick in the wake of smashing and extraction of juice. Sugar cane bagasse ash remains is the waste result of the ignition of bagasse ash for vitality in sugar industrial facilities. Sugar cane bagasse ash remains is discarded in landfills and is presently turning into a natural weight.

2. CBR TEST PROCEDURE

It is the ratio of force per unit area required to penetrate a soil mass with standard circular piston at the rate of 1.25 mm/min. to that required for the corresponding penetration of a standard material. The California Bearing Ratio Test (CBR Test) is a penetration test developed by California State Highway Department (U.S.A.) for evaluating the bearing capacity of subgrade soil for design of flexible pavement. Tests are carried out on natural or compacted soils in water soaked or un-soaked conditions and the results so obtained are compared with the curves of standard test to have an idea of the soil strength of the subgrade soil.

2.1 APPARATUS USED

- Mould
- Steel Cutting collar
- Spacer Disc
- Surcharge weight
- Dial gauges
- IS Sieves
- Penetration Plunger
- Loading Machine
- Miscellaneous Apparatus

2.2 CBR TEST PROCEDURE

- Normally 3 specimens each of about 7 kg must be compacted so that their compacted densities range from 95% to 100% generally with 10, 30 and 65 blows.
- Weigh of empty mould
- Add water to the first specimen (compact it in five layer by giving 10 blows per layer)
- After compaction, remove the collar and level the surface.
- Take sample for determination of moisture content.
- Weight of mould + compacted specimen.
- Place the mold in the soaking tank for four days (ignore this step in case of unsoaked **CBR**.
- Take other samples and apply different blows and repeat the whole process.
- After four days, measure the swell reading and find %age swell.
- Remove the mould from the tank and allow water to drain.
- Then place the specimen under the penetration piston and place surcharge load of 10lb.
- Apply the load and note the penetration load values.
- Draw the graphs between the penetration (in) and penetration load (in) and find the value of **CBR**.
- Draw the graph between the %age **CBR** and Dry Density, and find **CBR** at required degree of compaction.

3. Conduct experiment

To check the quality of the soil various test has been carried out on the soil . The soil sample was collected from mathura ,U.P..After collecting the soil sample, sieving was done by different sieve. The soil is classified as Clayey Silt . Then Atterberg limits were determined from Casagrande apparatus. The Atterberg limits are- Liquid Limit (LL) - 30, Plastic Limit (PL) - 22.45, Plasticity Index (PI) - 7.55.Standard Procter method is used for determining dry density, moisture content. Pycnometer method is used for Specific Gravity. The soil properties are Dry density- 1.77gm\cc, Optimum moisture content is 15.5%, Specific Gravity- 2.56, Moisture content of the soil sample- 20%.The bagasse ash sample is collected from , and Bambusa Vulgaris or Bamboo is carried from streets way of firozabad, up. Various properties of soil are listed bellow in a table no 1.

Table -1: Properties of soil

properties	**Value**
Specific gravity	2.5
Liquid limit	30
Plastic limit	22.45
Plasticity index	7.55
Gravel	4.13%
Sand Content	6.45%
Silt & Clay Content	89.42%
Maximum dry density (gm/cc.)	1.77gm/cc
Optimum moisture content (%)	15.4%
CBR	5.47
Soil type	Clayey silt

Table No -2: Comparison of CBR Value of Soil bagasse ash mixtures at different depth.

	CBR VALUE		
APR size	1/3	2/3	MID
1X1	6.97	9.86	7.23
2X2	6.14	8.82	6.33
3X3	3.25	8.01	6.12

In the this graph we use the mixture of bagasse ash and soil with the bamboo grid at the different depth with the different aperture size and then we find the CBR value at the different depth .i.e. 1/3,2/3 and mid, we found that he max. Value at the depth of 2/3.in any aperture size.

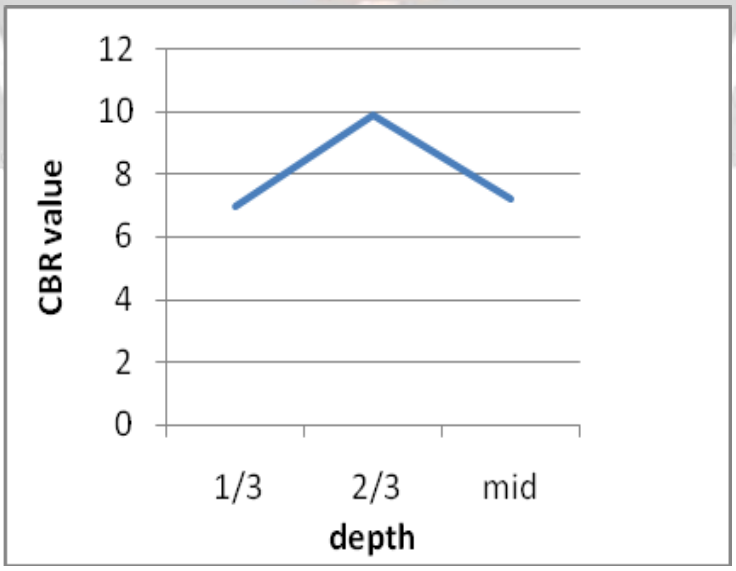


Fig - 1: Graph Of CBR Of soil + BA and Bamboo grid(1x1 APR)

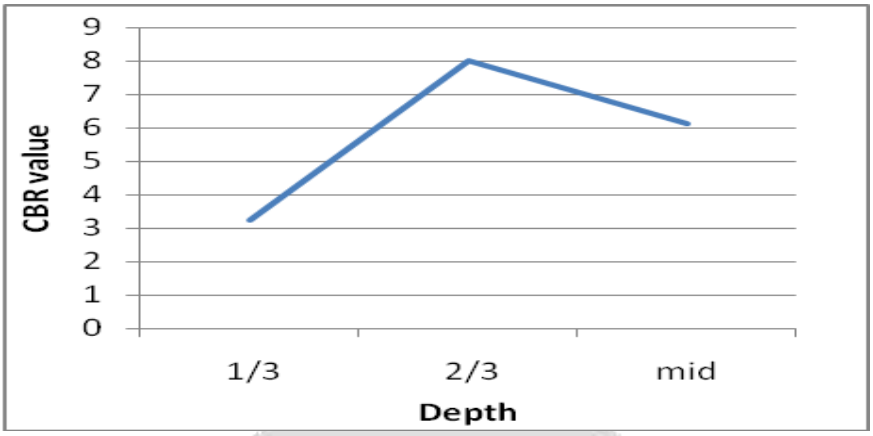


Fig – 2: Graph Of CBR Of soil + BA and Bamboo grid(2x2 APR)

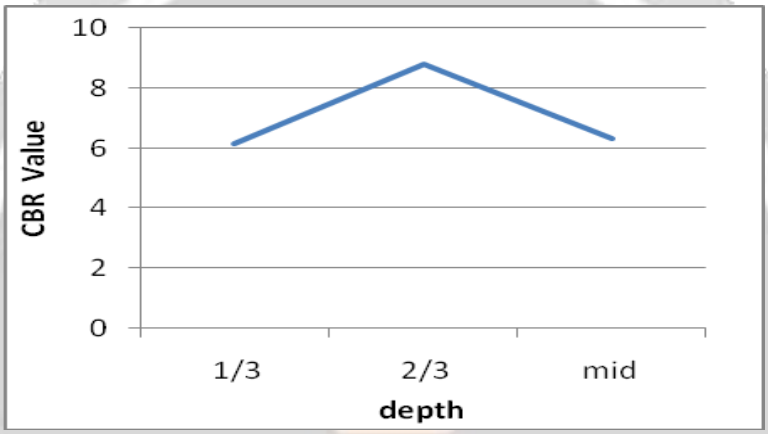
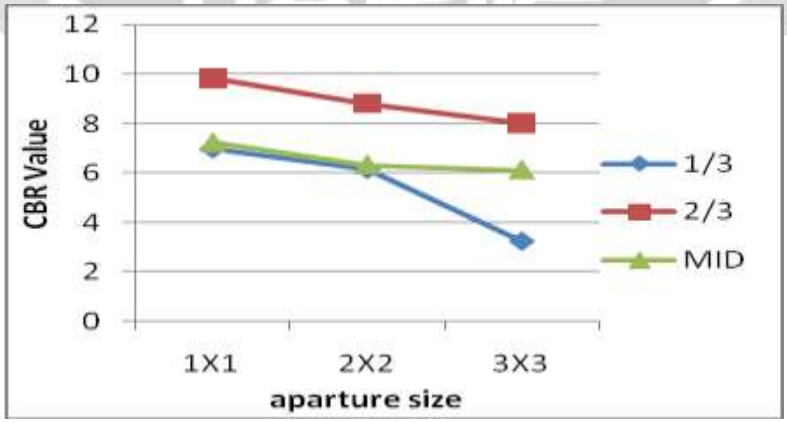


Fig – 3: Graph Of CBR Of soil + BA and Bamboo grid (3x3 APR) Test Result of Soil-Coal Ash Mixture and bamboo at 1/3,2/3, and mid with the aperture size of about 1x1,2x2 and3x3.



4. RESULTS AND DISCUSSION

Bamboo has excellent engineering properties and can be utilized for low cost housing project. It can mainly be used as reinforcement to the structure. Drawback of bamboo as construction material is its water absorption and moisture content properties. This mainly affects its strength. To reduce this effect seasoning and proper coating to bamboo should be done before using it for reinforcement. From work schedule has been prepared, accordingly tests will be carried out to analyse up to what extent the combination of soil, bagassel and bamboo is beneficial in what proportions. From the different test which is carried out on soil with bamboo grid we can say that when we mix virgin soil with bambusa vulgaris(bamboo) at different depth we found that soil gains maximum strength at 1*1 aperture bamboo grid orientation comparison to 2*2 and 3*3 bamboo grids placed in different levelsand proctor test indicated that as we increases ash content in soil optimum moisture content increases and moisture dry density decreases. After that we proceeded for California bearing test. From the results of CBR in soil-bagasse ash mixture we found that clayey silt soil gain maximum strength in 10% coal ash mixture in soil with 20% water content. Now we can move for phase two in where we tested soil – coal ash (maximum strength) mixture with oriented grid form bambusavulagaris or bamaboo in different apertures. After determining the soil-bagasse ash maximum strength proportion, the soil-coal ash (10%) prepared sample placed for CBR test. Bamboo reinforcement having 3mm to 5mm diameter and 150mm diameter was placed into the CBR at different depth. Every specimen was compacted in three layers by a hammer that delivers twenty five blow to each layer. The hammer weights 2.5 kg and has a drop of 130mm. Then the sample was placed over it and was taken into the CBR machine. The sample model was accustomed to load in the CBR machine and corresponding settlement data was recorded instantly. Using this procedure, the experiment was executed on different layer systems of bamboo reinforcement in different depth [1\3, 1\2, 2\3 (height from top in CBR mould)] and also change the oriented grid aperture dimension (i.e. 1x1cm, 2x2cm, 3x3cm). The orientation of the multi-layer system was in grid form. The settlement of the soil-bagasse ash-bamboo mixture would be tested. This experiment was performed for different aperture dimensions of soil –bagasse ash mixture with different layer system of bamboo reinforcement. The layer systems were- single layer system, two layer system, middle layer system of bamboo grid reinforcement. And the grid aperture sizes were- 1cm x 1 cm, 2 cm x 2 cm, 3 cm x 3 cm. From the investigations we can say that soil gains maximum strength in 1*1 aperture grid form when placed in both layers.

5. CONCLUSIONS

From the results of this study, the soil is classified as Clayey Silt and CL by AASHTO and USCS classification systems. The characteristics and strength of a highly expansive soil can be improved by BAGASSE ash stabilization. The C.B.R. value is increased. Therefore the inclusion of fiber is helpful in augmenting the soaked CBR and hence, resulting in less thickness of pavement crust in high rainfall area. We reached on following observations:

1. The California Bearing Ratio can be increases approximately to the initial strength of the soil, when mixed with bagasse ash.
2. The load bearing capacity of soil increases and settlement decreases when the bamboo reinforcement placed within the depth of soil in layers with the apertures 1*1, 2*2 and 3*3.
3. The settlement is minimum when bamboo grid layer placed in both layers at the height of 1/3 and 2/3.
4. The CBR value is maximum in bamboo grid apertures 1*1 in both layers and minimum in 3*3 in single layer.
5. For multilayer system, settlement decreases with increasing number of grid form bamboo layer. The settlement is minimum for both layers and maximum when bamboo placed in 1\3 position from top in CBR mould

6. REFERENCES

[1]. Bhuvaneshwari S., Robinson R. G., Gandhi S. R., “Stabilization of expansive soils using fly”, in proceedings of Fly Ash Utilization Programmed (FAUP), New Delhi, India, 2005.

[2]. John Paul V.and Antony Rachel Sneha M., “effect of random inclusion of bamboo fibers on strength behavior of fly ash treated black cotton soil”, International Journal of Civil Engineering and Technology (IJCIET), 7(5), 153–160, 2016.

[3]. Karthik S., Kumar A., Gowtham P., Elango G., Gokul D., Thangaraj S., “Soil stabilization by using fly ash”, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) , 10(6), 20-26, 2014.

[4]. Kumar A, Walia B, Mohan J., Compressive strength of fiber reinforced highly compressible clay, Construction and Building Materials, 20(10), 1063-1068, 2006.

[5]. Singh S. K., Arif S. M., "Inclusion of coconut coir fiber in soil mixed with coal ash", International Journal of Research in Engineering and Technology, 3(11), 209-213, 2014.

[7]. Soosan George T, Alice T V, Mini M I, "Improvement of kaolinite clay sub-grade using coir fibre waste", International Journal of Engineering Technology and Advanced Engineering, 3(3), 988-995, 2013.

[8]. Tiwari A., Mahiyar H. K. , "Experimental study on stabilization of black cotton soil by fly ash, coconut coir fiber and crushed glass", International Journal of Engineering Technology and Advanced Engineering., 4(11), 330-333, 2014.

[9]. S K Singh, S M Arif ―Inclusion of coconut coir fiber in soil mixed with coal ash‖ International Journal of Research in Engineering and Technology, Nov 2014.

[10]. Ghavami K. ―Ultimate load behaviour of bamboo reinforced lightweight concrete beams‖. Cement Concrete Compos 1995; 17(4):281–8.

[11]. Andréa Aparecida , Lourival Marin , Normando Barbosa , Thiago de , Nathalia Campos , Gustavo Henrique Department of Forest Science, Department of Civil and Environmental Engineering, Centro de Tecnologia, Universidade Federal da Paraíba, Brazil presents ―Incorporation of bamboo particles and synthetic termite saliva‘‘inadobes‖in Construction and Building Materials 98 (2015) 250–256

[12]. Ghavami K, Hombeeck RV. Application of bamboo as a construction material: Part I—Mechanical properties and water repellent treatment of bamboo, Part II—Bamboo reinforced concrete beams. In: Proc of Latin American on Rational Organization of Building Applied to Low Cost Housing, CIB, Sa˜o Paulo, Brazil, 1981. p. 49–66.

[14]. Arpan Sen, RishabhKashyap ―Soil Stabilization using Waste fiber Materials‖M.techthesis, NIT Rourkela, May 2012..

[15]. Rajesh Chauhan (2010) ―A Laboratory Study on Effect of Test Conditions On njfdnxj Subgrade Strength‖ M.tech. Thesis, NIT Rourkela, May 2010.

[16]. SriramaVenkateswaraRao, Pradeep Kumar ―Application Of Fal-G Hollow Masonry Blocks In Building Construction‖ in IJETMAS October 2014, Volume 2 Issue 6, ISSN 2349-4476 describes FaL-G is the product name derived from a cementitious mixture composed of Fly ash (Fa), Lime (L) and Gypsum (G) The experimental results reveal that the FaL-G hollow blocks are suitable to be used for the construction of masonry structures.

[17]. Yudhbir and Honjo, Y. (1991) ―Application of geotechnical engineering to environmental control‖, In Proceedings of the 9th Asian Regional Conference on Soil Mechanics and Foundation Engineering, Bangkok, Vol. 2. pp. 431–466.

[18]. SupriyaMohanty and NiharRanjan Patra (2015) ―Geo-technical characterization of Panki and Panipat Pond ash in india‖ presented in international journal of geo- engineering DOI 10.1186/s40703-015-0013-4.