SUB GRADE STABILIZATION BY USING FLY ASH REINFORCED WITH BITUMEN COATED BAMBOO MESH

[1] R.V.S Raghava Sarma, [2] Dr. D.S.V Prasad
[1]Research Scholar, [2]Research Supervisor
[1]Mewar University,
[1] Chittorgarh.

ABSTRACT

Transportation is one of the major necessities in the development of country for effective transfer of goods and services, men, machinery from one place to other. It is well established fact that roadways serve as the major constituent for effective transportation. As India is rich in various soil deposits expansive soils creates a big problem for the laying of pavements because of its volume change at different climatic conditions. As the strength of the pavement depends upon its beneath layers, sub grade in expansive soils is rich in clay and silt content. So, for stabilization purpose fly ash is added as partial replacement and an additive of bitumen coated bamboo mesh is placed at 4 different layers in the sub grade is observed to be stabilized with optimum moisture content and maximum dry density. The prepared sub grade is observed to have high CBR values when compared with the CBR of unmodified soil.

KEYWORDS: Sub grade, flyash, Stabilization, CBR.

1. INTRODUCTION

In India nearly 20% of the geographical land is covered with expansive soils. It is an established fact that suitable site conditions are not available everywhere due to wide variations in sub soil specially the presence of expansive soils pose a challenge to civil engineers. Due to the change in climatic conditions there exists a great change in behaviour of the soil. Because of its swelling nature with respect to moisture content the settlements increasing with loads which in turn a great damage to flexible pavements. So, in order to increase the bearing capacity of the soil at the site either by partial replacement of sub grade or complete replacement of soil. As complete replacement is not a useful idea so partial replacement of fly ash along with the placement of bitumen coated bamboo mesh is observed to be more effective at less cost. Thus, by the adoption of this technique the soil bearing capacity is increased and settlement is decreased which helps in expansive soil to attain considerable stiffness binding properties. Due to the presence of bamboo mesh the moisture absorption capacity is also reduced in the soil.

RESEARCH

Several researchers (Dembichi and Jermolowietz, 1988; Rao, 1996) felt that reinforced earth technique could solve majority of civil engineering problems in the near future. The advantages with the use of geo synthetics in civil engineering structures have been realized by the researchers (Rao, 1996). Majority of the previous studies involved the use of geo synthetics either as a separator at pavement-sub grade interface (Jorenby and Hicks, 1986; AL Qadi and Bhutta, 1999) or at the pavement overlay interface (Button, 1989; Pradeep kumar, 1995). However, a few cases of using geo synthetics for reinforcing one of the flexible pavement layers laid over conventional non-swelling sub grades (Hass et al, 1988) have also been reported. Recent studies by Prasada Raju (2001) reveal that the introduction of geo grid, bitumen coated chicken mesh and bamboo mesh in subbase course, increased the load carrying capacity of the flexible pavement system on expansive soil subgrades. In another study, Lindh and Eriksson (1991) reported that fiber reinforced sand in road construction improved the strength and deformation properties of pavements. Dresher et al (1991) used shredded tires in subbase/road base to improve the drainage below the pavement laid on expansive soil sub grade.

In another investigation reinforcement has been provided in the flyash subbase course in the laboratory model flexible pavement construction (Sreenivasa Rao, 2003) and it was observed from cyclic plate load test results that, introducing the reinforcement in the subbase of the flexible pavement system significantly increased the load carrying capacity of the flexible Pavement system.

2.MATERIALS USED

2.1 Soil

The present soil sample is collected at 1 metre depth below the ground surface is allowed to dry and then allowed to pass through the IS sieve and the passed soil is used for testing. The soil properties are tested and tabulated in Table:1

Table:1 Geotechnical properties of unmodified soil

S.No	Property	Value
1	Sand	15.8%
2	Silt	22.4%
3	Clay	61.8%
4	Specific gravity	2.69
5	Liquid limit	54.32
6	Plastic limit	28.16
7	Plasticity index	26.16

2.2 Fly ash

It is an industrial waste obtained from power plants. As per recent estimation nearly half of the fly ash produced is seems to be useless. So, fly ash can be used as a partial replacement of sub grade through which California bearing ratio of the soil is increased which in turn reduces the settlement in expansive soils. The present fly ash used is obtained from a local dealer with chemical composition tabulated in Table:2

Table:2 Chemical composition of fly ash

S.No	Chemical component	Value by % weight
1	Al_2O_3	17.6
2	SiO_2	61.32
3	FeO_3	5.99
4	CaO	6.68
5	MgO	3.69
6	SO_3	1.34
7	Loss on Ignition	3.38

2.3 Bitumen coated Bamboo mesh

The bamboo mesh is coated with bitumen and applied in two coats to increase the binding property of the soil.

3.METHODOLOGY

In the present study compaction tests are carried for different percentages of fly ash replacements to determine the maximum dry density and optimum moisture content. The suitable fly ash content having maximum dry density is considered for further investigation. The CBR tests carried by the procedure according to IS code. The bitumen coated chicken mesh is placed at different layers in the specimen.

The CBR mould of diameter 150 mm and height of 128 mm is marked into 4 layers and the chicken mesh is placed in all layers individually and then at 1,3 and 2,4 positions and then in all layers and their CBR values are noticed in both soaked and un soaked tests.

Table:3 OMC and MDD of Soil with variations in Fly ash content and CBR values of same

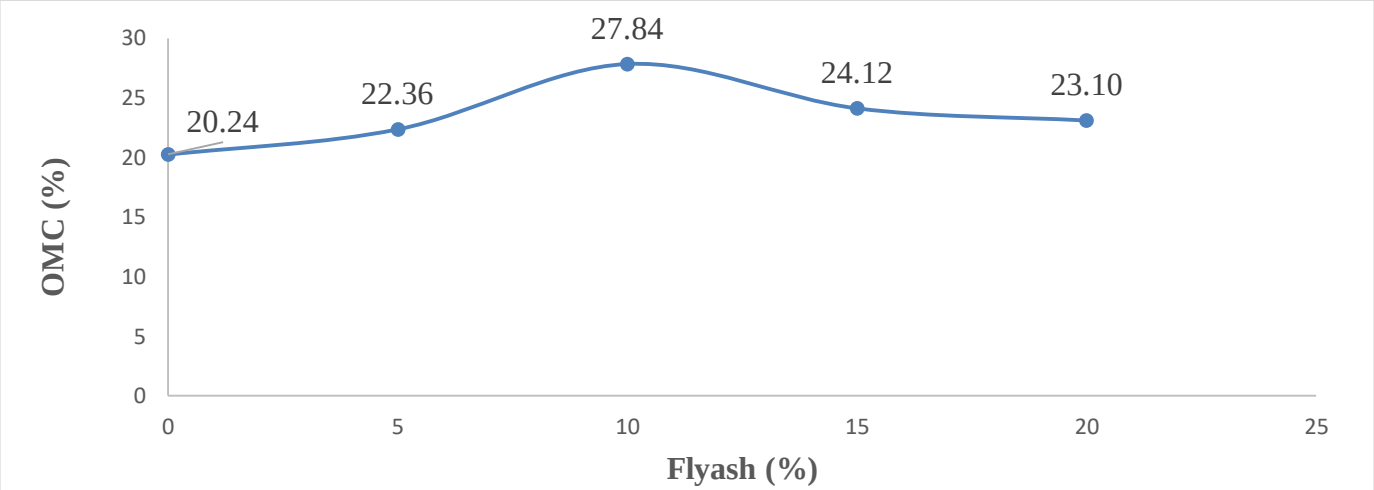
S.No	OMC(%)	MDD
Unmodified soil	20.24	1.47
Soil+5% fly ash	22.36	1.44
Soil+10% fly ash	27.84	1.38
Soil+15% fly ash	24.12	1.48
Soil+20% fly ash	23.10	1.42

Table:4 CBR values of Soaked and Un-soaked samples with different soil conditions

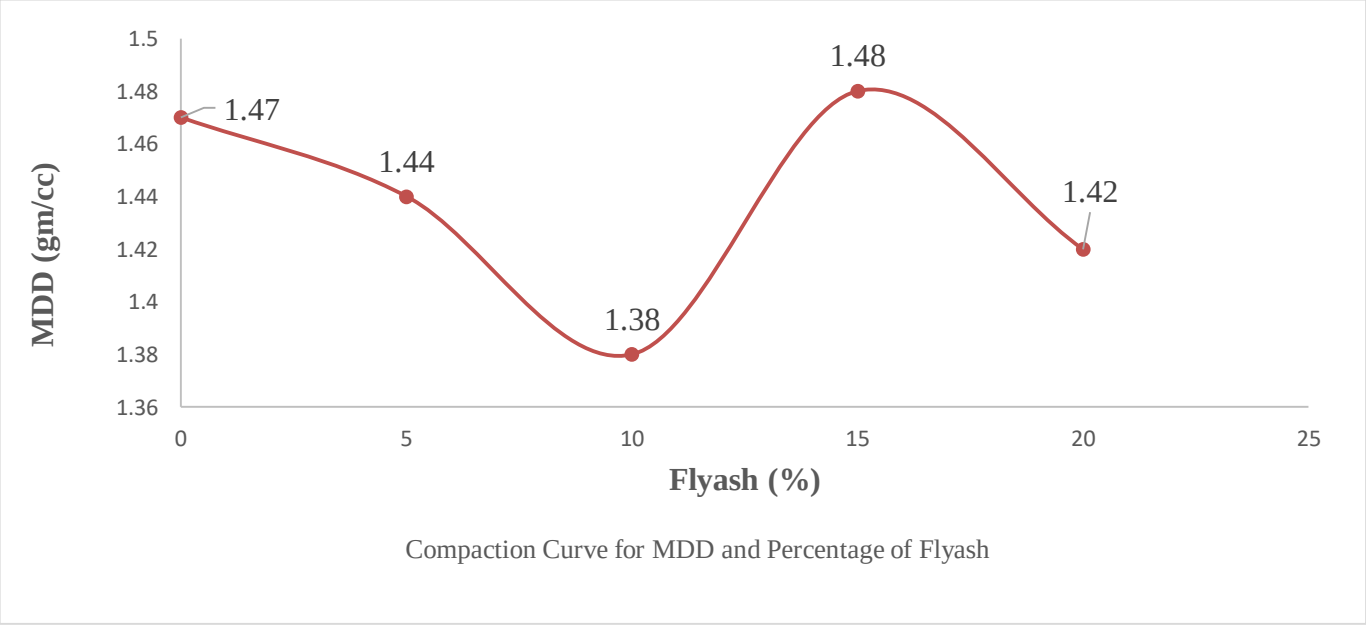
S.No	CBR Value	
	Un-soaked	Soaked
Unmodified soil	5.9	4.12
Modified soil	6.12	4.33
First layer	6.2	4.54
Second layer	6.14	4.28
Third layer	6.01	4.18
Fourth layer	5.94	4.09
1,3 layers	6.18	4.51
2,4 layers	6.39	4.82
All layers	6.91	5.01

4. RESULTS AND DISCUSSIONS

Based on the tests conducted on the soil the functional behaviour of fly ash replaced soil and the effect of bitumen coated bamboo mesh on OMC,MDD is graphically represented below.

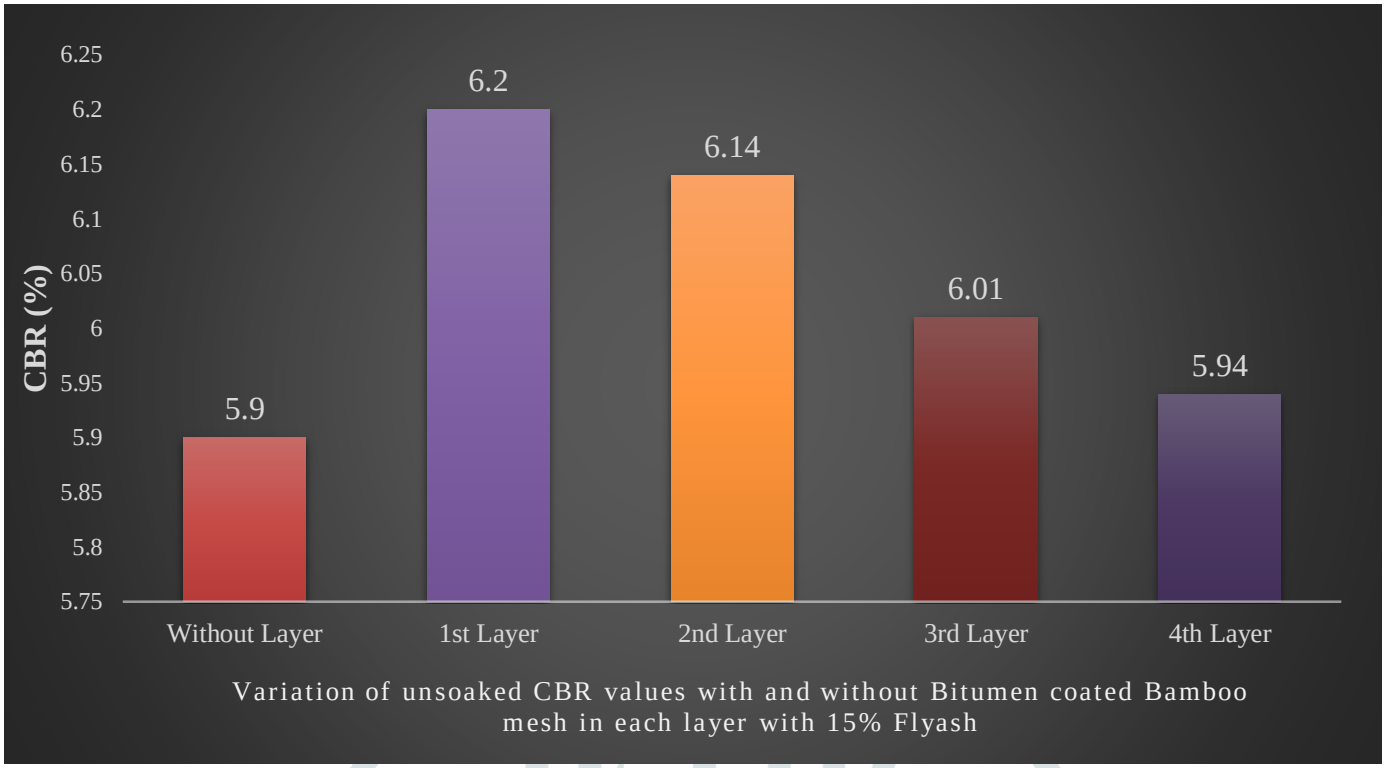


Compaction Curve for OMC and Percentage of Flyash

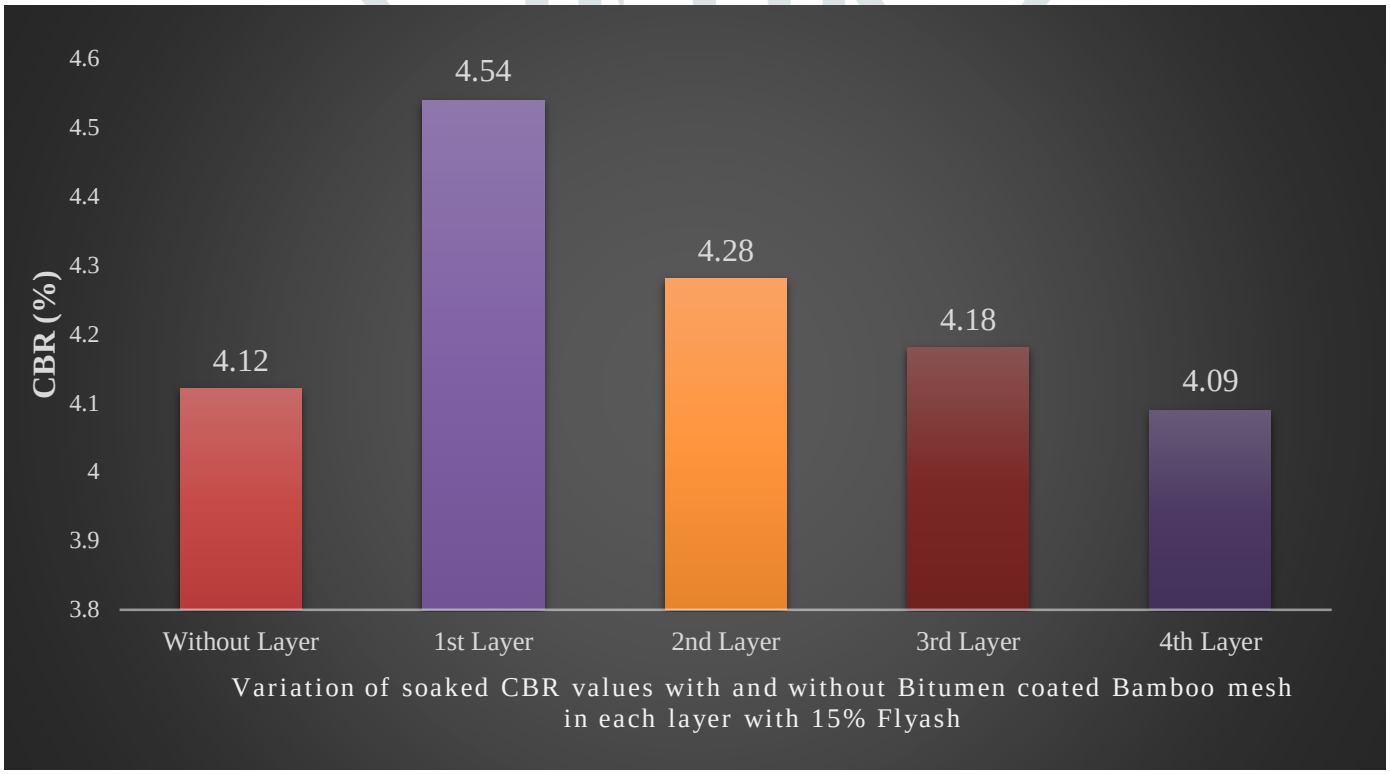


Compaction Curve for MDD and Percentage of Flyash

The moisture content available in the natural soil is found to be 20.24%. As fly ash is replaced at different percentages by weight of the soil the water content is increasing with increase in fly ash and attained its optimum moisture content value at 15 % fly ash replacement and is found to be 24.12%. Thus, the point at which the maximum dry density achieved 1.48 and the moisture content at 15% fly ash replacement is considered in present expansive soil.

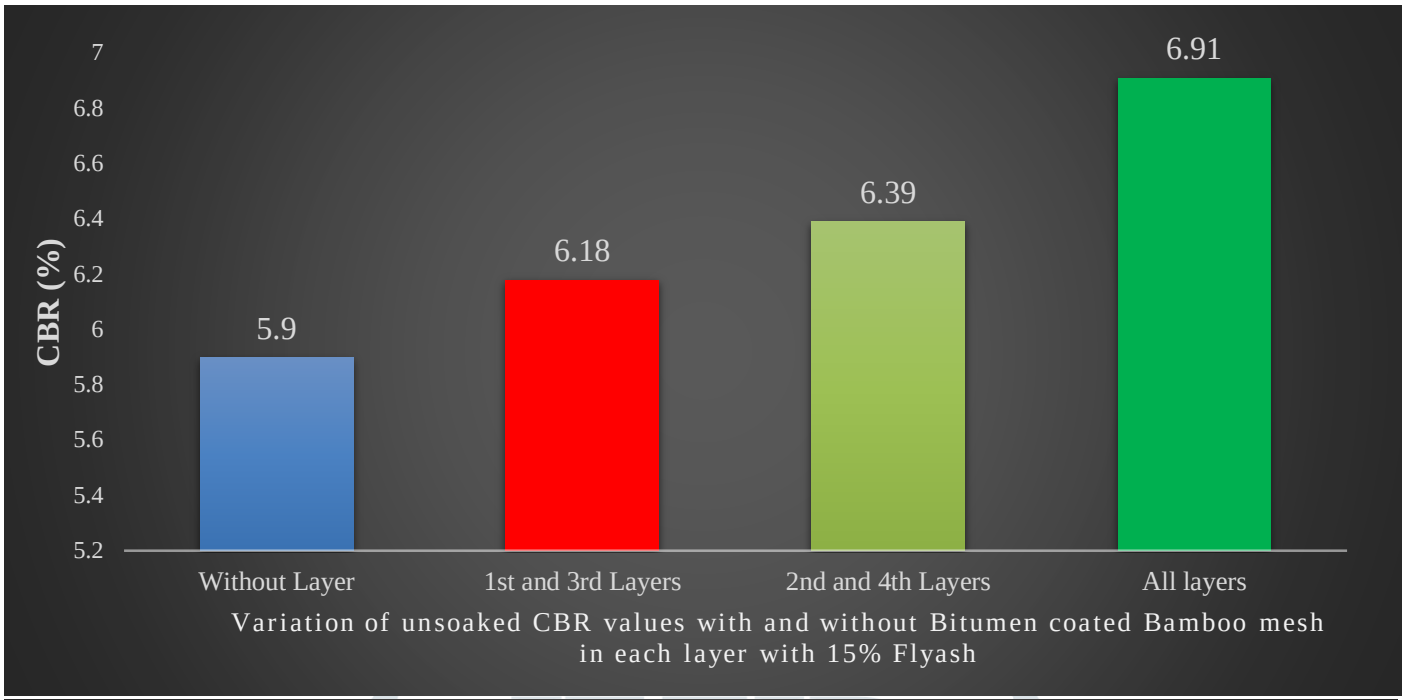


Variation of unsoaked CBR values with and without Bitumen coated Bamboo mesh in each layer with 15% Flyash

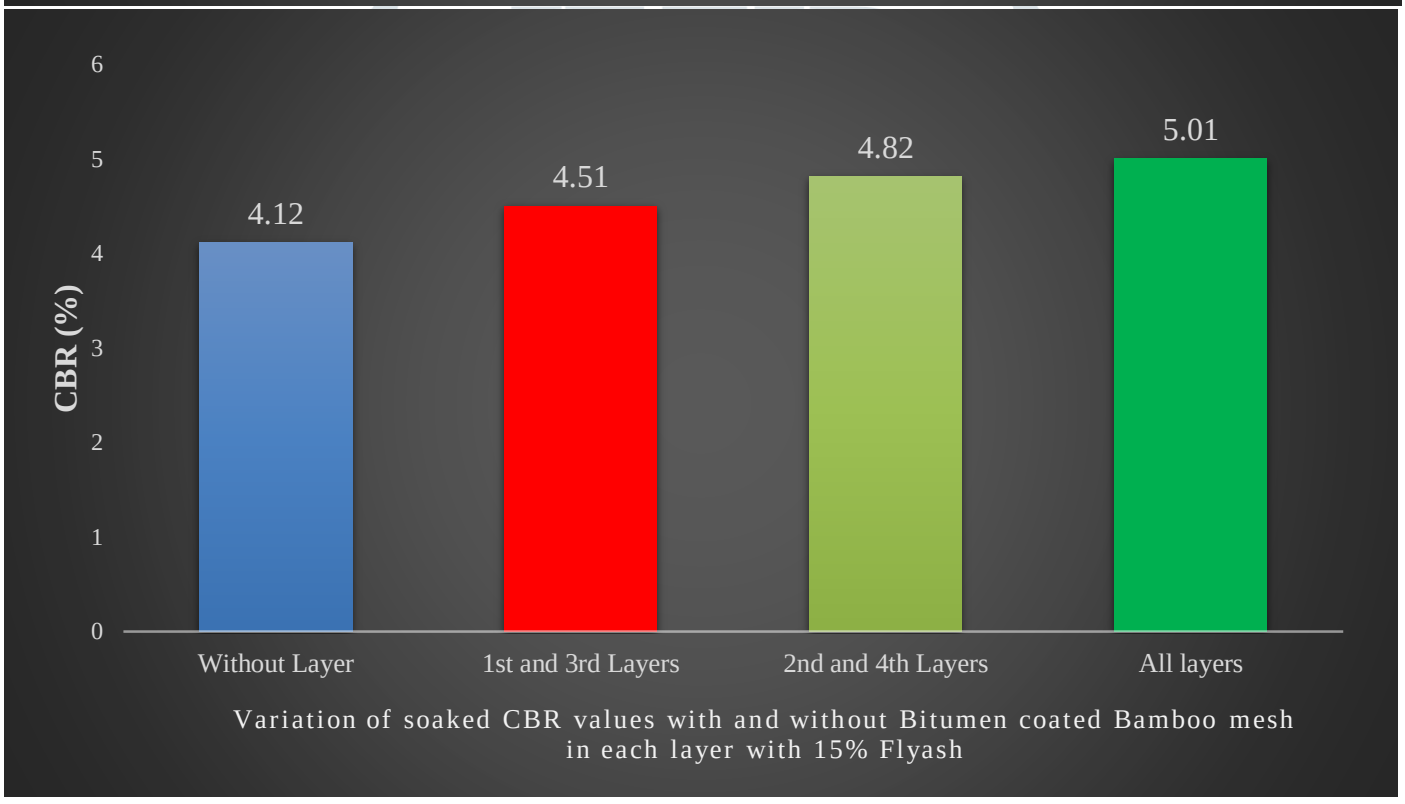


Variation of soaked CBR values with and without Bitumen coated Bamboo mesh in each layer with 15% Flyash

The observed CBR for natural soil under soaked conditions is 4.12%. By the addition of 15 % fly ash and the placement of bitumen coated bamboo mesh at 4 different layers influenced the CBR values to a great extent. The value of CBR observed at 1 st layer is maximum when compared with 2,3,4 th layers.



Variation of unsoaked CBR values with and without Bitumen coated Bamboo mesh in each layer with 15% Flyash



Variation of soaked CBR values with and without Bitumen coated Bamboo mesh in each layer with 15% Flyash

The CBR values of 6.91 and 5.01 are observed at 15 % replacement of fly ash along with bitumen coated bamboo mesh placed at all the 4 layers is observed to be maximum under un soaked and soaked conditions. Thus by placing the mesh at 4 different layers in the sub grade the strength of the pavement is improved and thus reduction in the thickness of the pavement can be achieved.

5. CONCLUSIONS

In the present project fly ash is used for soil stabilization with alternative material as bitumen coated bamboo mesh.

1. The optimum moisture content and maximum dry density is observed at 24.12% and 1.48 respectively at 15% replacement of expansive soil with fly ash.

2. The placement of bitumen coated bamboo mesh at different layers in soil increased the bearing capacities of the soil.

3. On addition of 15% fly ash in soil along with addition of bitumen coated bamboo mesh is desired for sub grade.

4. As the placement of bitumen coated bamboo mesh goes deep into the sub grade the CBR value decreases.

5. The CBR value is increased from 4.12 to 4.51 with the placement of mesh layer at all 4 layers in soaked conditions.

6. The CBR value is increased from 5.9 to 6.18 with the placement of mesh layer at all 4 layers in un soaked conditions.

7. As the sub grade is stabilized the thickness of the flexible pavement can be reduced.

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