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Enhancement of CBR of Weak Soil Using Flyash And Cement as Admixtures

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Abstract:- Fly Ash is the waste material, which is obtained after burning coal in Thermal Power Plants. It can be used as a stabilizer for soil due to its pozzolanic effect or an inherent self-hardening property under favourable conditions of moisture and compaction. This project aims at increasing the strength of poorly graded soil by using Fly Ash and cement as admixtures in various proportions. Some percentage of Fly Ash without any additives was utilized so as to reduce the cost of construction and this is a good method for disposal of it. Fly Ash was added in various percentages like 10, 20, 30 and 40 (% by volume). Initially all basic Geotechnical properties of the soil such as liquid limit, plastic limit,Grain Size Analysis, Specific Gravity, Free Swell Index, Unconfined Compressive Strength, OMC and MDD were determined. Later on the stabilized mixes were tested for CBR (California Bearing Ratio) which is an indirect measurement of strength. After the detailed experimental investigation it is observed that 30% addition of Fly Ash has shown optimum values, same investigation was continued with addition of cement in 2, 5, 8 and 10 percentages to the optimum mix of Fly Ash with soil. The strengths were determined in both Unsoaked and soaked conditions and at various curing periods such as 7 and 28 Days. Among all proportions of mixes 30% Fly Ash+8 % of the cement has shown maximum strengths, so that it was decided as optimum mix. Maximum strengths were obtained at 28 days curing period for all proportions of mixes so that this period is decided as optimum curing period. Eventually this project work facilitates aneconomical, strong and durable construction material for Flexible Pavements.

I. INTRODUCTION

The scarcity of suitable graded soil at construction sites has forced engineers to utilize waste products of industries that either degrade the environment or pose problems for their disposal. In this connection, utilization of by-products like Fly Ash as suitable ingredients for Geotechnical Construction is necessary. Soils with low Bearing Capacities underlying heavy structures are always problematic from the Geotechnical Engineering point of view. It is essential to overcome this problem by strengthening the soil using Admixtures. Soil stabilization by means of Fly Ash has environmental benefits in preventing pollution of water and air that can result from its mere disposal near thermal power plants. Many research results have indicated that Fly Ash is an effective material and also has the potential application to stabilize soft subgrade soils.Ajanta kalita and Baleswar have carried out a Research on fly ash and cement stabilized soil mixes. They concluded that 35% addition of Fly ash and 5% addition of cement to optimum dosage of fly ash mixes have shown maximumstrengths.Shenbaga et al. summarized that 3% of cement with 1% of fibre mixes have shown optimum Characteristics. M.K. vaidya et al. summarized that soil-cement mixes shown favourable results for their use in Flexible Pavements.The increase in percentage content of Fly Ash in Fly Ash-soil mixtures leads to decrease in dry unit weight, which is attributed to the low specific gravity of Fly Ash.

II. MATERIALS USED

Fly Ash:

For the present study Fly Ash was collected from the National Thermal Power Corporation (NTPC), which is located at paravada in Visakhapatnam.

Cement:

The cement used in this Research is OPC43 grade (Priya cement) which is collected from the local construction site.

Table No: 1

Property of the soil	Value
Colour	Brown
Specific Gravity	2.68
Unconfined Compressive Strength (UCS) (kPa)	30
Liquid limit (%)	26.50
Plastic limit (%)	22.60
Shrinkage limit	13.4
Plasticity index	3.90
California Bearing Ratio (CBR)	2.6
Grain Size Distribution	
a) Coarse sand (%)	3.06
b) Medium sand (%)	20.36
c) Fine Sand (%)	37.58
d) fines (%)	39
Free swell index	4.20%

Table No: 2

Property of the Fly Ash	Value
Appearance	Powder form
Colour	Grey
Specific Gravity	2.3
Liquid limit (%)	26
Plastic limit (%)	Non plastic
Wet sieve analysis	
a) fines(%)	45
b) sand (%)	55
Free swell index (%)	9

Table No: 3

S.NO	Property Of The Cement	VALUE
1	Specific Gravity	3.1
2	Normal Consistency	31%
3	Initial Setting Time	40min
4	Final Setting Time	160min

Table No: 4

S.NO	% OF FLY ASH	DRY DENSITY(g/cc)
1	0	1.54
2	10	1.82
3	20	1.85
4	30	1.99
5	40	2.12

III. COMPACTION CHARACTERISTICS

Optimum Moisture Content & Maximum Dry Density

The parameters like OMC (Optimum Moisture Content) and MDD (maximum Dry Density) were determined for the soil sample. The parameters were found by using MINI COMPACTION apparatus which is

suggested by Professor A. Sridharan and Professor P.V.Sivapullaiah of IISC Bangalore. The values are as shown below in the table and corresponding Figures

Table No:5

S.NO	% OF FLY ASH	OMC (%)
1	0	14.5
2	10	11.53
3	20	9.65
4	30	9
5	40	8.5

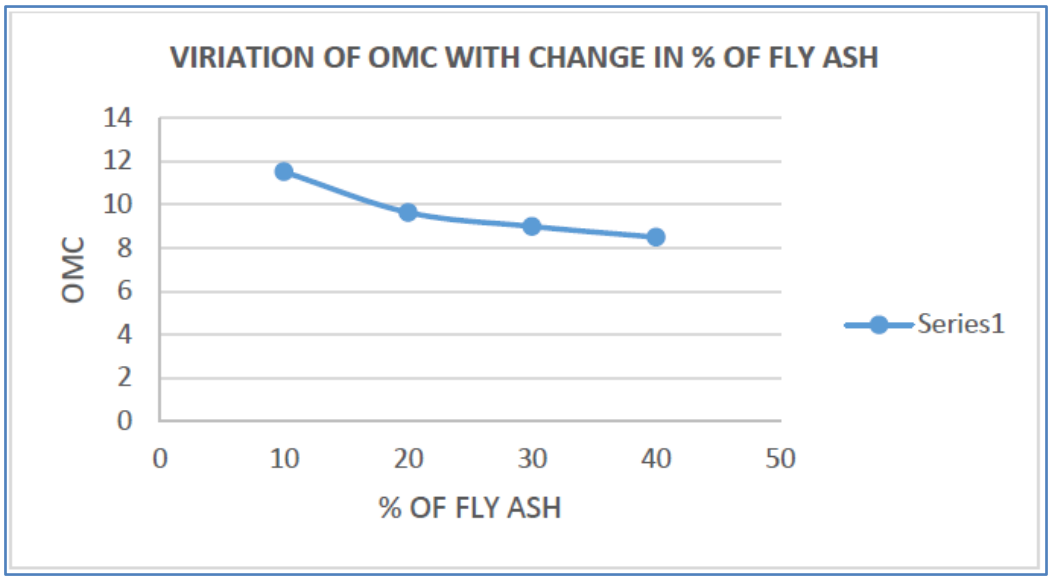

Figure No: 1

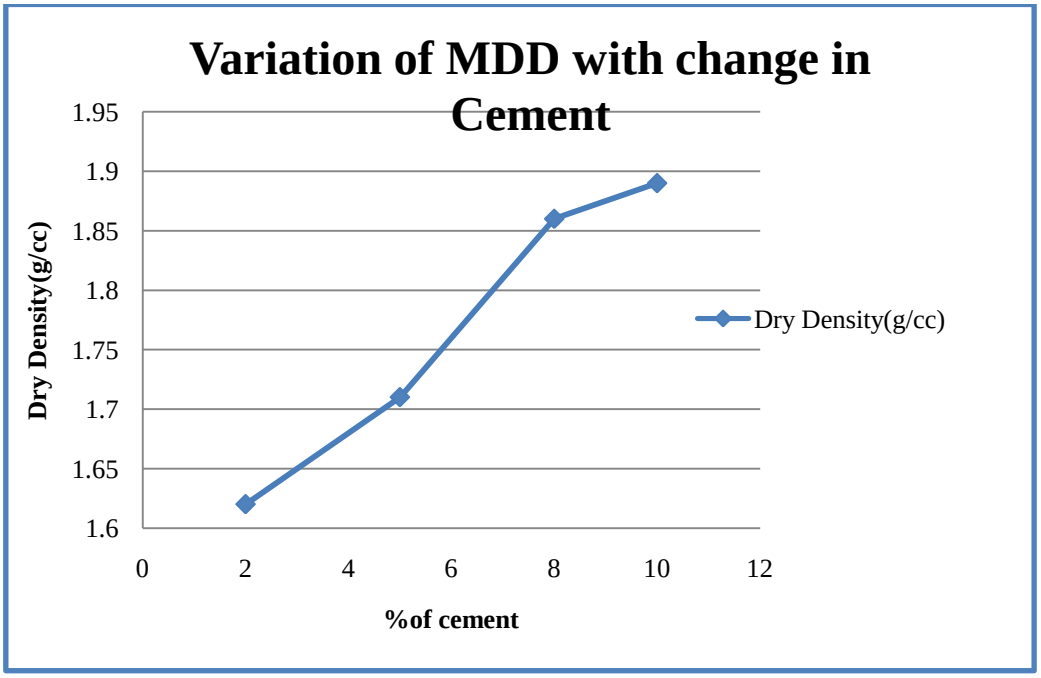

Figure No: 2

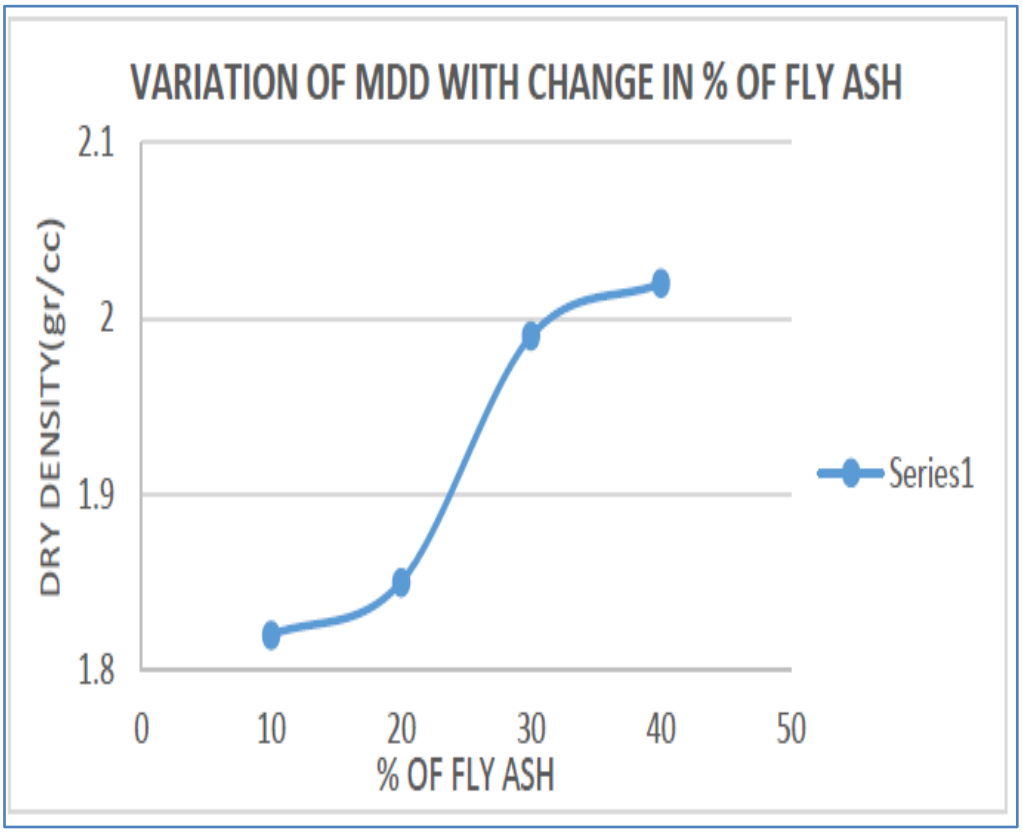

Figure No: 3

The increase in percentage of Fly Ash results in Decrease of OMC and increase of MDD. This is because of the presence of calcium Oxide in Fly Ash which plays a significant role in enhancing the MDD values. Consequently the strengths of the mixes would increase to a greater extent. The following Figures are representing the OMC and MDD values of various percentage additions of cement with optimum percentage of Fly Ash i.e. 30%.

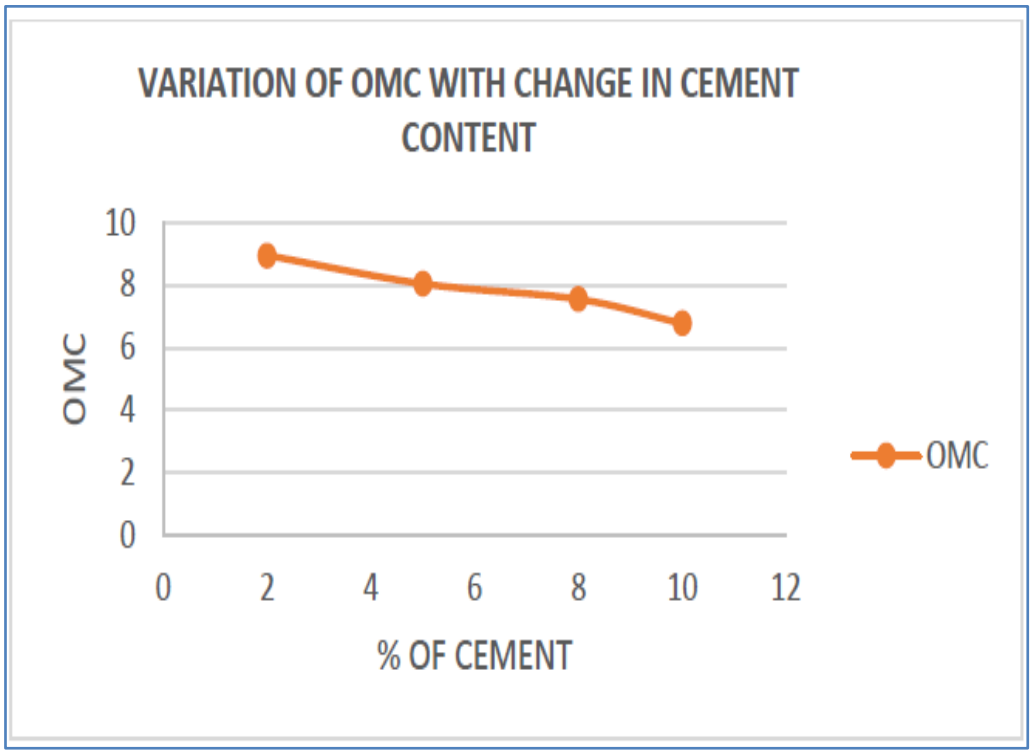

Figure No: 4

There is reduction in the values of OMC and increase in the values of MDD due to presence of calcium Oxide in major percentage. Effective agglomeration has taken place in the Cement stabilized mixes which helps in increase of MDD values. The occurrence of agglomeration increased the particle size so that the mix took less amount of water for hydration consequently the decreased trend was observed in OMC values.

IV. STRENGTH CHARACTERISTICS

California Bearing Ratio was determined for all proportions of mixes for 7 and 28 days cured samples. The tests were also performed in both soaked and Unsoaked conditions. The variation in the values are shown below

Table No: 6

S.NO	% of fly ash	% of cbr at 2.5 mm (unsoaked)	% of cbr at 2.5 mm (soaked)
1	10	8	3.5
2	20	9.6	4
3	30	11.2	4.8
4	40	9.6	4.6

Table No: 7

S.No	% Of Cement+30%Fly Ash	% Of CBR at 2.5 mm (Us)	% Of CBR at 2.5 Mm (S)
1	2	16	9
2	5	24	15
3	8	38	23
4	10	40	25

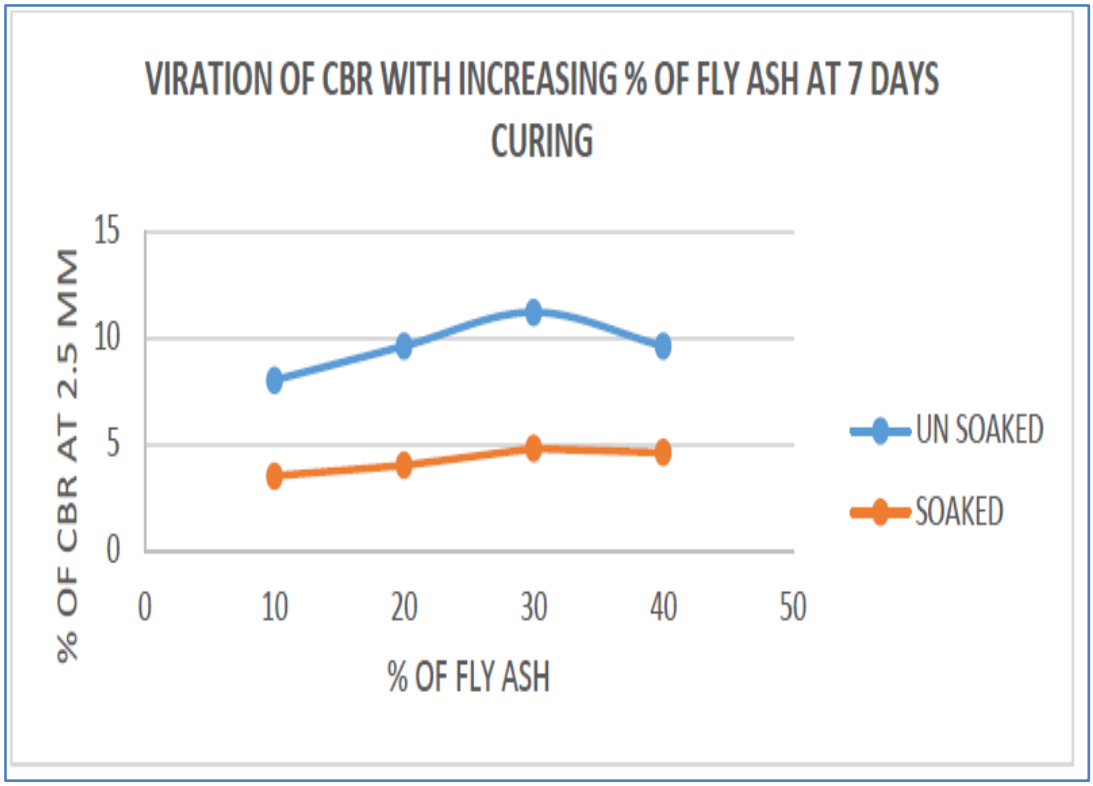

Figure No: 5

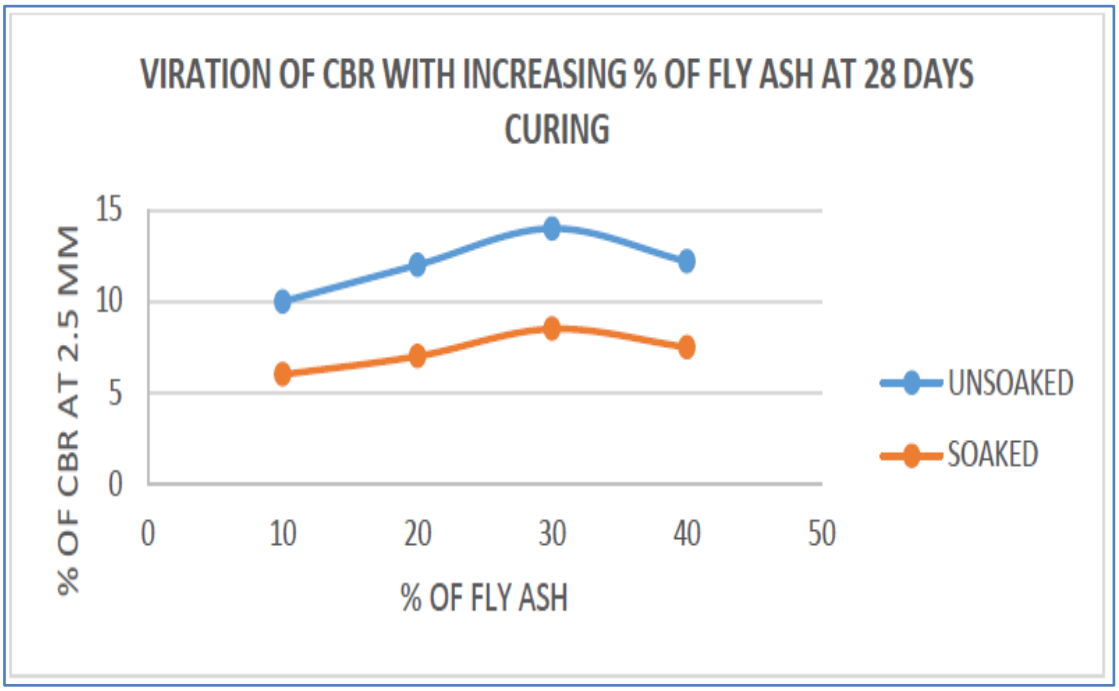

Figure No: 6

The increase in CBR is due to effective hydration that took place in the Fly Ash soil mixes. The curing period helped in occurrence of agglomeration in the mixes. Consequently the strengths have been increased. The dosage of 30% Fly Ash was decided as optimum which has shown higher CBR values and the 28 days was decided as optimum curing period which has given maximum strengths. This is because of increase in calcium oxide and Silica in the mixes which is predominant in enhancing the CBR values. It is observed from the experimental findings that there is an increase of 87% in CBR values upto optimum percentage addition i.e. 30% Fly Ash, later on no much variation was observed in the strengths of the mixes.

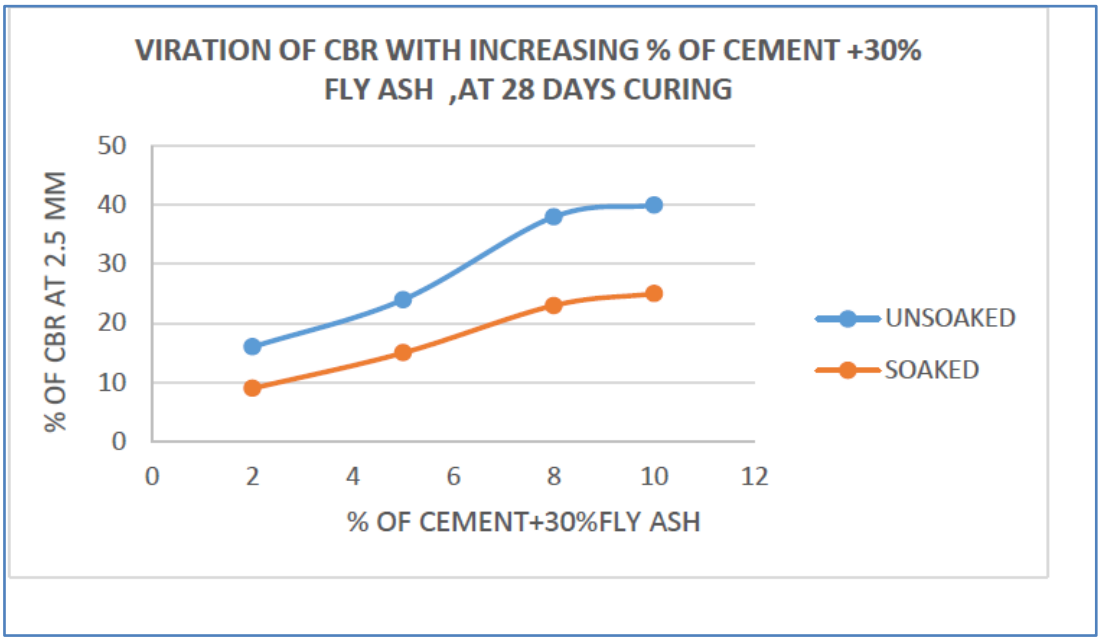

Figure No: 7

The obtained CBR values for Fly Ash stabilized soil mixes have shown better results at 30 percentage addition so that it was taken as optimum mix. In order to prepare the strong construction material for Flexible Pavements Cement was added to those mixes in various percentages (%by volume). 8% dosage of cement to the Fly Ash soil mix has shown Optimum values. Further dosage of cement has not shown much variation in the

increase of strengths so the mix of Soil+30% Fly Ash+ 8% cement was considered as optimum mix. The obtained CBR for this mix is 38 so that it can be used as Base course or Subgrade for Flexible Pavements. It is observed from the experimental findings that there is an increase of 96% in CBR values up to optimum percentage additions of Fly Ash and cement.

V. CONCLUSIONS

1. It is observed from all experimental findings that the certain proportions of Fly Ash added to the soil improved the CBR values.
2. The optimum dosage of the Fly Ash is **30%** at both Un soaked & soaked conditions.
3. The optimum percentage addition of the cement was decided as **8%** for optimum mix of Fly Ash-soil at both un soaked & soaked conditions.
4. Maximum strengths were obtained at 28 days curing period for all proportions of mixes.
5. The percentage increase in Fly Ash increases the maximum dry density and decreases the optimum moisture content.
6. The percentage increases in cement and optimum percentage of Fly Ash (30%) combination leads to the increase in maximum dry density and decrease in moisture content.

REFERENCES

[1]. Dili Kumar, Ashish Gupta &Neetesh Kumar " Some Geotechnical Properties of Coal Fly Ash and Sand Mixtures with Different Ratio using in Highway & Embankments"
[2]. M.K. Vaidya, Chore H.S, P.Kousitha, S.K.Ukrande"Geotechnical Characterization Cement - Fly Ash - Fibers Mix "
[3]. H. P. Singh "Strength Characteristics of Fly Ash Reinforced With GeosyntheticFiber "
[4]. ChayanGupta ,Dr. Ravi Kumar Sharma "Influence of Marble Dust, Fly Ash and Beas Sand on Sub Grade Characteristics of Expansive Soil".
[5]. Ajanta Kalita "Experimental Study on Strength Behaviour Of Cement Blended Soil-Fly Ash Mixes".
[6]. Asce, 128(6): 462-472. Kaniraj, S.R. And Havanagi, V.G. (1999a). "Geotechnical Characteristics Of Fly Ash-Soil Mixtures", Geotechnical Engineering Journal, 30(2):129-146.
[7]. Kaniraj, S.R. And Gayathri, V. (2003). "Factors Influencing The Strength Of Cement Fly Ash Base Courses", Journal Of Transportation Engineering, Asce, 129(5): 538-548.
[8]. Pandian, N.S. And Krishna, K.C. (2002). "California Bearing Ratio Behavior Of Cement-Stabilized Fly Ash-Soil Mixes", Journal Of Testing And Evaluation, 30(6): 1-5
[9]. Consoli, N. C., Prietto, P. D., and Ulbrich, L. A. (1998). ''Influence of fiber and cement addition on behavior of a sandy soil.'' J. Geotech. andGeoenvir. Engrg.,ASCE, 124(2), 1211-1214.
[10]. Kaniraj, S. R., and Havanagi, V. G. (1999b). ''Geotechnical characteristics of Fly Ash-soil mixtures.'' Geotech. Engrg. J., 30(2), 129-147.