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IMPROVEMENT ON SOIL IN FOUNDATION USING LIME AND FLYASH

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Abstract **—** Soil reinforcement is a technique adopted to improve the characteristics of soil such as shear strength, compressibility and density. Deformations in subgrade can be avoided and subgrade strength can be increased by reinforcing the subgrade soil. Soil stabilization performed the use of technique to adding a binder to the soil in order to improve the engineering performance of soil .This study reports the improvement in the strength of a locally available cohesive soil by addition of both lime and fly ash. Researches were illustrated that adding the additives leads to progress in workability and mechanical behaviour of soil after stabilization lime and fly ash as local natural and industrial resources were applied for chemical stabilization. Lime alone has traditionally been used in clay-bearing, highly cohesive soil whereas fly ash has been used to bind non-cohesive soil, granular or poorly cohesive soil. Fly ash is mainly used to stabilize the sub base or base course. Disturbed soil sample was collected from kovilancherry, in kanchipuram district and laboratory tests were conducted to classify the soil based on its index properties. Soil specimen for CBR test and permeability test were prepared based on OMC (Optimum moisture content) and MDD (Maximum dry density) obtained from standard proctor compaction test. The study also made an attempt to improve the strength in clayey soil with addition of Lime and fly ash as a admixture in various percentages (5%, 10%, 15%, 20%).

Keywords — Soil, Stability, Lime, Fly ash.

I. INTRODUCTION

In India, the modern era of soil stabilization began in early 1970's, with a general shortage of petroleum and aggregates, it became necessary for the engineers to look means to improve soil other than replacing the poor soil at the building site. Soil stabilization was used but due to user of obsolete methods and also due to the absence of proper technique, soil stabilization lost favor. In recent times, with the increase in the demand for infrastructure, raw materials and fuel, soil stabilization has started to take a new shape. With the availability of better research, materials and requirements, it is emerging as a popular and cost effective method of soil improvement.

Here, in this project, soil stabilization has been done with the help of lime and lime fly ash which is used as admixtures. The improvement in the shear strength parameters has been stressed upon and comparative studies have been carried out using different methods of shear resistance measurement.

II. OBJECTIVE

1. Stabilization soil with admixtures like lime and fly ash is an extremely cost effective method of converting poor quality soil into strong impermeable medium and making it into the constructing material.
2. Virtually any soil found on site can be improved for bulk fill applications and to build roads, pavements, embankment, reinforced earth structures, railways, housings and industrial units.
3. By rehabilitating natural materials in-situ construction can be carried out cost-effectively and quickly.

III. EXPERIMENTAL PROGRAMME

The experimental work consists of the following steps:

1. Determination of soil index properties.
   - Specific gravity
   - Liquid and plastic limits
2. Particle size distribution by sieve analysis.
3. Determination of maximum dry density

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(MDD) and the corresponding optimum moisture content (OMC) of the soil by Proctor compaction test .

4. Determination of stability of soil sub grade
   - California Bearing Ratio (CBR)

IV. RESULTS AND DISSCUSSION

1) Specific Gravity:

It is the ratio between the mass of any substance of a definite volume divided by mass of equal volume of water.

TABLE 1 OBSERVATIONS FOR SPECIFIC GRAVITY

S.NO	DESCRIPTION	TRIAL 1	TRIAL 2	TRIAL 3
1.	Weight of pycnometer W1(g)	0.411	0.411	0.411
2.	Weight of pycnometer + wet soil W2(g)	0.735	0.965	1.222
3.	Weight of pycnometer + wet soil + water W3 (g)	1.355	1.483	1.632
4.	Weight of pycnometer + water W4 (g)	1.163	1.163	1.163
5.	Water content	3.846	6.538	6.413
6.	Average water content	5.60		

Thus, Specific gravity G – 2.58 no unit

2) Liquid Limit:

It is the water content at which a soil changes from plastic to liquid behavior.

TABLE 2 OBSERVATIONS FOR LIQUID LIMIT

S.NO	OBSERVATION	TRAIL 1	TRAIL 2	TRAIL 3
1.	No of blows	63	38	23
2.	Weight of empty container (W1)g	18.43	13.34	11.45
3.	Weight of empty container + wet soil (W2)g	53.75	53.84	49.5
4.	Weight of empty container + dry soil(W3)g	49.9	48.17	43.8
5.	Weight of dry soil(W3-W1)g	31.47	34.83	32.35
6.	Weight of wet soil(W2-W3)g	3.85	5.67	5.79
7.	Moisture%	12.23	16.28	17.9

Liquid limit from graph = 17.2%

3) Plastic Limit:

The objective of the test is to determine the plastic limit of the soil sample and then to determine the plasticity index.

TABLE 3 OBSERVATIONS FOR PLASTIC LIMIT

S.NO	OBSERVATION	TRAIL 1	TRAIL 2	TRAIL 3
1.	Weight of container (W1)g	11.74	11,83	13.42
2.	Weight of container + wet soil (W2)g	14.4	13.4	15.81
3.	Weight of container + dry soil(W3)g	14.15	13.3	14.64
4.	Weight of dry soil (W2 -W3)g	0.25	0.1	1.17
5.	Weight of wet soil (W3-W1)g	2.41	1.47	1.22
6.	Plastic limit%	10.37	6.8	95.9

Plastic limit of soil = 37.69%

4) Grain Size Analysis:

A sieve analysis is a practice or procedure used to assess the particle size distribution of a granular material.

TABLE 4 GRAIN SIZE ANALYSIS

S.NO	SIEVE SIZE BRITISH IN mm	SIEVE SIZE IN mm	WEIGHT RETAINED IN EACH SEIVE (g)	% OF RETAINED IN EACH SIEVE	CUMULATIVE % RETAINED ON EACH SIEVE	% FINER
1.	4	4.75	94	4.7	4.7	95.3
2.	8	2.375	301	15.05	19.75	80.25
3.	10	1.188	0	0	19.75	80.25
4.	16	0.594	152	7.6	27.35	72.65
5.	22	0.294	277	13.85	41.20	58.8
6.	30	0.148	590	29.5	70.7	29.3
7.	36	0.074	8	0.4	71.1	28.9
8.	60	0.037	355	17.75	88.85	11.15
9.	35	0.019	47	2.35	91.2	8.8
10.	120	0.009	113	5.65	96.85	3.15
11.	150	0.005	16	0.8	97.65	2.35
12.	200	0.002	24	1.2	98.85	1.15

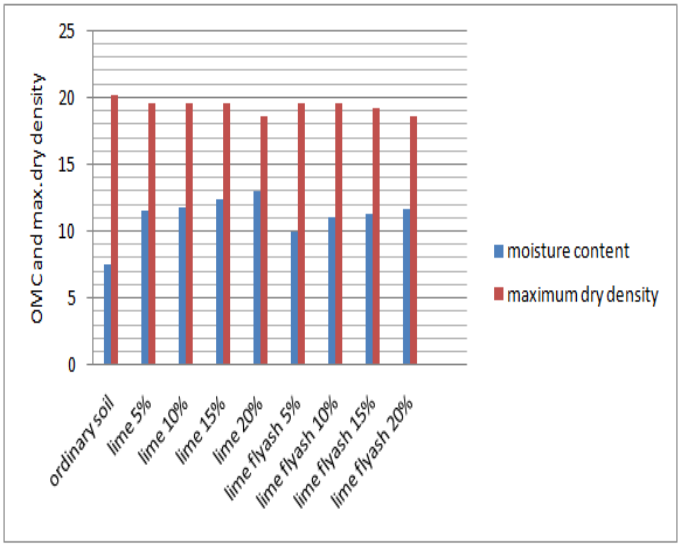
5) Standard Proctors Test:

Compaction tests were carried out in proctor's compaction test apparatus for different proportions such as 5%, 10%, 15% for clayey soil and the significant changes were observed in maximum dry density and optimum moisture content.

TABLE 5 MDD AND OMC VARIATIONS WITH ADMIXTURES

% Admixture	Lime		Fly Ash	
	$\gamma_{d\ max}$ KN/m^3	OMC %	$\gamma_{d\ max}$ KN/m^3	OMC %
0	20.18	7.5	20.18	7.5
5	19.58	11.5	19.5	10
10	19.5	11.8	19.48	11
15	19.51	12.40	19.20	11.3
20	18.59	13	18.59	11.7

It is evident from the Table that as the percentage of Lime increases from 0% - 20%, MDD also decreases from 20.18 KN/m^3 to 18.59 KN/m^3 such that there is a net decrease of 9% and in the case of Fly ash there is a decrease in the MDD values from 20.18 KN/m^3 to 18.59 KN/m^3 and hence a net decrease of 9%.



The OMC increases from 7.5 % to 13 % with a net increase of 16% for Lime and increases from 7 % to 11.7 % for Fly ash with a net increase of 13%. Hence it can be concluded that Lime and Fly ash can be effectively used to increase the compaction of soil as compaction is very effective method of improving existing soil and it is the easiest method for strengthening the soil.

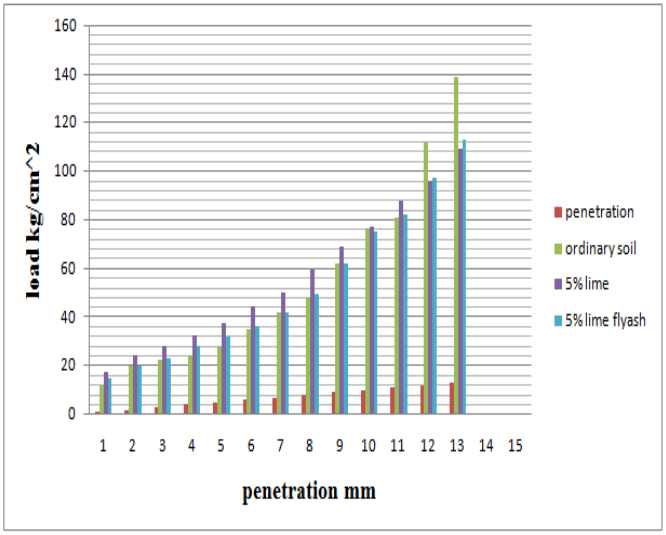
6) California Bearing Ratio:

CBR tests were conducted for different % of admixtures.

TABLE 6 VARIATIONS IN CBR VALUES WITH WASTES

% Admixture	CBR in %	
	Lime	Fly Ash
0	1.36	1.36
5	1.55	1.26

It is seen that in case of lime there is an increase in the cbr value from 1.36% to 1.55% such that there is a net increase in the value by 19% and hence it can be used as highly satisfying material for a sub grade.



For Fly ash also there is an decrease in the CBR value from 1.36% to 1.26% thereby showing a net decrease of 10% and it is also suitable to be used as a sub grade material. Figures shows the comparative analysis of both Lime and Fly ash.

V. CONCLUSION

Based on the experiments done the following result is achieved.

- From the results of the present study, it is concluded that, the soil stabilization using lime and fly ash is a very effective process for the strengthening of soil. During comparison the clay obtain maximum strength .
- Since lime and fly ash are low cost material it obtains high strength and make the structure strong and durable.
- It can be used to strength the building and roads.
- Due to stabilization the soil the bearing capacity of the soil gets increasing and any foundation can be construction in the soil.

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