AN EXPERIMENTAL EVALUATION OF THE BEHAVIOUR OF STRIP FOOTING ON REINFORCED CLAY SOIL

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Abstract

This look into might have been performed with explore those conduct for reinforced clay soil in establishment, furthermore on examine those impact from claiming distinctive parameters helping to their execution utilizing research center model tests. The parameters investigated in this contemplate incorporate sort for reinforcement, embedment depth and shape of footing. The impact about support on the vertical stress circulation in the clay soil might have been investigated. The test effects exhibited the possibility profit about utilizing reinforced clay foundation and also indicated that the support configuration/ design need a critical impact on the conduct technique for strengthened clay soil foundation. Clay soil may be reinforced eventually composites of Turmeric, Lime, GGBS (Ground Granulated Blast Furnace Slag) and Granite powder which performs superior to typical Clay soil alone. This reinforced foundation from claiming support could redistribute those connected balance load should be in more uniform pattern, henceforth lessening the stress concentration, which will bring about diminishing settlement. Finally, as a result of this paper, inclusion of reinforcement in clay soil has remarkable effect on Bearing Capacity and Settlement.

KEYWORDS: Reinforced clay soil, Turmeric, Lime, GGBS (Ground Granulated Blast Furnace Slag), Granite powder, Bearing capacity and Settlement.

INTRODUCTION

For any land-based structure, the establishment is essential and must be solid to bolster the whole structure. All together for the establishment to be solid, the Clay soil around it assumes an exceptionally basic part. Along these lines, to work with soils, we need appropriate information about their properties and variables which influence their conduct. The procedure of soil adjustment accomplishes the required properties in a Clay soil required for the development work. Soil adjustment was utilized however because of the utilization of out of date strategies and furthermore because of the nonappearance of legitimate system, soil adjustment lost support. As of late, with the expansion in the interest for, crude materials and fuel, soil adjustment has begun to take another shape. With the accessibility of better research, materials and hardware, it is developing as a well known and savvy technique for soil change. Here, in this venture, soil establishment adjustment has been finished with the assistance of fortification materials like Turmeric powder, GGBS, Granite powder, Lime. The change in the settlement parameters has been tried tentatively and the most extreme settlement for seven days has been found.

Scope of the project

Soil adjustment systems are important to guarantee the great strength of soil with the goal that it can effectively maintain the load of the superstructure particularly in the event of soil which are exceptionally dynamic, likewise it spares a considerable measure of time and a huge number of cash when contrasted with the strategy for removing and supplanting the precarious soil.

EXPERIMENTAL INVESTIGATION

MATREIALS USED

1) Turmeric Powder

2) Lime

3) GGBS (Ground Granulated Blast Furnace Slag)

4) Granite Powder

a) TURMERIC POWDER

The active ingredient in turmeric is called "cur cumin", although in its raw state turmeric only contains 2-5% curcumin. Curcumin is the substance that is responsible for improving the bearing capacity of soil.The active properties of cur cumin are best called "protective properties". The same components that prevent deterioration of clay soil, possibly extending the life span of foundation

b) LIME

Physical Properties of Lime

Characteristics	Values
Colour	White
Density	3.345 g/m^3
Hardness	3.5

Chemical Properties of Lime

Characteristics	Values
Chlorides (%)	0.04
Sulphate (%)	40
Aluminum, Iron, and Insoluble matters (%)	1
Arsenic (%)	0.0004
Lead (%)	0.004

.c) GGBS (Ground Granulated Blast Furnace Slag)

Physical Properties of GGBS

Characteristics	Values
Specific Gravity	2.78
Specific Surface Area	400-600 m^2/kg
Bulk Density (loose)	1000-1100 kg/m^3
Bulk Density (vibrate)	1200-1300 kg/m^4
Water Absorption	0.14%

Chemical Properties of GGBS

Chemical Formula	Percentages (%)
Cao	30-40
SiO$_2$	17-38
Al$_2$O$_3$	15-25
Fe$_2$O$_3$	0.5-2

d) GRANITE POWDER

Physical Properties of Granite powder

Characteristics	Values
Porosity	Very Low
Absorption	0.5-1.5%
Specific Gravity	2.6-2.8
Density	2500-2650 kg/m^3
Crushing Strength	1000-2500 kg/m^2

Chemical Properties of Granite powder

Characteristics	Values
Silica	70-77%

Alumina	11-13%
Potassium Oxide	3-5%
Soda	3-5%
Lime	1%
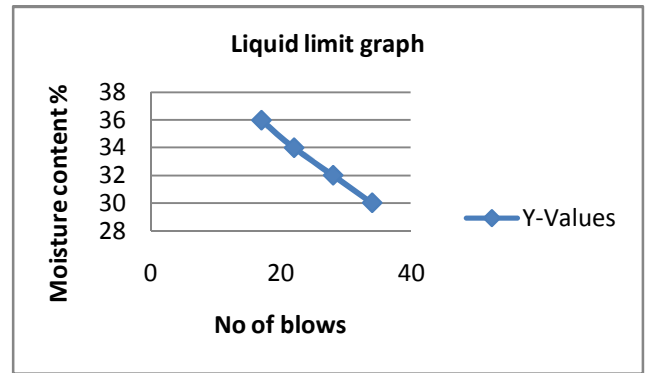
RESULTS AND DISCUSSION

a) *SPECIFIC GRAVITY*

Sl.no	Description	Values (gms)
1	Mass of empty bottle (W_1) in gms	655
2	Mass of bottle+ dry soil (W_2) in gms	857
3	Mass of bottle + dry soil + water (W_3) in gms	1618
4	Mass of bottle + water (W_4) in gms	1490
5	Specific gravity	2.72

$$\text{Specific Gravity } G = \frac{W_2 - W_1}{(W_2 - W_1) - (W_3 - W_4)}$$

b) ATTERBERG LIMITS

LIQUID LIMIT

SI.NO	Weight of Dry Soil (g)	Quantity of Water Added (%)	Number of Blows	Flow Index
1.	100	3	34	23.7
2.	100	3	28	19.0
3.	100	3	22	17.8
4.	100	3	17	17.1
			Average	**19.4**

Liquid limit graph

Flow index of clay soil =   19.46%

Liquid limit of clay soil =   33 (From graph)

PLASTIC LIMIT

Plastic limit = 24.8

Plasticity index $I_p = W_L - W_p$
                        = 8.2

Description	Trial 1	Trial 2
Empty wt. of container (w1) g	13.72	13.85
Wt. of container and wet soil (w2) g	29.86	27.14
Wt. of container and oven dry soil (w3) g	26.65	24.62
Wt. of moisture (w4= w2-w3) g	3.21	2.52
Wt. of dry soil (w5= w3-w1) g	12.93	10.77
Moisture content w = 100 X (w4/w5) %	24.83	23.40
Average	24.12	

c) PARTICLESIZE DISTRIBUTION

| SI.NO	IS Sieve (mm)	Mass Of Soil Retained Of Gram	Cumulative Retained	% Retained	% Finer
1.	100	0	0	0	100
2.	75	0	0	0	100
3.	19	0	0	0	100
4.	4.75	3	3	.3	99.7
5.	2.00	5	8	.8	99.2
6.	.425	77	85	8.5	91.5
7.	.15	97	182	18.2	81.8
8.	.075	280	462	46.2	53.8
9.	Pan	538	1000	100	0

Uniformity coefficient C_u = 2.57

c) STANDARD PROCTOR COMPACTION TEST

Weight of mould (A) = 3660 gms

Ref ID	Description	Volume of mould (V) = 1000 cc Reinforced sample		
		16%	**20%**	**24%**
B	Test No.	1	2	3
C	Wt. of wet soil + mould gm	5517	5620	5485
D	Wt. of wet soil(D = C – A) gm	1857	1960	1825
E	Wet density of soil(E = D/V) gm/cc	1.857	1.960	1.825
F	Wt. of container gm	66	70	68
G	Wt. of wet soil + container gm	323	257	183
H	Wt. of dry soil + container gm	292	225	160
I	Wt. of water (I = G – H) gms	31	32	23
J	Wt. of dry soil (J= H – F) gms	226	155	115

|				
K	Moisture content $(K = 100 \times (I/J))$ %	13.72	20.65	20
L	Dry density $[L= 100 \times (E/(100+K))]$ gm/cc	1.633	1.625	1.52
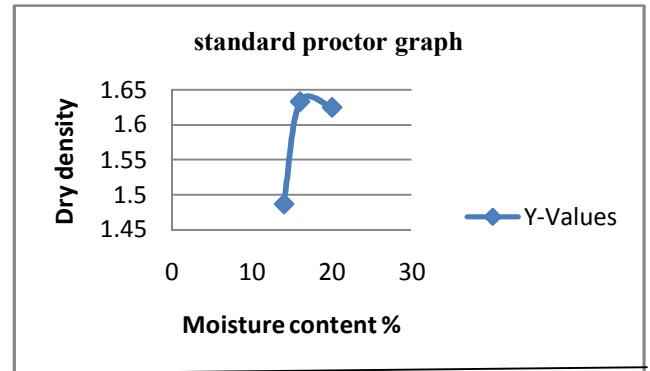
Maximum Dry Density (MDD) = 1.625

e) CALIFORNIA BEARING RATIO TEST

S.No	Penetration division	Penetration (mm)	Reinforced clay Load		Unreinforced clay Load	
			division	**Kg**	**Division**	**Kg**
1	50	0.5	7	20.86	5	14.9
2	100	1.0	12	35.76	13	38.74
3	150	1.5	24	71.52	21	62.58
4	200	2.0	35	104.3	34	101.32
5	250	2.5	66	196.68	56	166.88
6	300	3.0	75	223.5	63	187.74
7	400	4.0	82	244.36	75	223.5
8	500	5.0	95	283.1	87	259.26
9	750	7.5	102	303.96	101	300.98
10	1000	10.0	120	357.6	118	351.64
11	1250	12.5	137	408.26	134	399.32

CBR of the reinforced clay soil after soaking = 14.32

CBR graph
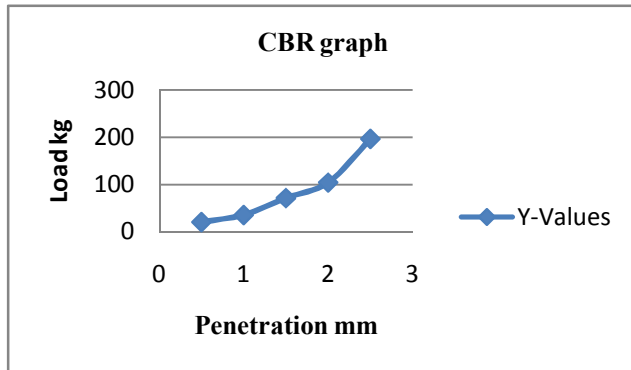
f) FREE SWELL INDEX

Description	Unreinforced clay	Reinforced clay
Volume in water after 24 hrs swell (V_d) cc	15	15
Volume in kerosene after 24 hrs swell (V_k) cc	18	16
Free swell index $[(V_d - V_k) / V_k] \times 100$ (%)	16.67	6.25

Free swell index = 16.67%

Free Swell Ratio = 0.833

CONCLUSION

In this review, a progression of lab model balance tests were directed on reinforced clay establishment to examine the potential advantages of utilizing reinforcement to enhance the bearing limit and diminish the settlement of establishment on earth soil. The review has been directed to evaluate the capability of GGBS, Granite powder, lime and turmeric for adjustment of a similar sort of soil and point by point correlation has been exhibited on various properties of soil.

1. It is watched that with the increments of GGBS, granite powder, lime and turmeric rate, ideal optimum moisture content continues diminishing while maximum dry density continues expanding, henceforth reduced capacity of soil increments and making the Clay soil more thick and hard.
2. The maximum optimum moisture content of 20.65% is come to at 10% of GGBS, 10% of Granite powder, 5% of turmeric powder and 2.5% of lime. This demonstrated the ideal esteem in view of OMC is 20%.
3. The CBR esteem increment with increment in Granite powder and accomplished greatest incentive at 10% and again diminishes. A similar pattern is additionally seen in GGBS in which the most extreme CBR esteem 10 % is achieved at 5% of turmeric. The underlying increment in the CBR is normal in view of slow arrangement of cementitious mixes between the GGBS, lime and CaOH show in the Clay soil.
4. It is inferred that the ideal incentive for Granite powder is 10%, turmeric powder is 5% and GGBS is 10% individually.

In view of the after effects of this review, it gives the idea that this chose soil can be viably balanced out with the expansion of GGBS 10%,Granite powder 10%,Tumeric 5% and Lime 2.5% by dry weight of soil. Granite powder, GGBS, Turmeric and Lime blends are appropriate for use in development of strip footing for structures in clay soil and it can be utilized as fill materials of equivalent quality.

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