IMPROVEMENT OF LOAD CARRYING CAPACITY OF BC SOIL USING REINFORCED STONE COLUMN

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Abstract - Black cotton soil are inorganic clays with high shrinkage and swelling properties. Due to its high swelling and shrinkage property it forms very poor foundation material for construction of roads. The present study was made to improve the load carrying capacity of black cotton soil by using reinforced stone column technique. The reinforcement used in this study is geotextile discs, which is placed laterally along the length of column to improve the load carrying capacity. The reinforcement is placed at different depths such as 0.25L, 0.5L, 0.75L and 1.0L. The load carrying capacity is determined for every 25mm settlement.

The result of the present investigation revealed that there was increase in load carrying capacity from 32% to 60% of 5cm dia stone column when compared to ordinary floating column and plain clay bed. The stone column of 2.5cm dia shows an increase in load carrying capacity from 40% to 90% at different depths of reinforcements when compared with ordinary floating column. The results also shows there is increase in load carrying capacity from 12% to 20% for every 25m settlement at different depths of reinforcement when compared stone column of 5cm dia and 2.5cm dia.

***Key Words*: diameter, reinforcement depth 0.25L ,0.5L ,0.75L&1.0L.**

1.0 INTRODUCTION

Stone column technique is chosen because they help in primary reinforcement and impart strength and deformation is minimized**.** Stone column are vertical elements, which are in circular column shape are constructed by replacing 10 to 35 percent of weaker soil with coarser or granular material such as stones, sand and stone chips-sand mixture. These stone column acts as a load bearing piles which is penetrated through the soft soil/weak strata and rests on firm/hard strata are known to be end bearing stone column. If stone column is penetrated through a medium stiff soil and not resting on firm strata are known as floating stone column.

1.1 ADVANTAGES OF STONE COLUMN

- High shear strength and low settlement characteristics are obtained with the account of bulging in lateral direction.
- Improvement of properties of soil after the formation of column, when bulging occurs under loading, soil also undergoes consolidation so water is easily drained out from column, so it acts as a drainage.
- Stone columns can be formed from recycled materials such as hardened concrete which can be crushed and reused as a stone column material.
- There is no disturbance to surface soil structure and there is no much excavation, hence there is no removal of earth mass.

2. MATERIALS

2.1.1CLAYEY SOIL

The soil used in this study was self-possessed from Kodaganura region, Davangere. That site clay sample is collected form Disturbed and undisturbed clay soil obtained by open dugout from the draft of 1.5 meter underneath the consistent ground surface.

2.1.2 COLUMN

The stone column material used in this study are stones which are retained 10mm during plastering which is collected from the nearby site. Specific gravity of 2.65

2.1.3 SAND

The sand used as blanket which is river sand collected from the nearby site. Sand is used for proper load distribution during loading

2.1.4 TECHNICAL INSTRUCTION REINFORCEMENT

The geotextile used in this study for reinforcement is non woven geotextile manufactured by Sofinco Industries (P) Ltd with its systematic approach to quality. The fibers are needled to form a network that retains dimensional stability relative to each other. The mass per unit area of geotextile is 120g/m^2 which is 1.25mm thick and tensile strength of 4.5kN/m.

Used in subsurface drainage, seperation, stabilization, erosion control and cushioning applications, nonwoven fabric are resistant to ultraviolet (UV) degradation and to biological and chemical environments normally found in soils.

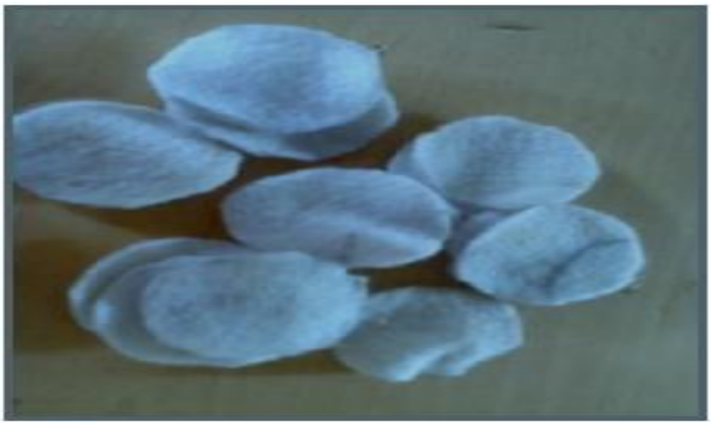

Fig 1.0 Non WovenGeotextile Discs

Table -1: Property clayey soil of soil

PROPERTY	VALUES
Specific Gravity	2.72
Water content	28%
Liquid Limit	62.85%
Plastic Limit	21.18%
Plasticity index	41.67%
MDD	15.2 KN/m^3
OMC	27.2%
Undrained cohesion	11.348 KN/m^2
free swell index	45.47%

The clay soil will obtain air dried and pulverized systemically. The black cotton soil should be passing 4.75 mm Indian standard sieve using for the practice and all the test are determined as per is code 2720 standard . The properties of expansive clay shown in above table.

2.1 EXPERIMENTAL PROCEDURE

Test was conducted in circular test tank made up ofmild steel plate having tank size 200mm dia, 300mm height and thickness 3mm. The air dried and pulverized was mixed with a optimum water content 27.2%. The soil filled with inlayers andtamping is done to achieve the field density test. The stone column will be casted by using the materials such asstone, pvc pipes and reinforcement. Pvcpipesare kept at centre reinforcement and stones are filled with in a pvc pipes in layers and hand compaction is done such that no air voids are left in the soil and simultaneously stone column at centre is also compacted with th help of tamping rod till the whole model reaches the desired height.

The whole mould assembly is kept for 24hr to achieve the undrained condition with different depth of reinforcement with variation in diameter. Then the sample is tested under the controlled strain rate. Sand bed is placed over the top and load is applied through footing of 12mm thick and dia of 10cm, load is calculated for every settlement .The pile is kept centre of the tank and filled soil the footing s placed on the centre of the loading jack to avoid the eccentric loading .the same procedure will be adopted fordifferent depth of reinforcement and spacing.

Fig 1.1 : Loading Arrangement on Tank

2.2 RESULTS AND DISCUSSION

2.2.1 LOAD AND SETTLEMENT GRAPHS OF REINFORCED STONE COLUMN AT VARYING DEPTH OF REINFORCEMENT (0.25L, 0.5L, 0.75L AND 1.0L) D=5cm

The stone column is reinforced with circular discs of geo-textiles placed horizontally at spacing equal to the diameter of the stone column (5cm). The load-settlement response is plotted with varying reinforcement depths (0.25L, 0.5L, 0.75, L). The maximum load carrying capacities of reinforced stone column with reinforcement depths of 0.25L, 0.5L, 0.75L and L are 612.0N, 663.2N, 704.0N and 742.4N respectively and the corresponding settlements is 25mm. This shows there is improvement in load carrying capacities when compared to the ordinary floating column were 32%, 43%, 54% and 60% respectively.

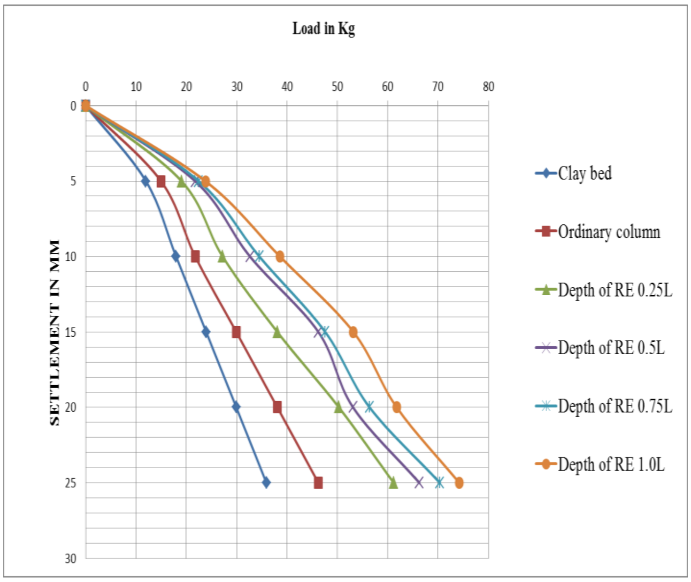

Fig 2.0 : Load Settlement curves of reinforced stone columns with varying reinforcement depths at a spacing of D (5cm)

2.2.2 LOAD AND SETTLEMENT GRAPHS OF REINFORCED STONE COLUMN AT VARYING DEPTH OF REINFORCEMENT (0.25L, 0.5L, 0.75L AND 1.0L) D=2.5cm

The stone column is reinforced with circular discs of geo-textiles placed horizontally at spacing equal to the diameter of the stone column (2.5cm). The load-settlement response is plotted with varying reinforcement depths (0.25L, 0.5L, 0.75, L). The maximum load carrying capacities of reinforced stone column with reinforcement depths of 0.25L, 0.5L, 0.75L and L are 686.5N, 744.8N, 810.2N and 893.4N respectively and the corresponding settlements is 25mm. This shows there is improvement in load carrying capacities when compared to the ordinary floating column were 48%, 61%, 75% and 93% respectively.

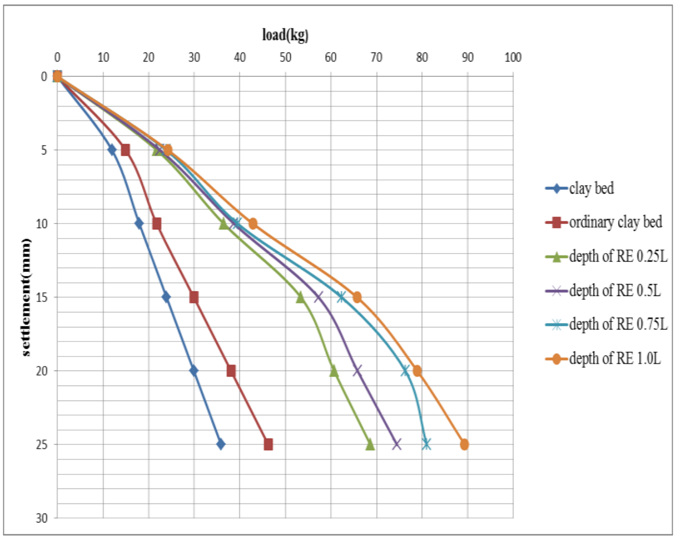

Fig 2.1 : Load Settlement curves of reinforced stone columns with varying reinforcement depths at a spacing of D (2.5cm)

3.0 BULGING ANALYSIS OF STONE COLUMN

Test was conducted on mould with different depth of reinforcement 0.25L, 0.5L, 0.75L and 1.0L. after every completion of single test stones are picked out from the column carefully and then plaster of paris paste was made and filled in the column space. The whole mould was kept for 24hrs to get deformed shape of column. The soil around the column was easily removed and hardened plaster of paris was taken out and deformation along the length of column was measured.

The bulging curves of floating stone column with varying depth of reinforcement at 5cm spacing. The horizontal deformation are measured at every outer face of column at 2.5 cm interval. The graph plotted above between depth of column and bulging of column. The maximum bulging observed was 1.5cm, 1.3cm, 1.1cm, 0.8cm and 0.6cm for ordinary column and reinforced column of 0.25L, 0.5L, 0.75L and1.0L respectively.

Fig 3.0 hardened models of reinforced stone columns with varying reinforcement depths at a spacing of D (5cm)

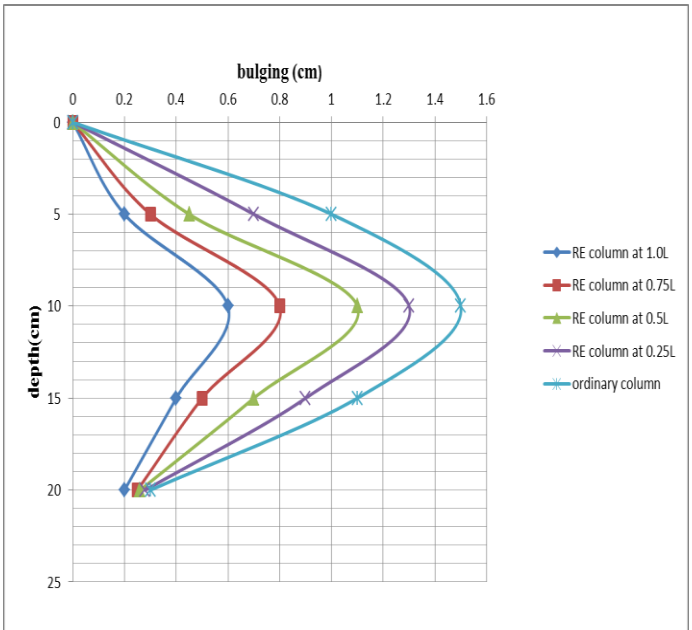

Fig 3.1 bulging behavior of reinforced stone columns with varying reinforcement depths at a spacing of D (5cm)

3.0 CONCLUSIONS

The model study is conducted on the performances of circulartank with different depth of reinforcement for floating stone column. The circular footing used to the vertical loading is determined load v/s settlement through an experimental study.The test was conducted circular tank to determine the improvement in load carryingcapacity and bulging analysis for different depth of reinforcement.

- The load carrying capacity and stiffness are increased by using lateral reinforcement of column using geo-textile circular discs.
- Load carrying capacity for D/2 spacing of reinforcement carries more load when compared with with D spacing of reinforcement.
- The settlement is decreased when stone column is reinforced with geotextiles and load carrying capacity is increased.
- Bulging of ordinary stone column is more when compared to reinforced stone column.

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