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Effect of Geotextile on Load Settlement Behavior of Ceramic Column

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***Abstract*—Indian ceramic production is 100 Million ton per year. Where 15% - 30% waste is generated from the total production. Dumping of ceramic waste leads to serious environmental and dust pollution and occupy large area. To avoid these conditions, it is desirable to reduce the ceramic waste by recycling or other alternative methods. Stone columns are one of the commonly used techniques for engineering the ground. It is the most effective solution for improving the strength of soil and thereby protecting against liquefaction with less installation time. Our aim is to investigate the feasibility of using ceramic waste as aggregates in stone columns there by reducing the waste disposal, to provide a replacement to aggregates in columns and to minimize the cost of soil stabilization. Experimental study on the load settlement behavior (as per IS 1888-1982) in test model of Ceramic stone column, Ceramic stone columns with geotextile casing, Ceramic stone columns with horizontal arrangement of geotextile, Ceramic stone columns with both horizontal layering and casing of geotextile and to compare with the ordinary stone column. Results shows that improvement in the load carrying capacity is found less in ceramic as compared to stone column but by the introduction of geotextile casing and layering, there is an increase in the load carrying capacity of ceramic column.**

***Keywords*— Stone column, geotextile, load settlement, ceramic column, reinforcement**

I. INTRODUCTION

Marine soil possess higher water content and they have low strength and high compressibility. Due to low supporting strength, these soils pose serious problems to construction of structures. Marine soil are normally present in seashore areas where ports are built for import and export operations. These operations involve stacking of materials at ports. If proper ground improvement is not done in soft marine clays and materials are excessively stacked, shear movements occur in subsoil affecting the neighboring structures. Constructions on such soil are being managed by stone columns.

Ceramic wastes are produced every day. Their main contribution are from tile manufacturing companies, houses etc. Stoke piling is the traditional way of disposal of these waste which may cause several environmental problems and dust pollution which also may occupy large useful land.

So in order to avoid such problems we are trying to cooperate ceramic wastes as aggregates in stone columns.

II. MATERIALS USED

The marine soil material is collected from the place near to the MULT of Port Trust. Crushed aggregates was collected from Metro Crushers, Kalady. They are having a size of between 6mm to 8mm. Ceramic wastes are collected from Surabhi tiles, Angamaly. The geotextile used is Non-woven polypropylene having a GSM OF 250 and thickness 1mm which is collected from Shri Raghavendra Geotextiles, Chennai.

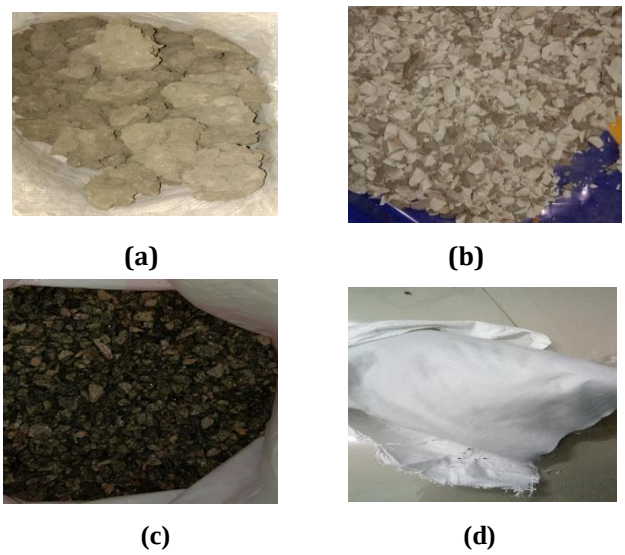

Fig. 1 (a) Marine Soil (b) Ceramic Chips (c) Aggregate (d) Non-Woven polypropylene geotextile

III. JUSTIFICATION FOR THE PROJECT

Marine soil possess high water content and as a result have low strength and high compressibility. Because of low supporting strength, these soils pose serious problems to construction of structures. Marine clays are normally present in seashore areas where ports are built for import and export operations. These operations involve stacking of materials at ports. If proper ground improvement is not done in soft marine soil and materials are excessively stacked, shear movements occur in subsoil affecting the neighboring structures. Constructions on such soil are being managed by stone columns.

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Ceramic production is 100 Million ton per year. In the ceramic industry, about 15% - 30% waste is generated from the total production. Dumping of ceramic waste leads to serious environmental and dust pollution and occupy large area.

So in order to avoid such problems we are trying to in co-operate ceramic wastes as aggregates in stone columns.

IV. EXPERIMENTAL STUDY

Index and Engineering properties of marine soil are given below in table:

TABLE 1: INDEX PROPERTIES OF SOIL

PROPERTIES	VALUES
Specific Gravity	2.48
Liquid Limit	34.5%
Plastic Limit	15.62%
Plasticity Index	18.78%
Optimum Moisture Content	20%
Max Dry Density	1.768 g/cc
Consolidation	$3.778*10^{-4}cm^2/s$
CBR	.0058%

A. Experimental Set Up and Loading Condition

Tests were conducted on a test tank of dimension 150 mm diameter and 175 mm height. A circular steel plate of 14mm diameter and 2mm thickness is placed on the surface of the test specimen to provide even distribution of loading. The load was applied on the plate at a rate of 1.25mm/min. Experimental setup and loading is shown in figure 2.

Fig 2 .Loading Using CBR Testing Machine

B. Preparation of soil Bed

The air dried soil sample was mixed with required quantity of water. The optimum moisture content of 20% was determined by conducting standard proctor test. After adding the required water to the soil, it was thoroughly mixed to get a consistent paste. This soil mix was then filled in the test tank in 3 layers by hand compaction such that no air voids are left in the soil. Before filling soil in the tank, the inner surface of the tank wall was first coated with grease to minimize the friction between soil and the tank wall. For each load test, a fresh soil was prepared in the test tank and stone columns were installed in it. Tests were conducted on stone columns formed in a soil bed of 150 mm diameter and 175 mm height.

C. Construction of Stone Column

After preparing the soil bed, a PVC pipe of internal diameter 40 mm and 1 mm thick was inserted into the soil bed manually. Later the pipe was pulled out by rotating slightly so that the soil is removed, and a hole was created. The hole is erected in prepared soil bed using PVC pipe. Then the stone column was casted by filling the stone chips by four layers by compaction. Each layer was given a light compaction of 25 blows. Stone column prepared is shown in figure 3.

After casting the stone column steel plate was placed over the soil bed and stone column, for the uniform distribution of load .Later the whole experimental setup was taken to CBR test apparatus and readings were taken.

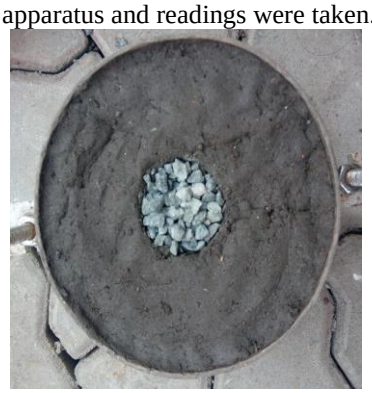

Fig 3.Stone Column

D. *Construction of Ceramic Columns*

After preparing the soil bed and the hole, ceramic tile chips of size 6 mm to 8 mm was filled into the hole as same as that of stone column preparation procedure. Later the steel plate was placed and loading was done as above.

E. Construction of Ceramic Column with Geotextile Casing

In the prepared soil bed, hole was created by using PVC pipe and the hole is encased with geotextiles as shown in figure 4. Then ceramic tile of required size is filled in the geotextile encased hole as mentioned in the above procedure.

Fig 4 Geotextile Encasement

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Fig 5 Geotextile Encased Ceramic Column

F. Construction of Ceramic Column with Geotextile Layering

Soil bed was prepared and hole was created. At the bottom to the desired position by the means of PVC pipe. Later the apparatus was loaded after placing steel plate.

G. Construction of Ceramic Column with Casing and Layering of Geotextiles

Here we are providing both casing and layering with geotextiles in the prepared soil bed, circular hole was created. The circular hole was encased with geotextile and was filled ceramic tile pieces, layer by layer. In between each layers geotextile was placed by using PVC pipe. Later at top the steel plate was placed and the whole apparatus was loaded as above.

H. Installation of Group of Stone Columns

There are two patterns for installing stone columns.

- Triangular Pattern
- Square pattern

Triangular pattern are more preferred due to its dense packing. Square pattern is also used. The figure shows the typical layout of stone columns.

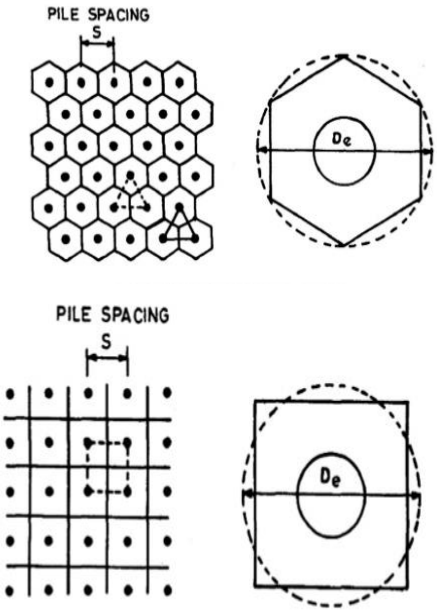

Fig 6 Triangular and Square Pattern Arrangement of Columns

I. Installation of Columns In Triangular Pattern

The columns are arranged in such a manner that they occupies the corners of an equilateral triangle of side dimension 6 cm. This arrangement is done in both ceramic and stone columns. They are installed in a same way as that of single column.

Fig.7 Triangular Pattern Arrangement

J. Installation of Columns in Square Pattern

The columns are installed in the soil bed which are placed at the edges of a square of sides 5 cm. They are installed in the same way as that of single column

Fig 8 Square Pattern Arrangement of (a) Stone Columns (b) Ceramic Columns

V.RESULT AND DISCUSSIONS

A. .Load Settlement Behaviour Of Plain Soil Bed

The figure 9 shows the load settlement behavior of soil bed from the test conducted. The ultimate bearing capacity of clay bed found to be 5.52 KN for the corresponding settlement of 16.5 mm.

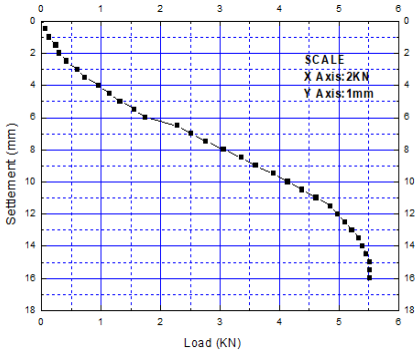

Fig 9.Settlement Curve of Soil Bed

B. Load Settlement Behavior Of soil Bed With Stone And Ceramic Column

From figure 10, it is inferred that load carrying capacity of soil bed with stone column gives a better result

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when compared to soil bed. This result found to be true with in the case of soil bed with ceramic column also. The load capacity corresponding to the settlement value of 21 mm is 7.2KN for soil with stone column. Whereas the value obtained for soil with ceramic column is 6.96 KN.

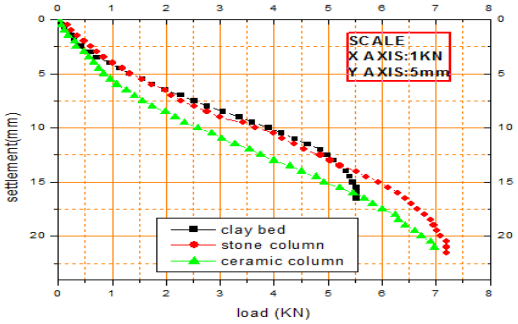

Fig 10. Settlement Curve of Soil Bed, Soil Bed with Stone and Ceramic Column.

C. Load Settlement Behavior Of Soil Bed With Reinforced Ceramic Column (Casing, Layering And Combination Of Both)

Form the figure 11 it is inferred that the load bearing capacity of ceramic column with geotextile layering is less than other two cases and the highest value is found for the ceramic column with both casing and layering. The ceramic column with layering can bear a loading value of 6.84KN. The loading value for the settlement of 22mm is 7.92KN for ceramic column with both casing and layering and 7.17 for ceramic column with casing only.

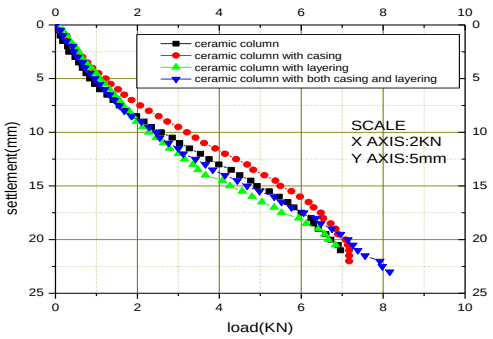

Fig 11. Settlement Curve of Different Cases of Ceramic Column

D. Load Settlement Behavior of Soil Bed By Triangular And Square Pattern Arrangement of Ceramic And Stone Columns

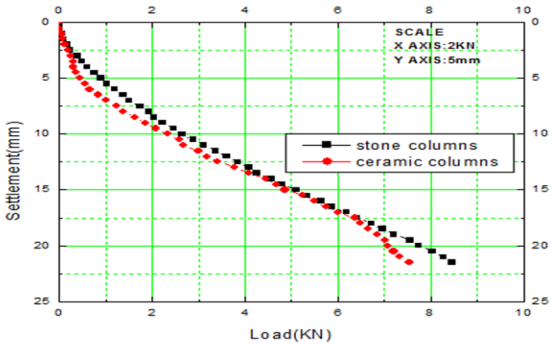

Fig 12. Square Pattern

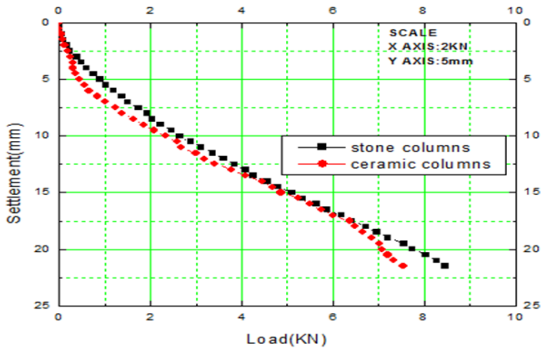

Fig 13.Triangular pattern

From the above graphs we can see that the load carrying capacity of ceramic column is less than that of stone column. In square pattern arrangement of stone columns, the max loading corresponding to the settlement 22 mm is 10.8 KN and for ceramic column the max loading is 9.84KN. For 21.5mm settlement, the maximum loading of stone column is 8.46 KN and ceramic column is 7.54 KN in case of triangular pattern arrangement .By providing casing and layering of geotextile in each ceramic column and arranging them in these triangular and square patterns, we can increase the load carrying capacity.

VI.CONCLUSIONS

The conclusions obtained from the test conducted is listed below:

- The load carrying capacity of soil bed is seems to be very low.
- By the installation of stone column the load carrying capacity of the soil bed is increased by 30%
- In case of ceramic column 26% increase in load carrying capacity is found when compared to soil bed but it shows 3.3% decrement in loading capacity as compared to stone column.
- There is no significant change in load carrying capacity is found in clay bed with geotextile layered ceramic column.

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- Ceramic column with geotextile casing gives 0.5% decrement in load bearing capacity as compared to stone column.
- The load carrying capacity of soil bed can be increased by 10% than stone column by the introduction of ceramic column with both geotextile casing and layering by the extra densification of the soil.
- In case of grouping of column load carrying capacity of ceramic column is less when compared to stone column
- It can be improved by the introduction of geotextiles casing and layering

REFERENCES

[1] Dr.T K Kiran Kumar, V.Lakshmi Thulasi (2017). "Ground improvement and load carrying capacity using stone column in clay soils", *International Journal of Innovative Research in Science, Engineering and Technology*, Vol. 6, Issue 2:2892-2897.

[2] S. Siva Gowri Prasad, P. V. V. Satyanarayana **(**2016). "Improvement of soft soil performance using stone columns improved with circular geogrid discs", *Indian Journal of Science and Technology*, Vol 9(30):1-6.

[3] Sarvaiya H. K, Solanki C. H (2015). "An experimental study on load capacity of floating stone column in soft soil", *International Journal of Advances in Engineering & Technology*, Vol. 8, Issue 6:965-975.

[4] J. Nazari Afshar, M. Ghazavi (2012). "A simple analytical method for calculation of bearing capacity of stone column", *International Journal of Civil Engineering*, Vol. 12, No. 1:16-27.

[5] Haralambos Saroglou, Andreas A. Antoniou, Spyros K. Pateras (2009). "Ground improvement of clayey soil formation using stone column: A case study from Greece", *International Journal of Geotechnical Engineering*, Vol. 3:493-498.

[6] S.N Malarvizhi, et al,2017 "load v/s settlement of clay bed stabilized with stone column and reinforced stone column".

[7] A P Ambily ,2004"Experimental and theoretical evaluation of stone column in soft clay"