International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

EFFECT OF STONE COLUMN AND ENCASED STONE COLUMN IN SETTLEMENT OF SOIL

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Abstract- *Ground improvement is an important requirement in today's construction industry, as land reclamation is becoming increasingly popular. The stone column technique is a very efficient method of improving the strength parameter of soil like bearing capacity and reducing consolidation settlement. Stone column technique is one of the soil stabilisation method that is used to increase strength and decrease the compressibility of soft and loose fine graded soil, accelerate consolidation effect and reduce the liquefaction potential of soil.*

Key words: Stone column, Encased stone column, Settlement, Consolidation time.

I. INTRODUCTION

India has large coastline exceeding 6000kms. In the recent past, the coastal areas are well developed and large number of ports, industries are being built. In addition, the availability of land for the development of commercial, housing, industrial and transportation, infrastructure etc., are scarce particularly in urban areas. This necessitated the use of land, which has weak strata, wherein the geotechnical engineers are challenged by the presence of different problematic soils with varied engineering characteristics. Many of these areas are covered with thick soft marine clay deposit. The Engineering structures constructed on thick deposits of soft soil strata have problems of low bearing performance, short time schedule, durability, constructability and low costs. Stone column technique seems to be very favourable and suitable ground improvement technique for deep soft soil improvement capacity, excessive total and differential settlement, lateral spreading etc. Further to prevent excessive bulging, squeezing of stone into soft soil, stone column can be encased with suitable geosynthetic material. This project presents the effect of stone column and encased stone column as a ground improvement technique in settlement process. Stone column that consist of granular material compacted in long cylindrical holes is used as a technique for improving the strength and consolidation characteristics of soft clays.

II. SCOPE

Embankment construction can begin soon after installation of stone column.

Due to rapid consolidation, the accelerated dissipation of excess pore water pressure into the drainage path formed by stone column,

construction can be started quickly.

Stone column can be used in tank foundation, raft or isolated footing, reinforced earth walls, railway embankment, ports etc.

III. LITERATURE REVIEW

Pradip Das and Dr.Sujit Kumar Pal (2013) conducted a study of the behaviour of stone column in local soft and loose layered soil. They had an investigation on the

utilization of stone column to improve the load capacity of sandy silt soil with clay in naturally consolidated state. Load tests are also conducted and the stone column treated soil can carry more load than untreated soil. In stone column, the load carrying capacity of layered soil increases with increasing diameter of the stone column. In encased stone column, the load carrying capacity of layered soil decreases with increasing diameter of stone column.

BehzadKalantari and Bandar Abbas (2012) made a review on Soft soil stabilization using stone columns. The use of stone column in soft clays has been found to provide moderate increase in load carrying capacity accompanied by significant reduction in settlement. Being granular and freely drained material, consolidation settlement is accelerated and post construction settlement is minimized. Stone columns may have particular application in soft soils such as N.C clay, silt and peat, they are generally inserted on volume displacement basis excavating a hole with specified diameter and desired depth.

IV. OBJECTIVES

- To determine the improvement of rapid consolidation of soil.
- To reduce the total and differential settlement of weak soil strata thereby improving the stiffness of soil.
- To determine the improvement in bearing capacity of soil.
- To reduce the compressibility of soft and loose fine graded soil.

V. MATERIALS TO BE USED

1. Cylindrical steel mould
2. Steel plate
3. Magnetic dial guage
4. Weight plates
5. Aggregates
6. PVC pipe
7. Geotextile

1. CYLINDRICAL STEEL MOULD

The steel mould of height 30cm, diameter 30cm and thickness 0.1cm is used for this experimental setup. The mould has a base plate at the bottom. The length and thickness of the base steel plate is 32.5cm and 0.2cm.

2. STEEL PLATE

The steel plate is kept above the top layer of the clay soil in which the load is applied to the soil. The weight of steel plate is 3.5kg.

3. MAGNETIC DIAL GUAGE

It is the instrument used to measure the settlement of soil and the deflection of the beam. Dial indicators typically measure ranges from 0.25mm to 300mm.

4. WEIGHT PLATES

A weight plate is a flat, heavy object, usually made of cast iron. We used this for a manual loading process. The weight of each plate is 0.5kg and we used this plate for gradual increasing of load.

5. AGGREGATE

Aggregate which passes through 10mm sieve is used for constructing stone column.

6. PVC PIPE

PVC pipe of diameter 6cm is taken for drilling hole in the sample present in the mould.

7. GEOTEXTILE

Geotextile of aperture size 6mm × 6mm is used in encasing stone column.

VI. TEST CONDUCTED IN SOIL

- Plastic limit
- Liquid limit
- Proctor Compaction Test
- Unconfined Compression Test

VII. BEHAVIOUR OF CLAY

SOIL WITHOUT STONE COLUMN

Here, to identify the behaviour of clay soil without stone column, the load is directly applied on the plate of 3.5kg, which is placed over the top of the clay soil. The settlement of clay soil is noted for every one minute and the graph is drawn between time and settlement for increase in load by 0.5kg.

VIII. BEHAVIOUR OF CLAY SOIL WITH STONE COLUMN

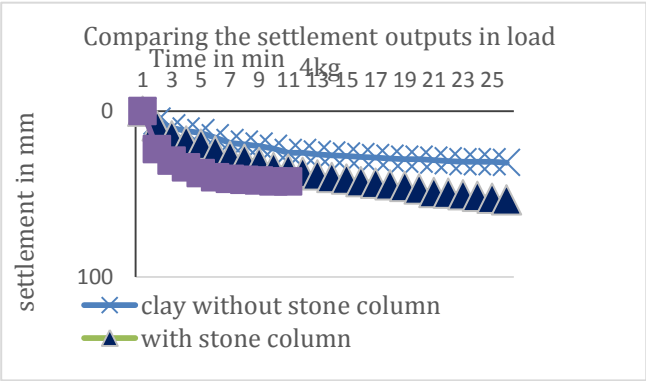
Here, to identify the behaviour of clay soil with stone column, firstly the clay soil is excavated using 6cm diameter pipe and the hole is then filled with aggregates. Here we have taken square pattern arrangement of stone columns. Then the load is applied on the plate. The settlement is noted for every one minute and the graph is drawn between time and settlement for increase in load by 0.5kg.

IX. BEHAVIOUR OF CLAY SOIL WITH ENCASED STONE COLUMN

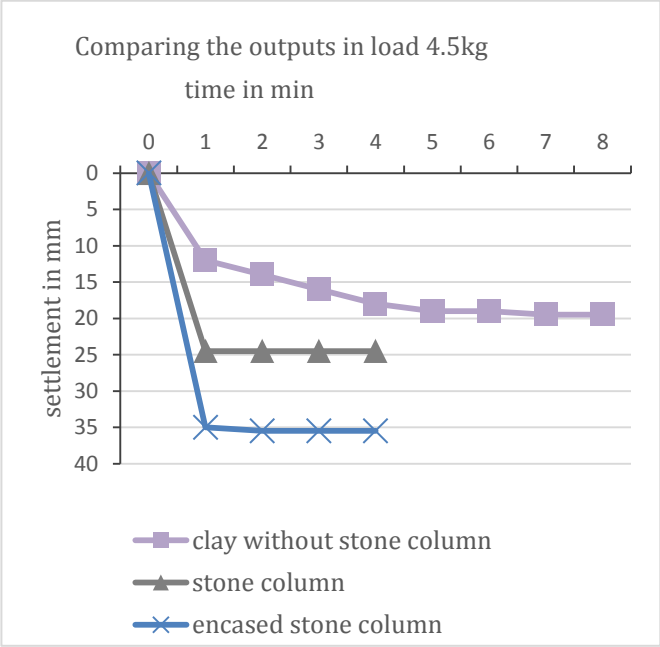
Here, to identify the behaviour of clay soil with encased stone column, firstly the clay soil is excavated using 6cm diameter pipe. Then the geogrid is placed in the hole and is filled with aggregates. Here we have taken square pattern arrangement of stone columns. Load is then applied on the plate. The settlement is noted for every one minute and the graph is drawn between time and settlement for increase in load by 0.5kg.

X. ANALYSIS OF RESULT

Graph drawn between settlement and time when load is 4kg.



Graph drawn between settlement and time when load is 4.5kg



XI. INTERPRETATION OF RESULT

CLAY WITHOUT STONE COLUMN: While applying load of 4kg, the difference in settlement at starting stage will be 4mm and reduced to a difference of 0.5mm which makes flatter curve. While applying load of 4.5kg, the settlement gradually decreases from 2mm to 0.5mm. The consolidation time increases while applying load directly on clay soil.

CLAY WITH STONE COLUMN: While applying load of 4kg, the difference in settlement at starting stage will be 6mm and reduced to a difference of 0.5mm which makes slightly flatter curve. While applying load of 4.5kg, there is no change in settlement of soil. The consolidation time decreases gradually when compared to clay without stone column.

CLAY WITH ENCASED STONE COLUMN: While applying load of 4kg, the difference in settlement at starting stage will be 7mm and reduced to a difference of 0.5mm which makes the curved plots. While applying load of 4.5kg, there is no change in settlement of soil. The consolidation time decreases gradually when compared to both clay without stone column and stone column.

XII. CONCLUSION

- Stone Column is used as a technique of soil reinforcement which is used to support isolated footings, embankment and large raft foundation.
- Stone Column improves the stiffness of soil to decrease settlement. Since the columns are ductile, it can carry very high load.
- Settlements are reduced and stability is increased. Consolidation time is rapid in encased stone column when compared to consolidation time in stone column and virgin clay. Hence construction can be started quickly.
- Geosynthetic encased stone column reduces settlement almost half that of untreated ground.
- Being granular and freely undrained material, consolidation settlement is accelerated and post construction settlement is minimized.

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