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PERFORMANCE OF CLAY SOIL WITH DIFFERENT MATERIALS IN STONE COLUMN

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ABSTRACT

In the advancement of ground improvement technique, stone column are broadly used in the poor grounded soil to increase the bearing capacity. The stone column technique is a very efficient method of improving the strength parameters and reducing primary consolidation settlement. It offers a much economical and sustainable alternative to piling and deep foundation solutions. The strength of the ordinary stone column could be improved by encasing the with suitable geogrid material. The encased stone column is increases the rate of consolidation when compared to the ordinary granular fills. The load bearing capacity of the soil is increases with no of columns increases with proper spacing, the lateral spreading of stone column can be arrested by providing encasement with geogrids. The main objective is to determine the most effective material that can be used for stone column construction and to compare the suitability of grain size of the materials. The maximum load taken by quarry dust encased with geogrid is 2.18 kN at 20 mm settlement than the gravel of similar type. Probably the load carrying capacity of the soil is increased by 50% through encased three stone columns of quarry dust then untreated clay.

Key words: Stone column, Consolidation settlement, Quarry dust, Surkhi, Gravel, Geogrid.

INTRODUCTION

The volume change in expansive soil is brought out the serious effects on foundation. The factors affecting the volume change in the soil due to effect of seasonal variation, vibration, mining subsidence, with respect to increase the potential of the soil are compaction, dewatering, pre compression vertical drains, pre loading; vibro compaction, grouting, stabilization methods and geogrids can be used. Generally stone column techniques are highly used to reduce the time taken for primary consolidation. Another

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major advantage with this technique is the simplicity of its construction method. The type and grain size of stone column material is the controlling parameter of stone column design.

EXPERIMENTAL

Materials used

Properties of clay soil

Specific gravity - 2.63, Gravel % - 8.5, Sand % - 80.1, Silt and clay % - 11.4, Liquid limit %- 71, Plastic limit % - 36.13, Plasticity index-34.87, Shrinkage limit %-16.11, Volumetric shrinkage %- 28.4, Shrinkage ratio- 1.72, Maximum dry density kn/m^3 _ 16.7, Opt. Moisture content %-15.76.

Properties of gravel

Specific gravity-2.8, Fineness-2.28, Percentage of voids-39.03%, crushing value-27.09%

Properties of quarry rock dust

Quarry dust is cohesion less material which consists mainly of sand size particles. It is also improve the bearing capacity of the soil. Specific Gravity-2.53, Bulk Relative Density (Kg/m^3)- 1710, Absorption (%)-1.10, Moisture Content (%)-Nil, D_{10}-2.9 mm, C_C-0.8, C_U-1.36, Fine Particles Less Than 0.075 mm (%)- 12-15, E (kN/m^2)- 12000.

Properties of geogrid materials

The Geogrid material has completely arrest the lateral movement of gravel. Material has been bought from the company named Geotextile arrow India pvt.ltd, Chennai. Type-Geogrids, Thickness (mm)- 3, Mass per unit area (gsm)- 150, Ultimate max. Tensile strength (kN/m)-7, Extension at max. Load (%)-3, Apparent opening size (mm)-5.

Properties of surkhi mortar

Surkhi is combination of clay lime and some properties of sand. The powder of surkhi should be fine enough to pass BIS No. 9 sieve and the residue should not be more than 10% by weight.

Replacement ratio

To quantify the amount of soil replaced by the stone, the term replacement ratio, a_s is used. $a_s = 0.907\ (D/S)^2$. where the constant 0.907 is a function of the pattern used which, in this case, is the commonly employed equilateral triangular pattern.

Methods and procedure

The tested laboratory stone column models following below; Three models were tested for clay soil with ordinary single stone column with different grain size like quarry dust, surkhi and gravel. Three models were tested for encased single stone column with geogrid with three different materials. Three models were tested for encased and unencased three number of three stone column in a triangular pattern respectively. The installation of stone column carried out for the laboratory test by non displacement method. By using hallow PVC pipe of 2.5 cm diameter was inserted in to the compacted clay medium and taken out for the bore hole. In the mould of having 150 mm diameter and 220 mm height, clay has been filled in the mould and it's loaded through the proving ring by keeping constant displacement rate at 0.025 mm/min.

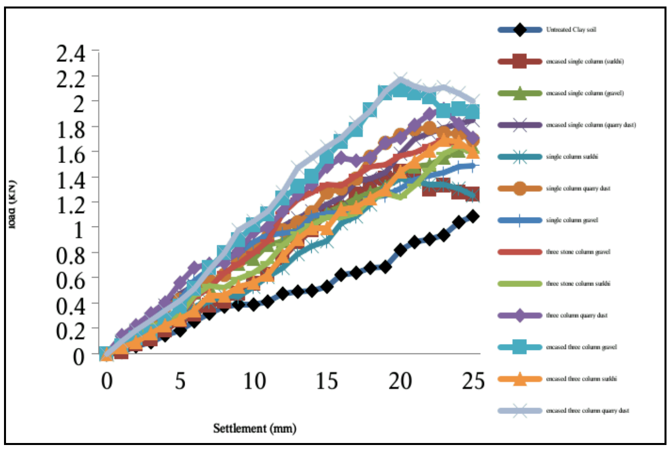

Fig. 1: Combined graph for stone column

Table 1: Stress for maximum load for 25 MM settlement (N/mm^2)

Materials	Single stone column	Encased single column	Three stone column	Encased three column
Clay	0.042	0.42	0.42	0.42
Surkhi	0.051	0.082	0.093	0.096
Gravel	0.085	0.093	0.093	0.113
Quarry dust	0.102	0.105	0.11	0.119

Table 2: Strain for maximum load for 25 MM settlement (N/mm^2)

Materials	Single stone column	Encased single column	Three stone column	Encased three column
Clay	10.91	10.91	10.91	10.91
Surkhi	11.364	10.045	11	10.636
Gravel	11	10.914	9.091	10.264
Quarry dust	9.818	11.955	10.59	11.364

The load was noted 25 mm settlement under compressive testing machine in the proving ring and corresponding displacement in the dial gauge. The test has repeated for single and three stone columns with unencased and encased geogrid material. The grain size of the stone column material is one the important parameter in the stone design of column. Three materials has been selected for the current studies are gravel, quarry dust and surkhi and used respectively. A detailed experimental investigation was carried out on a single stone column and group of three stone columns, provided with geogrids.

CONCLUSION

The stone column with encased geogrid is more effective in load settlement behavior than the ordinary stone column. The transformation of load into the encased stone column can be increased and corresponding settlement is decreased. Quarry dust is more effective in the load deformation behavior than the surkhi, which is combination of clay, lime and sand. Liquefaction of the soil and lateral displacement could be reduced by stone columns. The rate of consolidation in encased stone column is higher than the ordinary stone column. The non displacement method of stone column installation is most suitable for the closely spaced adjacent structure and the deeper depth stone column than the vibro-replacement method. The peak load for untreated clay soil is 1.1 kN at 25 mm settlement. The peak load for single column quarry dust is 1.8 kN at 22 mm settlement. The peak load for three column quarry dust is 1.95 kN at 23 mm settlement. The peak load for encased single column quarry dust is 1.86 kN at 25 mm settlement. The peak load for encased three column quarry dust 2.18 kN at 20 mm settlement. The maximum load taken by quarry dust encased with geogrid is 2.18 kN at 20 mm settlement than the gravel of similar type. Probably the load carrying capacity of the soil is increased by 50% through encased three stone columns of quarry dust then untreated clay.

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