Ground Improvement Using Stone Column

Ajeet Rathi[1], Akshita[2], Alka[3], Mayank Aggarwal[4], Tauseef Ahmed[5], Vivek Gupta[6]

[1]*Assistant Professor, N.I.E.C, Delhi, India*
[2, 3, 4, 5, 6]*N.I.E.C, Delhi, India*

Abstract: **In today's construction industry, Ground improvement is important requirements land reclamation is becoming increasing popular. The stone column technique is a very useful method of improving the strength parameters of soil like bearing capacity and reducing consolidation settlement. It offers a much economical and sustainable alternative to piling and deep foundation solutions. The paper is an attempt to discuss the soil improvement due to the construction of stone column. The result with stone and without stone column on soil bed are obtained and compared.**

I. INTRODUCTION

India's coastline exceeds 6000 km. Keeping in view the developments on coastal areas in the recent past, large number of ports and 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, with very low shear strength and high compressibility.

Out of several techniques available for improving the weak strata, stone column have been used to a large extend for several applications. It is a technique for improving both cohesive clay and silty sand. Stone column is constructed by making a hole into the soft deposit by different techniques and then filled with stones and compacted to form the complete column. When the structure is placed over the area (where stone columns are built) the majority of load is transferred to the stone column due to their higher stiffness.

The design of stone column is still empirical, based on past experience and needs field trials before execution. Stone columns are continuing to gain popularity today due to the considerable savings to cost and program schedule that it can offer over conventional piling solutions in many circumstances. Potential applications include stabilizing the foundation soils to support the embankments, approach fills, supporting retaining structures (including retaining earth), landslide stabilization and reducing liquefaction potential of clean sands.

II. MATERIALS USED AND METHODS

2.1 Material used

Material used are soil found from nearby college (well graded sand), coarse aggregate, geogrids, geotextile

2.2 Experimental method

Soil is prepared with water content 21% and left for 3 days . then soil is poured in layers and compacted each time. First testing is done on plain soil bed by applying loads in fixed intervals and result is noted down. Second testing is done on soil with stone column reinforced with geogrids, for this a hole is made of 40mm diameter with pvc pipe and filled with stones in layers and geogrids are provided at suitable intervals. Loads are applied and result is noted down. Third testing is done on soil with stone column encased with geotextile. Cover the outer surface of pipe with geotextile and put inside the hole, then stones are filled in layer and compacted. Loads are applied after the column is completely formed and result is noted down.

Table 1 Properties of Soil (air dried sample)

Property	Value
Specific gravity (%)	2.5
Liquid limit (%)	43
Plastic limit (%)	34
Plasticity index (%)	11
OMC (%)	21
Max. dry density (KN/m^3)	22
Dry unit weight	15.8

III. RESULT

3.1 Plain soil bed

Figure 1 shows the load settlement curve obtained from load tests on soil bed. The graph shows the settlement with the increment of load.

s.no.	Time interval (min)	Load (kg)	Settlement (mm)
1	0	0	0
2	5	4	4
3	5	7	6.5
4	5	11	8
5	5	13	10
6	5	16	12

7	5	19	14
8	5	22	17

Table 2- soil bed observations

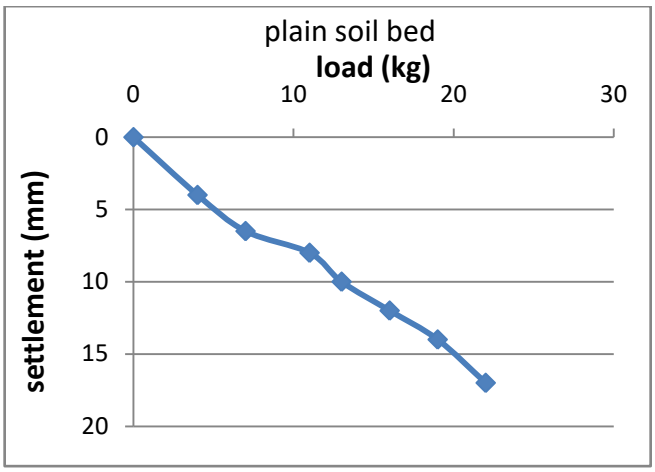

Figure 1- load settlement curve

3.2 Soil bed with stone column reinforced with geogrids.

Figure 2 shows the load settlement curve obtained from the load test on soil bed with stone column reinforced with geogrids.

s.no.	Time interval (min)	Load (kg)	Settlement (mm)
1	0	0	0
2	5	4	0.5
3	5	7	2
4	5	11	3.5
5	5	13	4
6	5	16	5
7	5	19	6.5
8	5	22	8

Table 3 soil bed observation

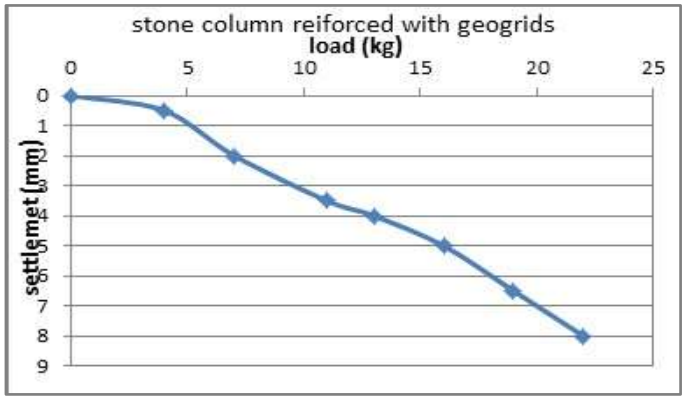

Figure 2- load settlement curve of soil with stone column reinforced with geogrids

3.3 Soil bed with stone column encased with geotextile

Figure 3 shows the load settlement curve obtained from the load test on soil bed with stone column encased with geotextile.

s.no.	Time interval (min)	Load (kg)	Settlement (mm)
1	0	0	0
2	5	3	0
3	5	6	0
4	5	9	1.5
5	5	13	2
6	5	16	3.5
7	5	19	5
8	5	22	7.5

Table 4– soil bed with stone column encased with geotextile

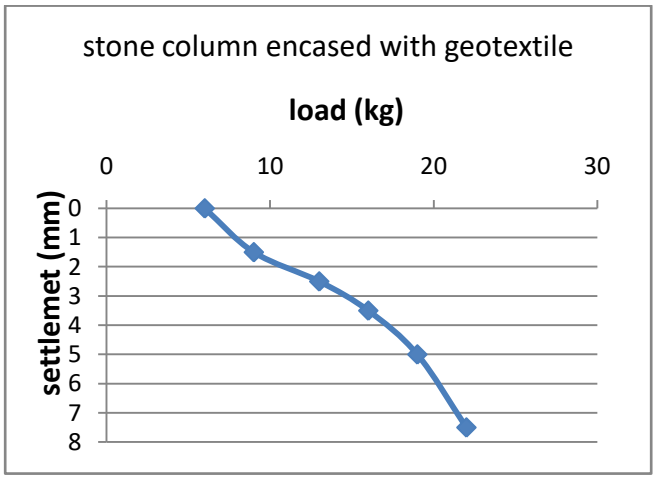

Figure 3- load settlement curve of soil bed with stone column encased with geotextile

IV. CONCLUSION

- The settlement of the soil bed has been reduced from 17 mm to 8 mm by placing the stone column with geogrids. It is because of the densification of the soil due to the construction of stone column and of its higher stiffness.
- The settlement of the soil bed has been reduced from 17mm to 7.5 mm by placing the stone column encased with geotextiles. It can be due to the higher stiffness of the stone column and failure of stone reduced to some extent. It was observed that some of the stones penetrate into the soil while loading in case of stone column provided with horizontal reinforcement, it was reduced to some extent in case of stone column encased with geotextile.
- It also provided the drainage path.

REFERENCES

[1]. Ambily A. p " Analysis of hydro test result for steel tank on stone column ground improvement", Department of civil engineering, Indian institute of technology, Madras
[2]. Arora K.R., "Soil mechanics and foundation engineering", Standard Publishers Distributors ,Delhi
[3]. Punima B.C, " Soil mechanics and foundation", laxmi publications, New Delhi
[4]. Rudrabir g. &Kashliwal A., " Ground improvement technique with a focus study on stone column", Dept of civil engineering, VIT university