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"EXPERIMENTAL STUDY ON IMPROVEMENT OF BEARING CAPACITY USING GEOSYNTHETIC STONE COLUMN"

Manohar Sankadal[1], Soumya Hiremath[2] & Gireesh Mailar[3]

[1]Assistant Professor, Department of Civil Engineering, R.T.E Society's Rural Engineering College, Hulkoti, Dist :Gadag, Karnataka, INDIA,582205manusankadal22@gmail.com

[2]Assistant Professor, Department of Civil Engineering, R.T.E Society's Rural Engineering College, Hulkoti, Dist :Gadag, Karnataka, INDIA582205 ,soumyahiremath03@gmail.com

[3]Assistant Professor, Department of Civil Engineering, R.T.E Society's Rural Engineering College, Hulkoti, Dist :Gadag, Karnataka, INDIA,582205 gireeshd122@gmail.com

ABSTRACT

Urbanization has also resulted in a dramatic rise in land prices and lack of suitable sites for development. The weak engineering properties of soft soils such as low bearing capacity, excessive settlement and ground movement, large lateral flow and slope instability are the problems faced by Geo-technical engineer.

There are a number of methods for ground improvement such as stone columns, jet grouting, compaction grouting, short pile, dynamic compaction, lime stabilization, In major construction projects all over the world, stone columns have been used extensively for ground improvement due to the economy and ease of construction. In the present thesis, experimental investigations were carried out to determine the load carrying capacity of ground treated with plain stone column, reinforced stone column and their behavior when placed in groups were soil increases its load carrying capacity and reduction of settlement.

1. INTRODUCTION

The coastal areas are covered with thick layers of very soft clay deposits which have low shear strength and high compressibility. In view of developments that are occurring in coastal region, a number of ports, industries and other infrastructure facilities are being built.

The solution for ground improvement depends on various factors like ground conditions, types of soil, design loads, treatment area and site location. There are a number of methods

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such as stone columns, jet grouting, compaction grouting, short pile, dynamic compaction, lime stabilization etc for improving the ground conditions.

Stone column consists of granular materials which are compacted and filled in a long cylindrical hole that improve the strength and consolidation characteristics. It is the cost effective and versatile method. This improved technique has been applied successfully to reduce the settlement for foundation and increase the bearing capacity of structures like liquid storage tanks, low rise buildings, abutments, earthen embankments, raft foundation and factories that can tolerate some settlement.

2. OBJECTIVES

1) To determine the basic properties of Shedi soil.

2) Design of stone column for Shedi soil.

3) To find the optimum number and spacing of stone columns.

4) To check the strength of stone column using geosynthetic material.

3. METHODOLOGY

1) Preparation of clay bed

2) Study the bearing capacity of the clay sample.

3) Stone column installation.

4) Determine the optimum spacing of stone column.

5) Study the behaviour of geosynthetic material on stone column.

4. RESULTS AND DISCUSSION

In this work, an attempt is made to study the load settlement behaviour of shedi soil treated with plain stone columns and reinforced stone column with geotextile material and their effect when placed in groups.

ENTIRE AREA LOADING

It shows typical load intensity versus settlement behaviour for plain soil bed and improved grounds with the stone column and also stone column encased with geosynthetic material.

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Table 4.1 Results of entire area loading for plain and entire stone column loading

Description	Load intensity(N) for 10mm settlement (Fig.4.1)
	L/D=4
Plain soil	758
Plain stone column	1124
Reinforced stone column	1490

From the Fig. 4.2 it can be observed that, installation of stone column provides the increment in bearing capacity upto 67.4% compared to plain clay bed.

From the Fig. 4.3 it is evident that, installation of stone column with geosynthetic material provides more strength up to 75.43% compared to stone column without reinforcement.

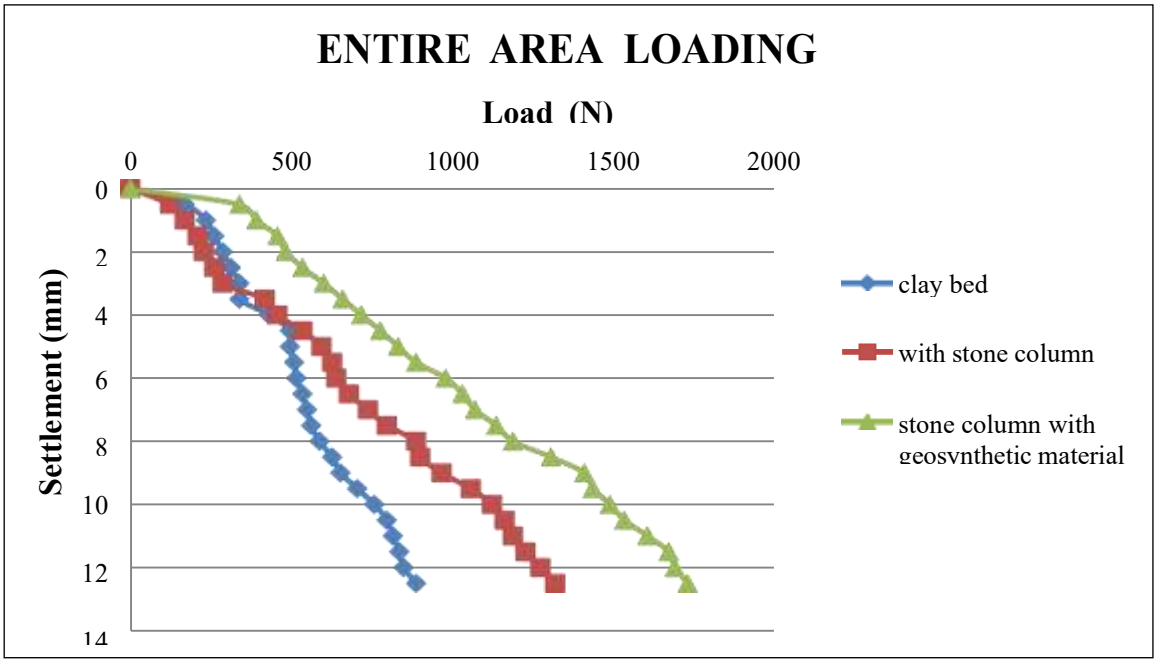

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Fig. 4.1 Load vs Settlement curve for plain clay bed, plain stone column and stone column with geosynthetic material

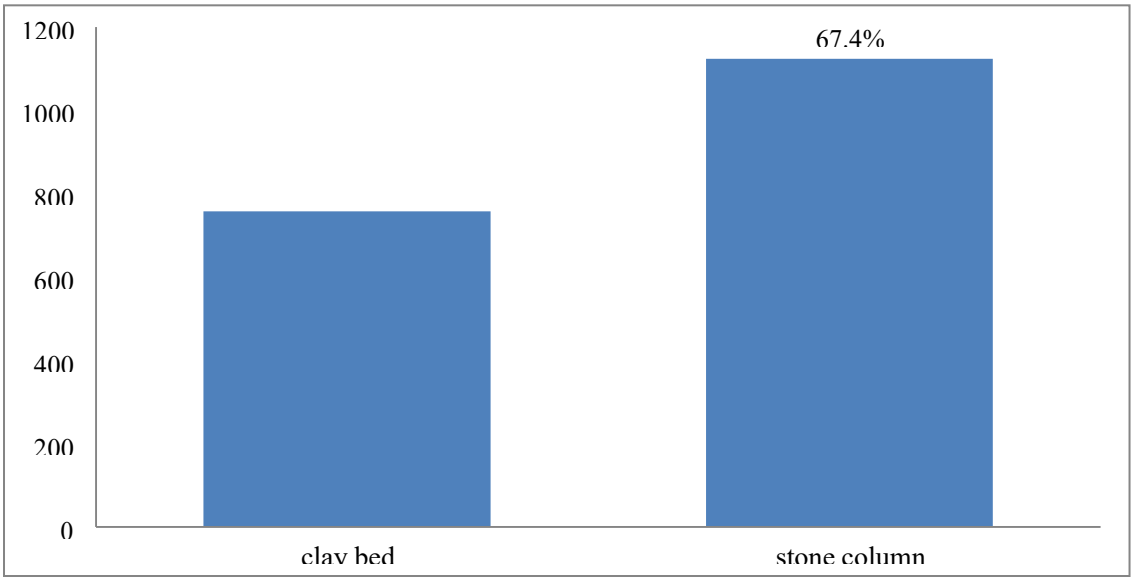

Fig. 4.2Percentage increase in load carrying capacity for plain clay bed to plain stone column

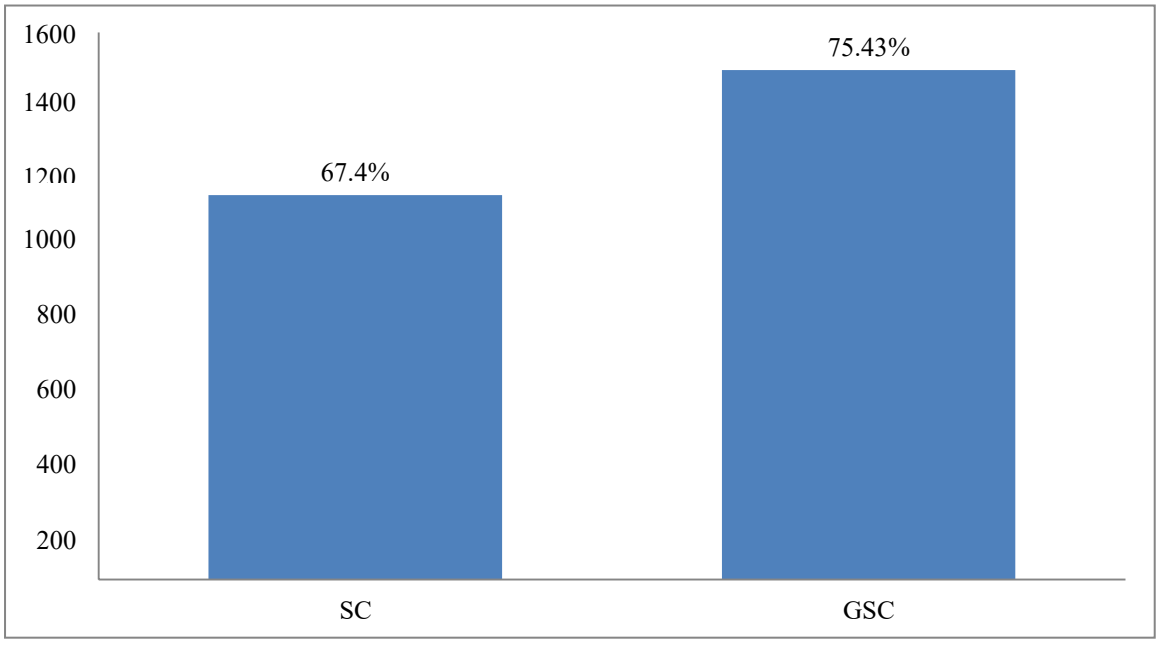

Fig. 4.3Percentage increase in load carrying capacity for plain stone column to reinforced stone column

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COLUMN AREA LOADING

Fig. 4.4 shows load intensity versus settlement behaviour of improved grounds with plain stone column and reinforced stone column.Fig.4.5 shows that, by comparing theclay bed and plain stone column, clay bed with plain stone column increases the bearing capacityof the clayey soil upto 67.4%.

Table 4.2 gives ultimate load bearing capacity for different L/D ratios of 4.

Table 4.2: Results of Column area loading for plain and reinforced stone column.

Description	Load Intensity (N)for 10mm settlement
Plain soil	131
Plain stone column	137
Reinforced stone column	156.8

Another observations made from column area loading is the modes of failures observed after the overall loading. From Fig. 4.6 for L/D ratio of 4 the failure occurs by bulging to a depth of 2D, where D is diameter of column.FromFig.4.7 it can be observed that by encapsulating stone column with reinforcement there is decrease in the bulging failure of stone column at the top.Load settlement response of geosynthetic encased stone column generally shows linear behaviour not indicating any catastrophic failure, unlike the conventional stone columns.

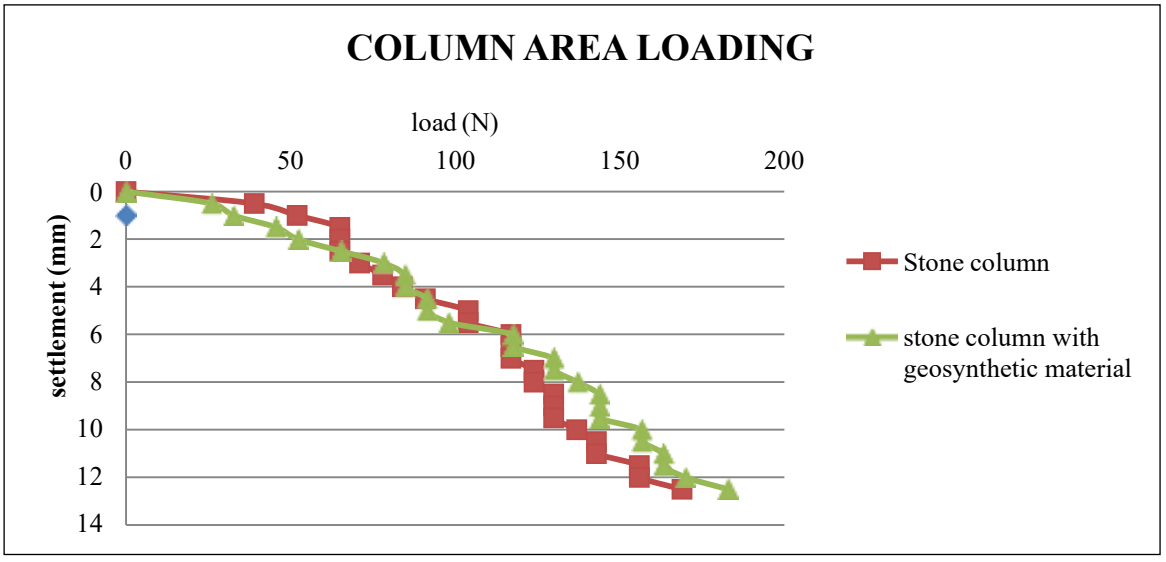

Fig. 4.4 Load vs Settlement curve for plain stone column and stone column with geosynthetic material

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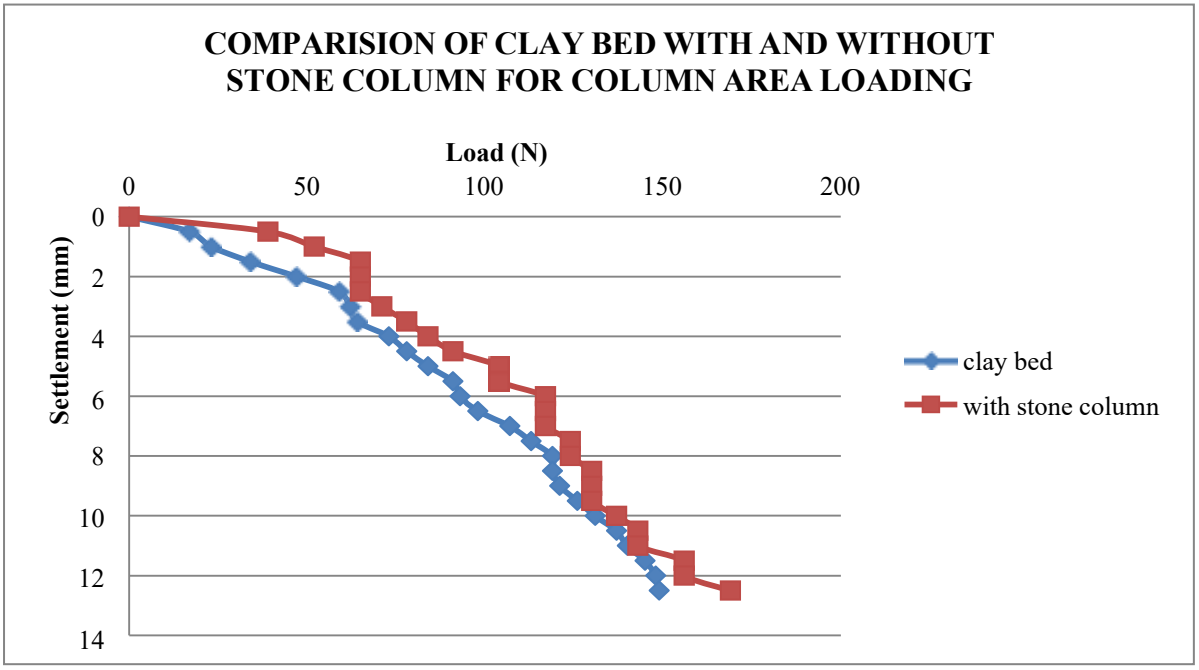

Fig. 4.5 Load vs Settlement curve for plain clay bed, plain stone column

STONE COLUMN PLACED IN GROUPS FOR DIFFERENT SPACING TO DIAMETER RATIOS

Table 4.3 Results of Ultimate bearing capacity of stone column in groups

Description	Stone column in groups for triangular pattern (N)
	L/D=4
S/D=2	4116
S/D=3	2614
S/D=4	2457

The optimum spacing to diameter ratio for stone columns when placed in groups (triangular pattern) is 2 observed from Table 4.3

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From Fig. 4.8 it is observed that as spacing increases there is decrement in load carrying capacity, of stone column for L/D=4

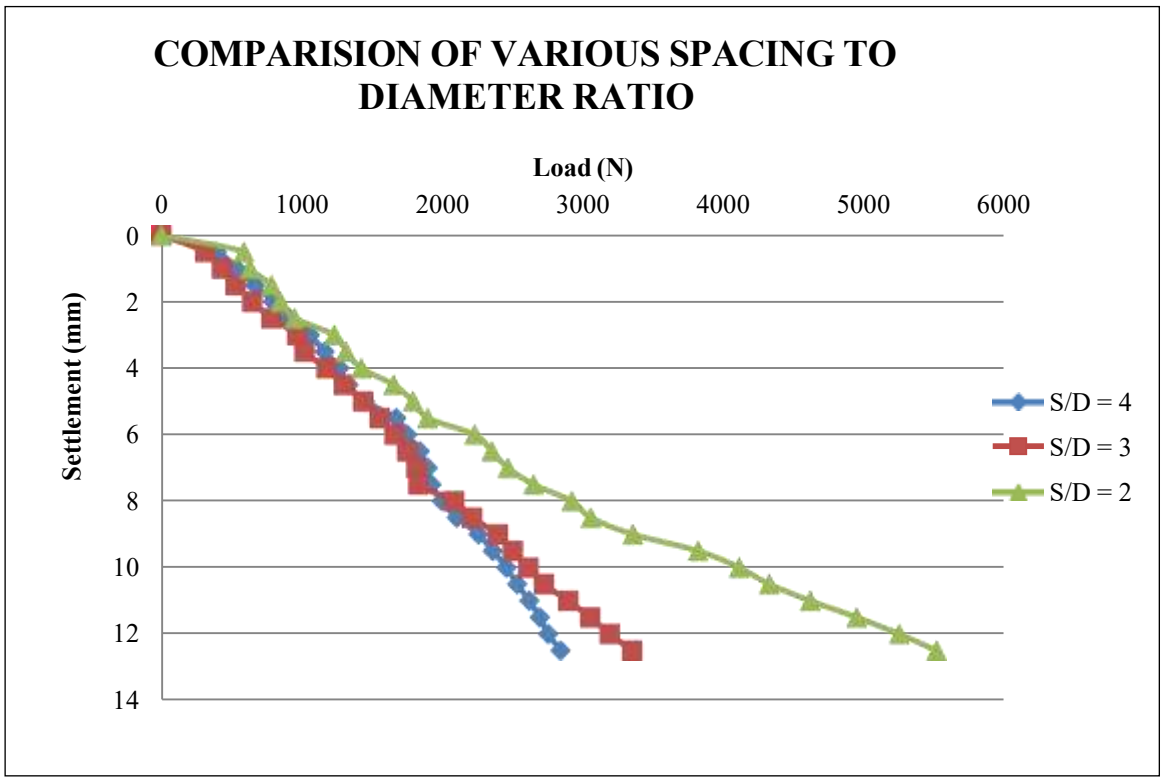

Fig. 4.6 Load vs Settlement curve reinforced stone column with different S/D ratios

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5. CONCLUSIONS

The following conclusions are drawn from this work:

1. Introduction of stone column in soft soil like shedi soil increases its load carrying capacity and reduction of settlement.

2. It was found that the bearing capacity was increased by 67.4% for entire area loading of stone column.

3. Encapsulation of stone column with geosynthetic material leads to increase in the load carrying capacity when compared to the plain stone column. (i.e. increased by 87.37% for column area loading)

4. The geosynthetic material encasement prevents the contamination of stone column and thus will not reduce the friction between clay and stone aggregates.

5. Since bulging of stone column takes place only in upper portion due to lack of lateral pressure, hence providing geosynthetic material in that portion may also be equally important.

6. From the study it was observed that the optimum spacing to diameter ratio for stone column placed in groups is 2(triangular pattern) and is recommended for construction.

6.ACKNOWLEDGEMENT

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