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A Study on the Inclusion of Geosynthetic to Clayey Soil Improved using Stone Column

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Abstract: *Stone column technique is an economical and environmentally friendly method used to improve the load settlement of problematic soils. Geosynthetics used for increasing bearing capacity and permeability of soil, reducing settlement of soil. Stone column with geotextile is placed horizontally and encapsulated in the soil and find the settlement done in by applying the load in the plate load test. The studiesshows that the settlement is lower for horizontally placed geotextile when compared to the settlement for encapsulated geotextile in the stone column. Improvement can be done by increasing the stiffness of the geotextile which increases the load bearing capacity of the soil. In the experimental programmed, we prove that the stone column with horizontally placed geotextile has high safe bearing capacity and low settlement. Geotextiles can be used in both vertical and horizontal applications to help solve drainage problems around the home and along the roads. For protection, geotextiles can be used to absorb stress and thus reduce or prevent damage and erosion in geotechnical structures. Stone column with Geosynthetic which ultimately increases the load bearing capacity of the stone column and prevents bulging.*

Keywords: Geotextile, Stone column, Plate Load Test

I. INTRODUCTION

An increasing activity of building construction process in many areas such a week soil in ground base. Present day value of land is increasing continually so scarcity of land occurs. It is actual hard to provide base foundation for minimal sites Stone column construction may consist the partial replacement of existing subsurface soils with a compacted vertical column of stone that usually completely penetrate frail strata.Geosynthetics is synthetic material utilized for soil support. Soil uses the developed powers in earth in fortification of soil due to erosion which creates strain in support. Geosynthetics is utilized in areas where shear stresses are produced due to the fact that shearing restrain among soil and reinforcement controls the horizontal movement of the soil.Ground improvement methods are used increasingly for new projects to allow utilization of sites with poor subsurface conditions and to allow design and construction of needed projects despite poor subsurface conditions which formerly would have rendered the project economically unjustifiable or technically not feasible. The aforementioned crushed aggregates in the definite proportion are to be placed into the soil at regular intervals throughout the area of the land where the soil bearing capacity is to be improved. Soil is stronger in compression than in tension but geosynthetics can be improve the tension strength in soils. Reinforcement of the soil by compacted granular columns or stone columns is accomplished by the top feed method. This is done either by using the dry or the wet top feed vibrators which are forced into the ground. The aggregates are then allowed to take the place of the displaced soil which exerts a pressure on the surrounding soil hence helping to improve the soil's load bearing capacity. The reinforced stone column consists of geosynthetics and crushed coarse aggregates of various sizes.

II. MATERIALS USED

2.1 Clay

Clayey soil were taken from Chenkal, Thiruvananthapuram.

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Table 1: Basic Properties of Clayey Soil

SL. No	Properties	Values
1	Liquid Limit (LL)	74%
2	Plastic Limit (PL)	25%
3	Specific gravity	2.15
4	Water content	31.29%
5	Percentage of clay	63%
6	Percentage of silt	32%
7	Maximum dry density (MDD)	14.12kN/m^3
8	Optimum moisture content (OMC)	26%

2.2 Geotextile

Geotextiles are permeable fabrics which, when used in association with soil, have the ability to separate, filter, reinforce, protect, or drain. Here we used 120 GSM geotextile. For filtration, geotextiles are used to allow water to move in both directions in a drainage system and can be used to prevent fine aggregates from moving between soil layers. Geotextiles can be used in both vertical and horizontal applications to help solve drainage problems around the home and along the roads. For protection, geotextiles can be used to absorb stress and thus reduce or prevent damage and erosion in geotechnical structures.

Table 2: Properties of geotextile

SL. No	Properties	Results
1	Colour	White
2	Type	Non-woven
3	Mass per unit area	120GSM
4	Thickness of geotextile	0.063mm
5	Puncture resistance of geotextile	31.2mm
6	Tensile strength on 120 GSM geotextile	4kN/m

2.3 Coarse Aggregate

Coarse aggregate is taken for fill the bore hole, the size of the coarse aggregate is 12mm.The aggregate is filled in three layer and to compact in each layer. Take four bore holes in the tank and its spacing is taken as 20cm center to center distance.

Table 3: Properties of Coarse aggregate

SL. No	Properties	Results
1	Specific Gravity	3.41
2	Aggregate crushing value	31.38%
3	Water Absorption	0.997%
4	Bulk Density	1.552 Kg/m^3
5	Void Ratio	1.45
6	Porosity	59.2%
7	Aggregate impact value	16.10

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III. EXPERIMENTAL WORK

3.1 Plate Load Test On Footing

The soil is filled in the tank at the height of 500mm. The footing is placed at the top of the soil, also in the above of the footing two spacer is provided. Then the load is applied on the footing to find the settlement of the footing. In the load gauge, each load is taken as 0.2kN and the settlement is noted in the dial gauge.

3.2 Bore Holes are Taken using PVC Pipe

Here we use PVC pipe for taken the bore holes. The height of the PVC pipe is taken as similar as the height of the tank for easily removing the pipes. Four PVC pipes are placed inside the tank and fill the soil in the surroundings. The diameter of the PVC pipe (bore holes) is 8.5cm, in each pipe the center-to-center distance of the bore hole is 20cm.After fill the soil at the height 500mm then the PVC pipe is removed.

3.3 Plate Load Test on Stone Column

The PVC pipe is removed, then each of the boreholes we fill the aggregate. The size of the aggregate is 12mm, the aggregate is filled at the height of 500mm.After setup, load is applied on the footing and to find the settlement done in the stone column.

3.4 Plate Load Test on Stone Column with Encapsulated Geotextile

The soil is removed after the plate load test done in stone column only. Then we immerse the PVC pipe for bore holes and then encapsulate the geotextile in the bore holes, after that fill the stone column in the encapsulated bore hole.After setup, load is applied on the footing and to find the settlement done in the stone column.

3.5 Plate Load Test On Stone Column With Horizontally Placed Geotextile

The soil is removed after the plate load test done in stone column with encapsulated geotextile. Then we immerse the PVC pipe for bore holes and then geotextile is placed horizontally in three each layer of the soil. Finally compare the settlement done in encapsulated geotextile and horizontally placed geotextile with stone column.

IV. RESULTS AND DISCUSSIONS

According to the experimental program, Plate load test were conducted on the stone column with encapsulated geotextile and horizontally placed geotextile andfinally compare the settlement done in encapsulated geotextile and horizontally placed geotextile with stone column.

Table 4: Settlement on footing

Load (kN)	Settlement (mm)
0.398	5.28
0.598	10.34
0.798	15.44
0.998	18.2
1.198	21.63
1.398	24.73

The footing is placed at the top of the soil. Then the load is applied on the footing to find the settlement of the footing. In the load gauge, each load is taken as 0.2kN and the settlement is noted in the dial gauge. The final settlement of the plate load test on the footing is 24.73mm.

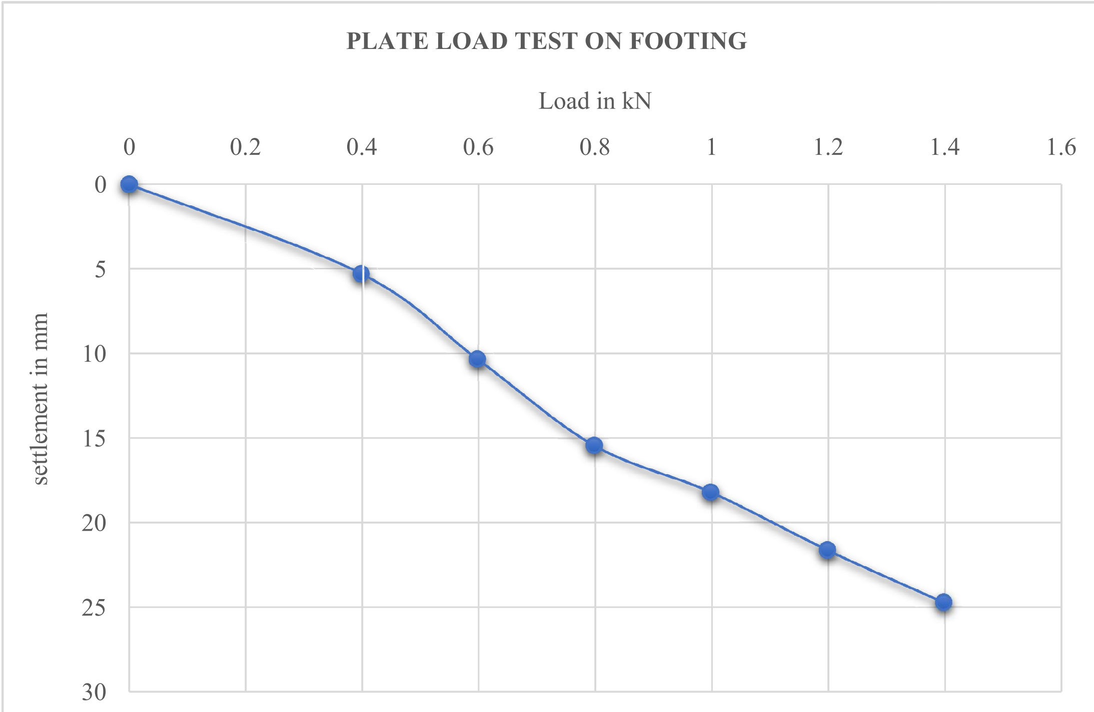

Fig 1: Load- Settlement graph on footing

Load (kN)	Settlement (mm)
0.398	4.65
0.598	7.67
0.798	10.36
0.998	12.78
1.198	17.42
1.398	22.96

Table 5: Settlement on footing with stone column

The footing is placed in the stone column with the top of the soil. Load is applied on the footing and to find the settlement done in the stone column. In the load gauge, each load is taken as 0.2kN and the settlement is noted in the dial gauge. The settlement done in the stone column with footing is 22.96mm.

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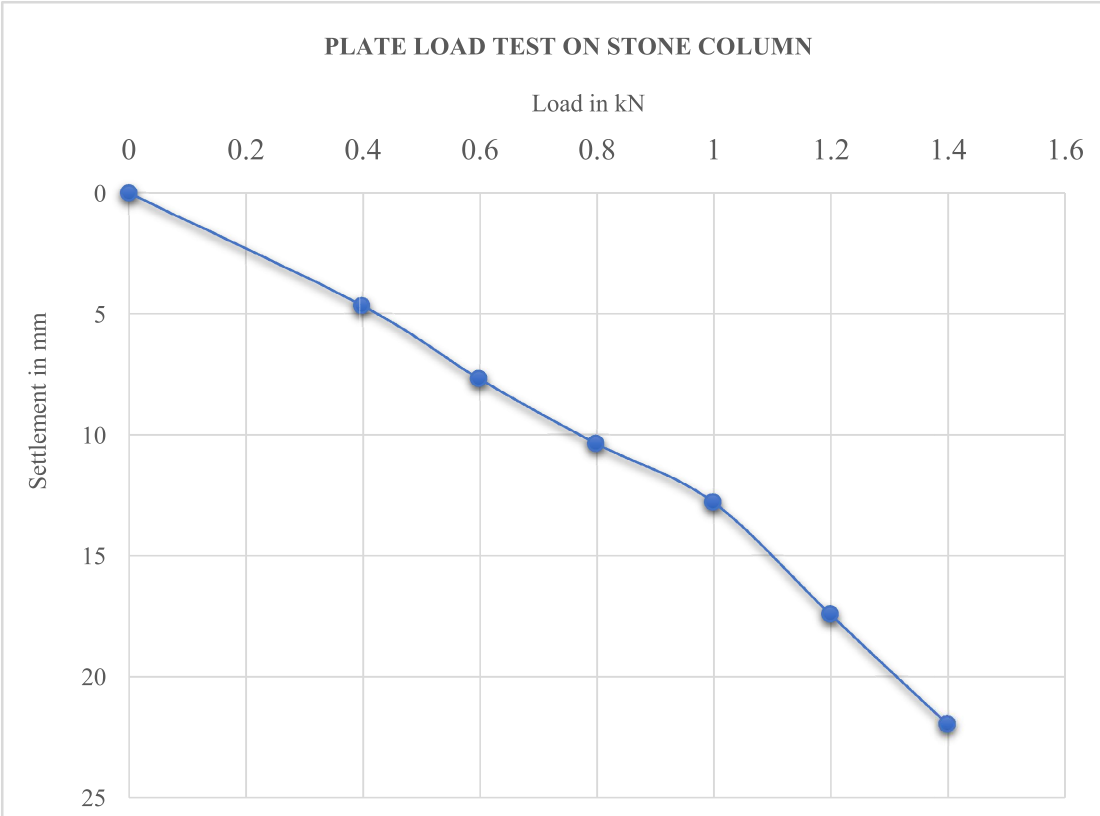

Fig 2: Settlement on footing with stone column

Table 6: Settlement on stone column with encapsulated geotextile

Load (kN)	Settlement (mm)
0.398	4.02
0.598	5.97
0.798	9.14
0.998	12.06
1.198	17.05
1.398	20.68

The footing is placed in the stone column with encapsulated geotextile at the top of the soilLoad is applied on the footing and to find the settlement done in the stone column with geotextile is encapsulated. In the load gauge, each load is taken as 0.2kN and the settlement is noted in the dial gauge. The settlement done in the stone column with encapsulated geotextile is 20.68mm.

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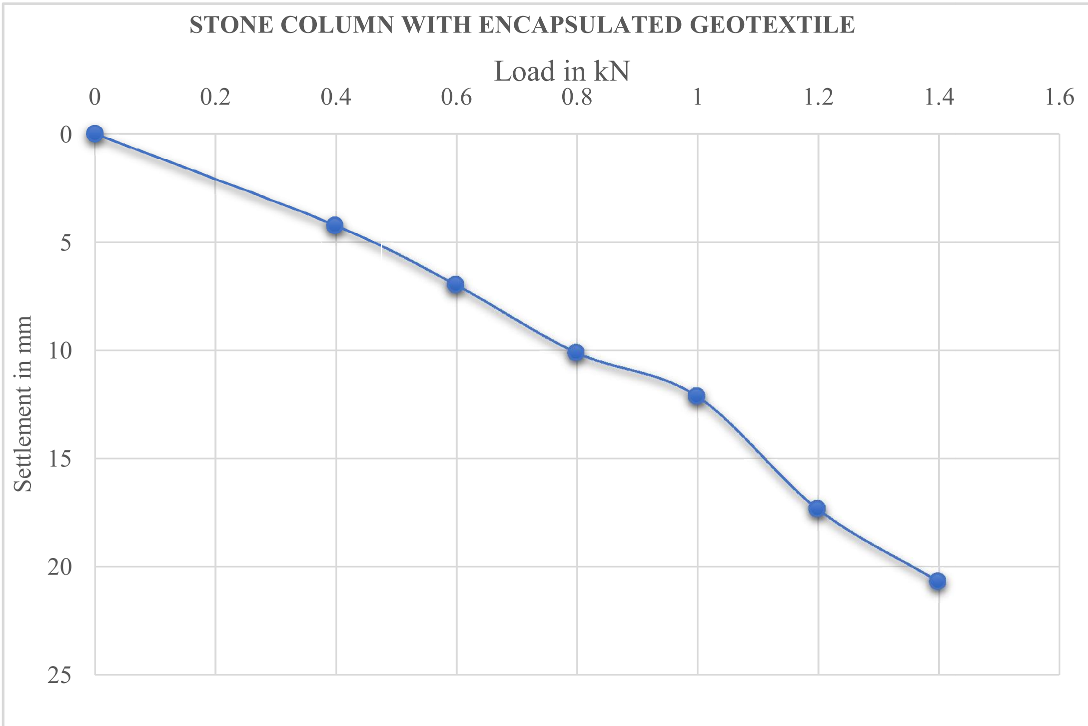

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Fig 3: Settlement on stone column with encapsulated geotextile

Table 7: Settlement on stone column with horizontally placed geotextile

Load (kN)	Settlement (mm)
0.398	3.63
0.598	5.54
0.798	9.06
0.998	11.83
1.198	16.92
1.398	20.06

The footing is placed in the stone column with horizontally placed geotextile at the top of the soil.Load is applied on the footing and to find the settlement done in the stone column with geotextile is horizontally placed.The settlement done in the stone column with horizontally placed geotextile is 20.06mm.

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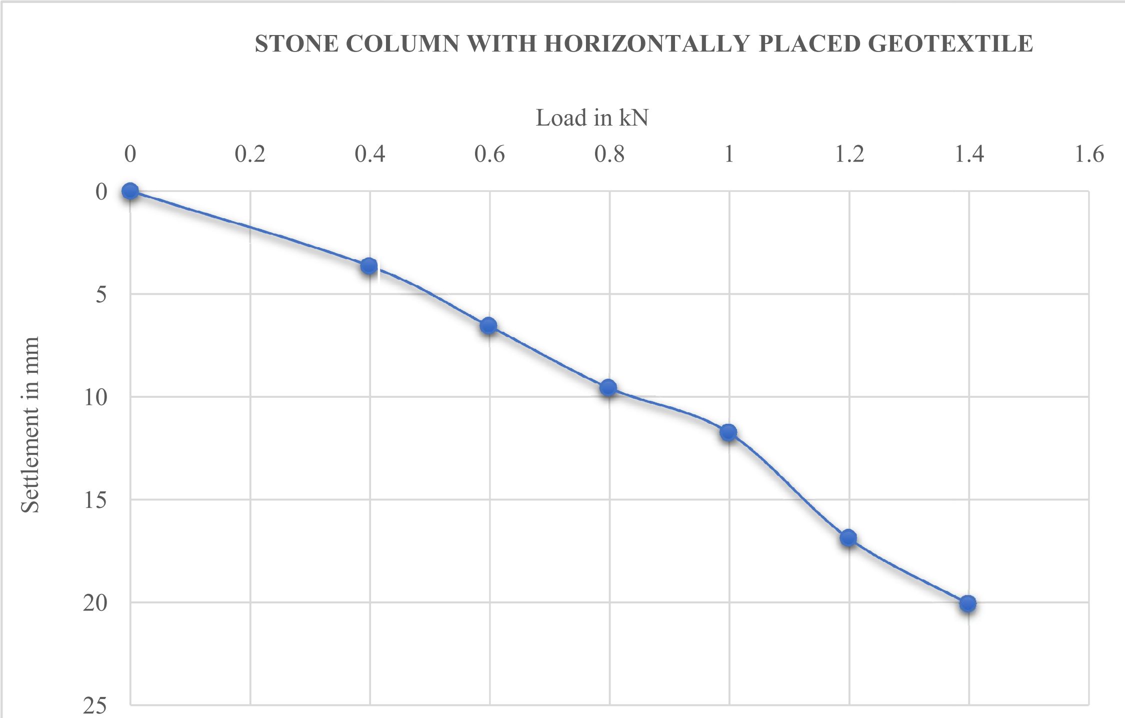

Fig 4: Settlement on stone column with horizontally placed geotextile

Table 8: Comparison of settlement in encapsulated and horizontally placed geotextile

Load (kN)	Settlement in encapsulated geotextile (mm)	Settlement in horizontally placed geotextile (mm)
0.398	4.02	3.63
0.598	5.97	5.54
0.798	9.14	9.06
0.998	12.06	11.83
1.198	17.05	16.92
1.398	20.68	20.06

The settlement done in the stone column with encapsulated geotextile is 20.68mm and the settlement done in the stone column with horizontally placed geotextile is 20.06mm.Comapre the settlement done in the stone column with encapsulated geotextile and the horizontally placed geotextile, stone column with horizontally placed geotextile is slightly better than the stone column with encapsulated geotextile. The percentage increase of the settlement is 2.99%.

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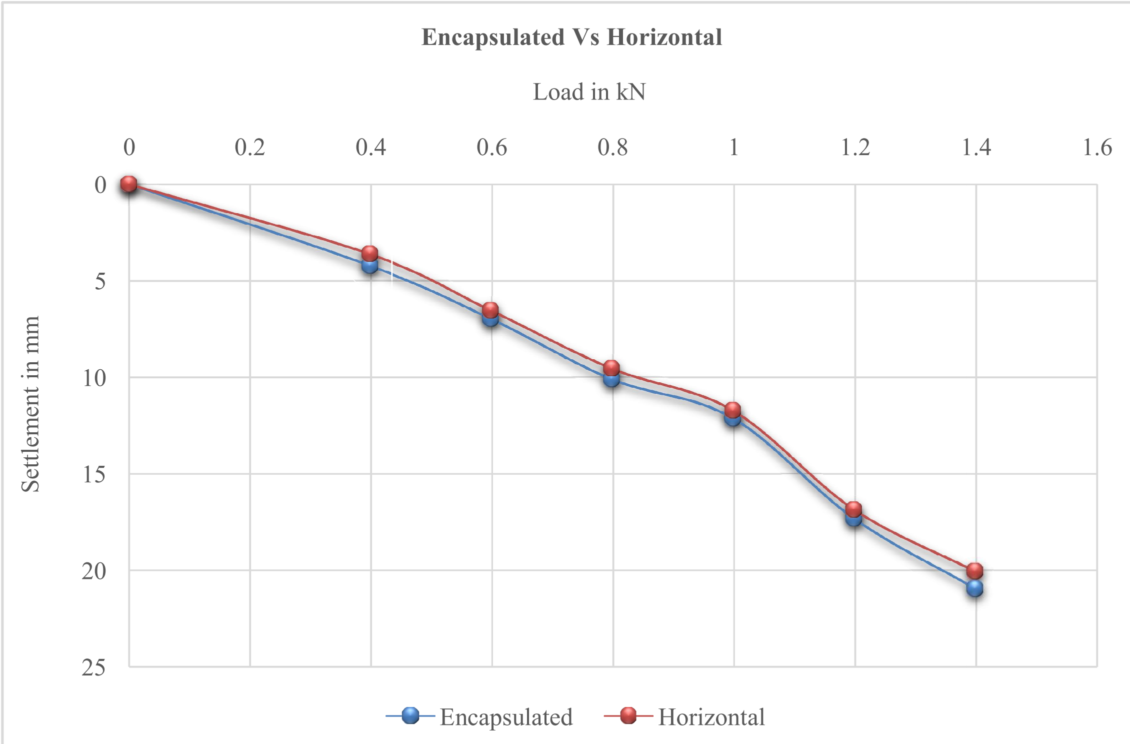

Fig 5: Comparison of settlement in encapsulated and horizontally placed geotextile

Table 9: Comparison of settlement in stone column and horizontally placed geotextile

Load (kN)	**Settlement in stone column (mm)**	**Settlement in horizontally placed geotextile (mm)**
0.398	4.65	3.63
0.598	7.67	5.54
0.798	10.36	9.06
0.998	12.78	11.83
1.198	17.42	16.92
1.398	22.96	20.06

Normally in the field, the stone column is used for reduce load bearing capacity and also increase the shear strength. But in this laboratory study we prove that the stone column with horizontally placed geotextile has high safe bearing capacity and low settlement.For protection, geotextiles can be used to absorb stress and thus reduce or prevent damage and erosion in geotechnical structures.

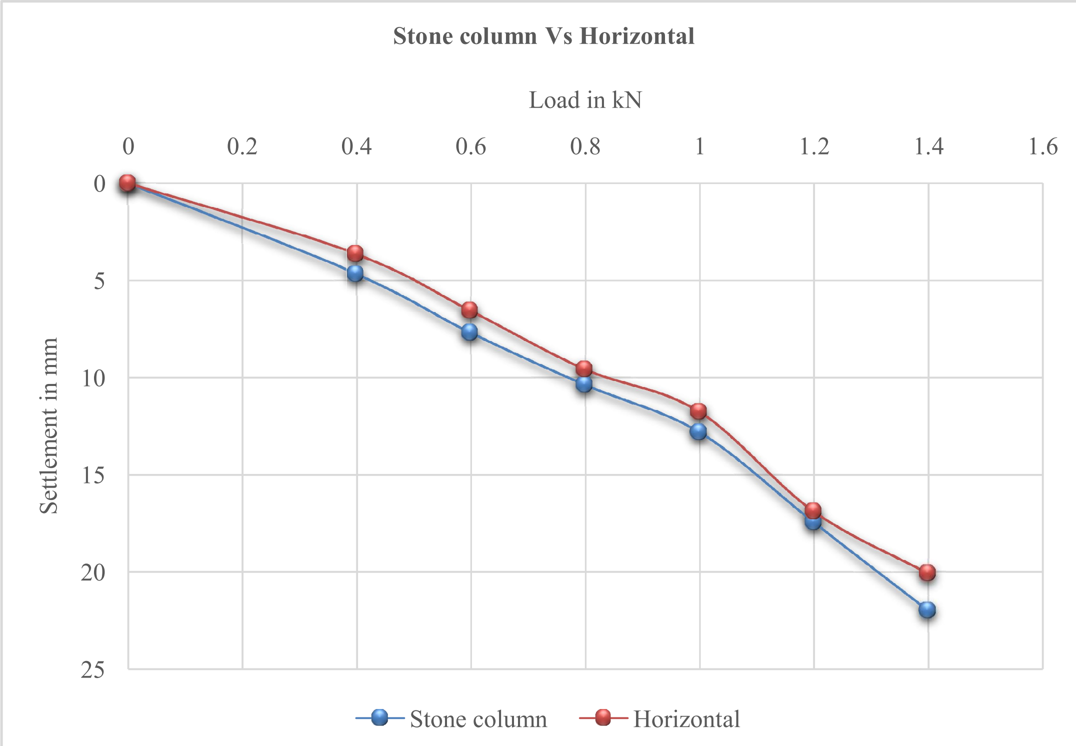

Fig6: Comparison of settlement in stone column and horizontally placed geotextile

V. CONCLUSION

The studies shows that the settlement is lower for horizontally placed geotextile when compared to the settlement for encapsulated geotextile in the stone column. Improvement can be done by increasing the stiffness of the geotextile which increases the load bearing capacity of the soil. Stone column with Geosynthetic which ultimately increases the load bearing capacity of the stone column and prevents bulging.Stone columns can improve the load carrying capacity and reduces the settlement of the problematic soil. Construction can be started quickly due to the accelerated dissipation of excess pore water pressure in to the drainage formed by the stone columns. Before designing the stone column, thorough subsoil investigation should be done from in-situ test results and bore log. Reinforced stone columns are a ground improvement method to improve the load bearing capacity of the soil. The local soils are by nature, unable to bear the proposed structure. Hence the ground improvement methods can be necessitated. The area replacement ratio is defined as the area of the stone column to the tributary area per stone column. It was also found that ductile materials in the plate forms were the best reinforcement arrangement for the granular columns. The geosynthetic encasement prevents the contamination of stone column and thus will not reduce the friction between the stone aggregates and clay bed.

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REFERENCES

[1]. Mr.T.Harish and Mr.P.Selvakumar (2020) “Stabilization of clay soil and red soil using geosynthetics” International Journal of Current Advanced Research Volume 9; Issue 06(C); June 2020; Page No 22515-22518.

[2]. Yagya Sharma (2020) “Ground Stabilization using Geosynthetics” IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) Volume 17, Issue 3 Ser. III (May - June 2020), PP 01-04.

[3]. Safa Hussain Abid Awn and Jasim M Abbas (2020) “Improvement of Soft Soil by Stone Column Treated with Bentonite” Key Engineering Materials ISSN: 1662-9795, Vol. 857, pp 283-291.

[4]. Ankit Vadi and Ismail Vaghela (2018) “Ground improvement technique using stone column” International journal of innovations in engineering research and technology [IJIERT] ISSN: 2394-3696 Volume 5, Issue 4.

[5]. Brian O. Oyegbileet,al, (2017) “Applications of geosynthetic membranes in soil stabilization and coastal defence structures”, International Journal of Sustainable Built Environment 6, 636–662.

[6]. Riya Robert and Annie Joy (2017) “A study on effect of stone column for soil stabilization” IJARIIE-ISSN(O)-2395-4396 Vol-3 Issue-3.

[7]. TilvaVikunj K (2017) “Study on Geosynthetic Reinforced Stone Column with soft & stiff clay” International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 07.

[8]. Dipty Sarin Isaac and Girish M. S. (2009)” Suitability of Different Materials for Stone Column Construction” Electronic Journal of Geotechnical Engineering, Vol 14, pp.1-14.

[9]. Ghazavi Mahmoud &LavasanArashAlimardani (2008) “Interference Effect of Shallow Foundations Constructed on Sand Reinforced with Geosynthetics”, Geotextiles and Geomembranes, Volume 26, Issue 5, pp. 404–415.

[10]. Ambily, A. P. and Gandhi, S. R. (2007) “Behaviour of stone columns based on experimental and FEM analysis.” J. Geotech. and Environ. Eng., ASCE, 133(4), 405–415.