IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 9, May 2023

Cost Effective Foundation System for G+4 Residential Building on Stratified Soil

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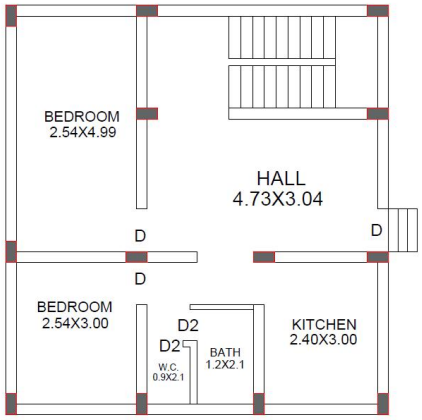
Abstract: *In this project we designed a cost effective foundation system for stratified soil. Firstly we calculated different loads acting on a G+4 residential building with the help of STAAD.Pro software. Then after getting the loads we deigned the stone column for the particular bearing capacity of the soil. Also we designed pile foundation for same soil but different lengths. After designing pile foundation and stone column we calculated the cost required for the construction for both. Comparison of stone column and pile foundation is then shown in the results.*

Keywords: Cost, Foundations, Ground Improvement technique, pile foundation, medium rise building

I. INTRODUCTION

Pune city is experiencing a rapid growth of urban population and it will continue to do so in future due to several unavoidable reasons. As a result, different new areas are being reclaimed near Pune city. Hydraulic filling procedure is the most widely used method among many filling procedures to reclaim such lands. Current practices of foundation design for buildings in such reclaimed areas are mainly construction of piles. The ultimate capacity of a reinforced shallow foundation on problematic soil is always estimated with empirical assumptions. Due to lack of analysis, the option of adopting reinforced shallow foundation on such soil has been neglected until very recently.Some studies have been carried out to evaluate the characteristics of dredged fill layer of the reclaimed sites. In most cases, the dredged material is silty sand with high fines content. The presence of fines in hydraulic fill means greater compressibility and reduced permeability and hence it is subjected to long term consolidation. Soft organic clay layer beneath the filling layer may also cause excessive settlement problem to the structures lying on top of such soil with a shallow foundation.

II. METHODOLOGY



FIRST FLOOR PLAN

Fig :Plan for Residential(G+4)Building

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All the necessary details for the analysis of the residential building (G+4) is mentioned inthe above given plans. These plans are made in the AutoCAD software, appropriate measurements for the room size are taken and the plan is made by taking into consideration of all standard norms for a residential building.

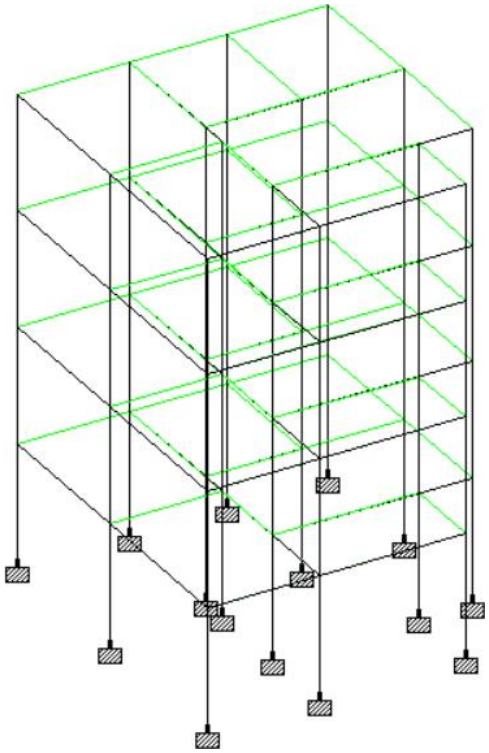

Fig: Staad. PRO Model for Residential (G+4) Building

Ground Improvement by Stone Column

In soft soil, bearing capacity may be improved either by preloading with vertical drains or stone column. In this case stone column method is considered. According to IS 15284 capacity of a stone column is calculated with the following parameter as shown in Table

Table : Stone Column Parameter

Sl. No	Description	Value
1.	Diameter of stone column	D
2.	Spacing of stone column	2D
3.	Angle of internal friction of column material	40^0
4.	Avg. co-efficient of lateral earth pressure for clay	0.6
5.	Avg. value of cohesion	29kN/m2
6.	Stone column pattern	Square

Design of Isolated footing

Design Parameters:

Grade of concrete and steel= M25andFe500

Clear cover=50mm

Diameter of reinforcing bar =32mm

Safe bearing capacity=100 KN/m2

Weight of the footing and backfill– 10% of the axial load.

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Design of Pile

Design Parameters:

Grade of concrete and steel= M25andFe500

Load = 400 kN

Diameter of reinforcing bar =25 mm

Safe bearing capacity=100 KN/m2

Length of pile = 20m.

Size of Column = 230 X 450 mm

III. RESULTS AND DISCUSSION

Our aim is to calculate loads acting on a G+4 residential building on stratified soil with the help of STAAD. Pro software. Then to design an isolated footing as well as pile foundation. Also calculating the cost for both stone column with isolated footing and pile foundation. Then compare the cost for Stone column with isolated footing and pile foundation and discuss which is more cost effective.

Table: Column Load Table

Column	Node	Env	Fx	Fy	Fz	Mx	My	Mz	Length of footing	Width of footing
C1	17	+ve	63.428	608.402	40.181	68.233	1.438	134.811	2.587	2.587
C2	20	+ve	81.765	683.568	44.306	73.975	1.484	157.575	2.742	2.742
C3	18	+ve	82.742	672.749	46.564	77.798	1.508	157.483	2.72	2.72
C4	23	+ve	60.111	583.387	43.595	76.502	1.438	139.528	2.533	2.533
C5	19	+ve	64.085	662.077	47.709	77.359	1.518	123.881	2.699	2.699
C6	21	+ve	73.224	652.774	43.027	74.392	1.473	135.542	2.68	2.68
C7	16	+ve	58.432	818.815	54.364	87.405	1.511	125.96	3.001	3.001
C8	10	+ve	29.543	898.571	101.662	207.07	1.471	43.406	3.144	3.144
C9	22	+ve	52.866	582.877	50.367	79.974	1.448	120.533	2.532	2.532
C10	12	+ve	57.269	605.171	49.875	79.49	1.52	96.185	2.58	2.58
C11	14	+ve	33.116	508.368	45.198	76.113	1.379	87.906	2.365	2.365
C12	15	+ve	35.518	622.301	41.53	74.661	1.513	103.014	2.616	2.616
C13	9	+ve	29.162	661.644	81.16	186.518	1.461	22.979	2.698	2.698
C14	11	+ve	37.356	582.148	43.535	73.188	1.469	87.065	2.531	2.531
C15	13	+ve	24.254	740.583	42.907	73.905	1.43	98.236	2.854	2.854

Table: Grouping of columns

Group No.	Load Range(kN)	Column No
1	500-600	C4,C9,C14,C11
2	600-700	C1,C2,C3,C5,C6,C10,C12,C13
3	700-800	C15
4	800-900	C7,C8

Cost for a single stone column length 15 m = Rs 17580

Total cost for 50 stone column = Rs 879000

Total cost for isolated square footing = Rs 270940

Total Cost of 50 Stone column + Total cost for isolated square footing

= Rs 1149940

Cost for single pile = Rs 55258

Total cost for 38 piles = Rs 2099804

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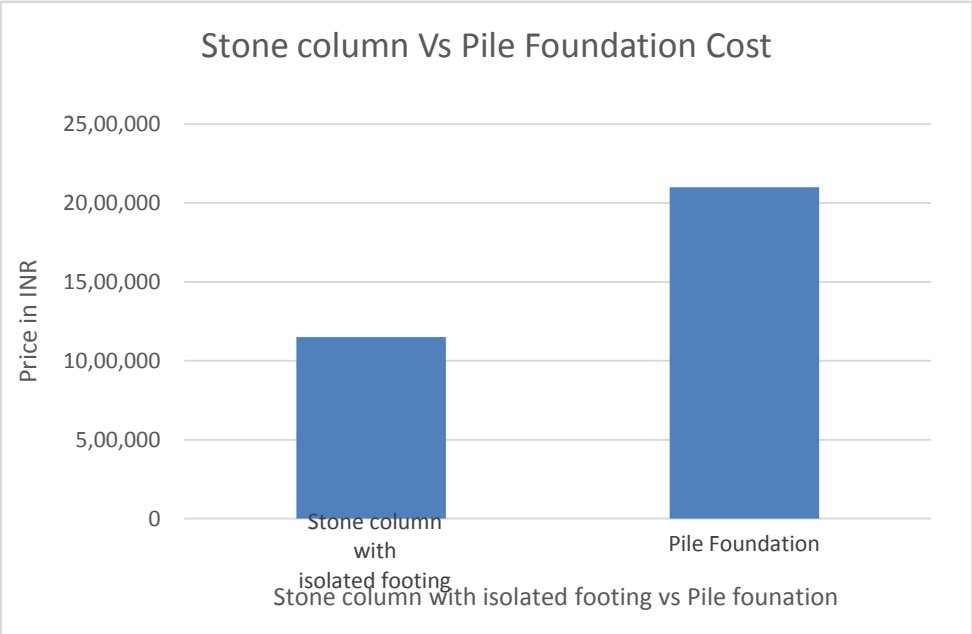

Fig: Cost comparison between stone column with isolated footing vs pile foundation

V. CONCLUSION

1. Total Cost of 50 Stone column with total cost for isolated square footing is Rs 1149940.
2. Total cost for 38 piles is Rs 2099804.
3. With the help of this calculation we can conclude that the total cost of stone column with isolated footing is less than that of pile foundation.
4. So using ground improvement technique like stone column with isolated footing is cost effective then using pile foundation on stratified soil.

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