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A Study on Micropiles in Foundation

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Abstract: *Micropiles are piles of smaller diameter used around footings capable of reducing settlement and improves the bearing capacity of soil. Studies were conducted on locally available clayey soil. Mild steel micropiles of length 10D, 20D and 30D and spacing of the micropiles were varied as 5D, 4D and 3D were D is the diameter of micropiles. Mild steel plate of dimension 150x150x10 mm were taken as the model square footing. Plate load test were carried out in a model tank of dimensions 800x800x500mm with and without micropiles and corresponding settlements were taken. It is studied that the settlement can be reduced considerably by increasing the length and reducing the spacing of micropiles*

Keywords: Micropiles, Plate Load Test

I. INTRODUCTION

Micropiles are drilled piles of smaller diameter having varying lengths typically between 5-12 inches of diameter and are capable of achieving heavy working loads. They transfer loads from the foundation to the soil through soil layers. Micropiles were used in several situations such as natural or man-made obstructions, poor ground conditions, sensitive ground with adjacent structures etc. Micropiles were used as a ground improvement technique includes the underpinning for existing foundations, seismic retrofittings and as foundations for new constructions. The major advantage of using micropiles are there faster installation and ground improvement. Mild steel bars of length 60 mm, 120mm and 180 mm were taken as micropiles. Square plate of dimensions 150mmx150mmx10mm were taken as the model footing. The settlements were noted by plate load test by varying the spacing as 5D, 4D and 3D where D is the diameter of micropile.

II. MATERIALS USED

2.1 Clay

Clayey soil were taken from Chenkal, Thiruvananthapuram.

Table 1: Basic Properties of Clayey Soil

Sr. No	Properties	Values
1	Liquid Limit (LL)	74%
2	Plastic Limit (PL)	25%
3	Specific gravity	2.12
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 Micropiles

Mild steel rod of diameter 6mm were taken as micropiles. Length of the micropiles were taken are 60, 120 and 180 mm.

2.3 Model Footings

Mild steel plate of dimensions 150x150x10 mm were taken as the square footing.

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III. EXPERIMENTAL WORK

3.1 Preparation of Foundation Medium

The clayey soil were sun dried and filled in the tank with dimensions 800x800x500 mm with proper water content in 3 layers with each layer having twenty five tampings. The footing is placed above the soil in the tank. The plate load test were conducted on the footing without micropiles and the corresponding settlements were noted.

3.2 Installation of Micropiles

Micropiles of various lengths were inserted into the soil in various spacings in the soil bed level. The footing were placed above the group micropiles and plate load test were performed. The corresponding settlements were noted.

IV. RESULTS AND DISCUSSIONS

According to the experimental program, Plate load test were repeated on square footing by varying lengths and spacings of micropiles and the corresponding settlements were noted.

Table 2: Settlement of Square Footing without Micropiles

Load (kN)	Settlement (mm)
0	0
0.82	10.77
1.02	13.11
1.22	16.93
1.42	20.27
1.62	24.18

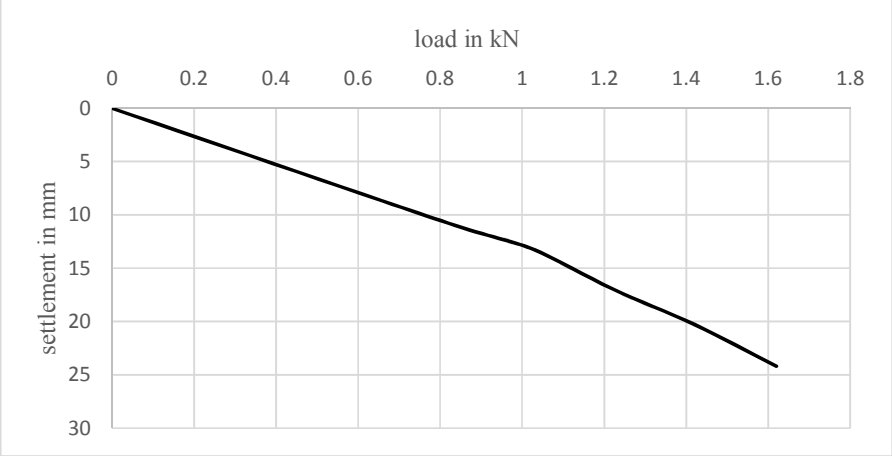

Figure 1: Load - Settlement graph of square footing without micropile

Table 3: Settlement of square footing

Load (kN)	Settlement (mm)								
	180 mm micropile			120 mm micropile			60 mm micropile		
	30 mm spacing	24 mm spacing	18 mm spacing	30 mm spacing	24 mm spacing	18 mm spacing	30 mm spacing	24 mm spacing	18 mm spacing
0	0	0	0	0	0	0	0	0	0
0.82	7.05	6.27	5.32	5.67	4.66	3.21	8.84	7.96	7.3
1.02	12.5	8.02	6.25	11.58	10.62	5.6	16.56	13.3	9.64
1.22	17.61	13.62	9.58	16.32	13.45	8.39	17.51	16.45	14.33
1.42	19.2	16.68	14.41	18.31	18.14	13.64	20.26	18.5	15.52
1.62	22	21.6	19.25	21.6	19.76	16.67	23.33	20.88	17.81

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Table 3 shows the settlement values obtained from the plate load test conducted on square footing by varying the length and spacing of micropile.

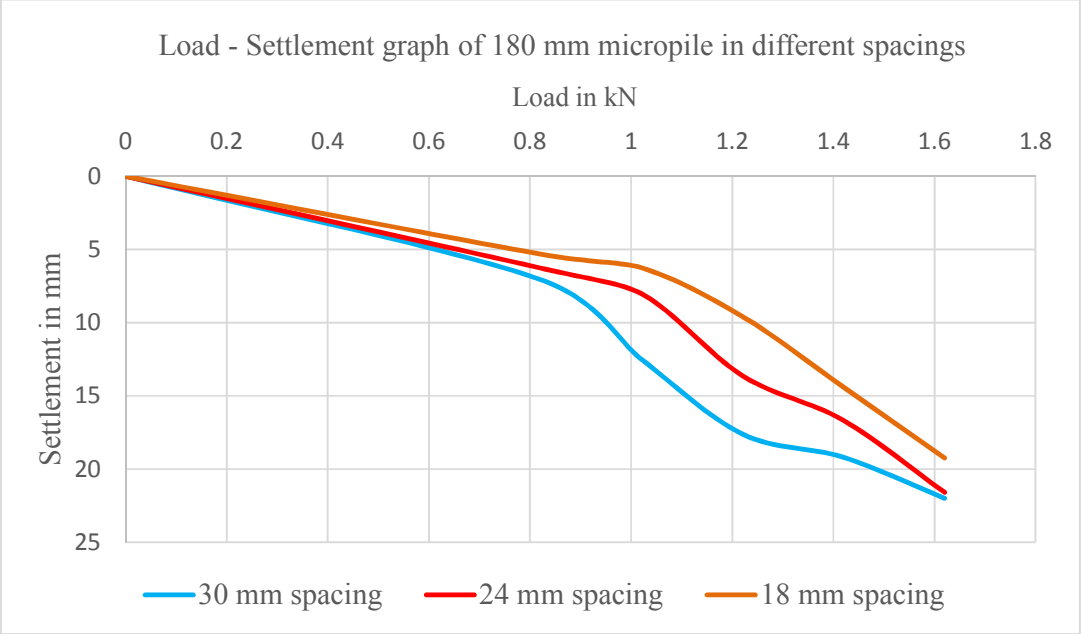

Fig 2 : Load Settlement graph of 180 mm micropile in different spacings

Fig 2 shows the variation in the settlement of square footing resting on micropiles of 180 mm length in 30, 24 and 18 mm spacing. It is observed that the 18 mm spacing has the minimum settlement.

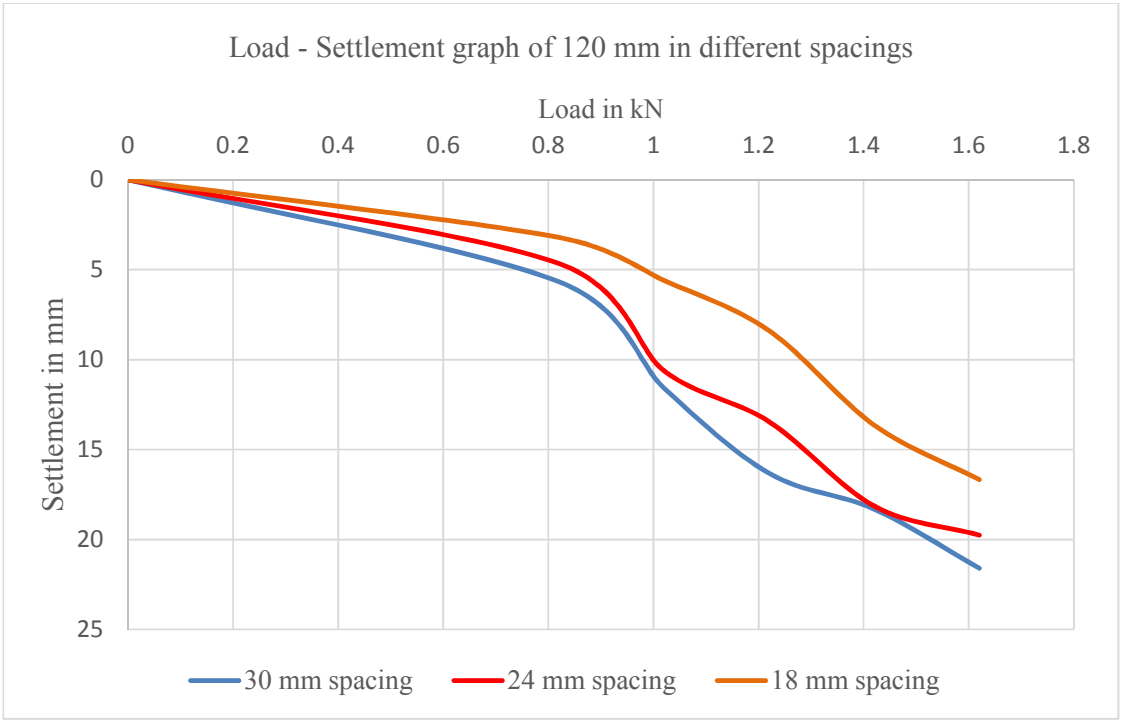

Fig 3 : Load Settlement graph of 120 mm micropile in different spacings

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Fig 3 shows the variation in the settlement of square footing resting on micropiles of 120 mm length in 30, 24 and 18 mm spacing. In this trial also the 18 mm spacing shows the lowest settlement compared to the other spacings.

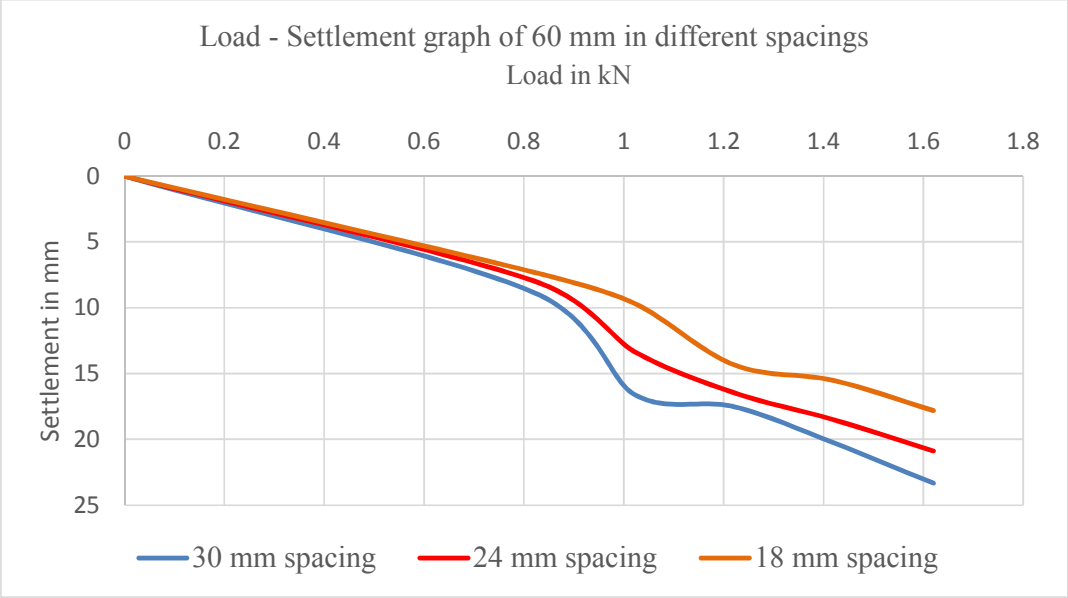

Fig 4 : Load Settlement graph of 60 mm micropile in different spacings

Fig 4 shows the variation in the settlement of square footing resting on micropiles of 60 mm length in 30, 24 and 18 mm spacing. Its evident from the graph that the settlement is minimum when the micropiles are arranged in 18 mm spacing.

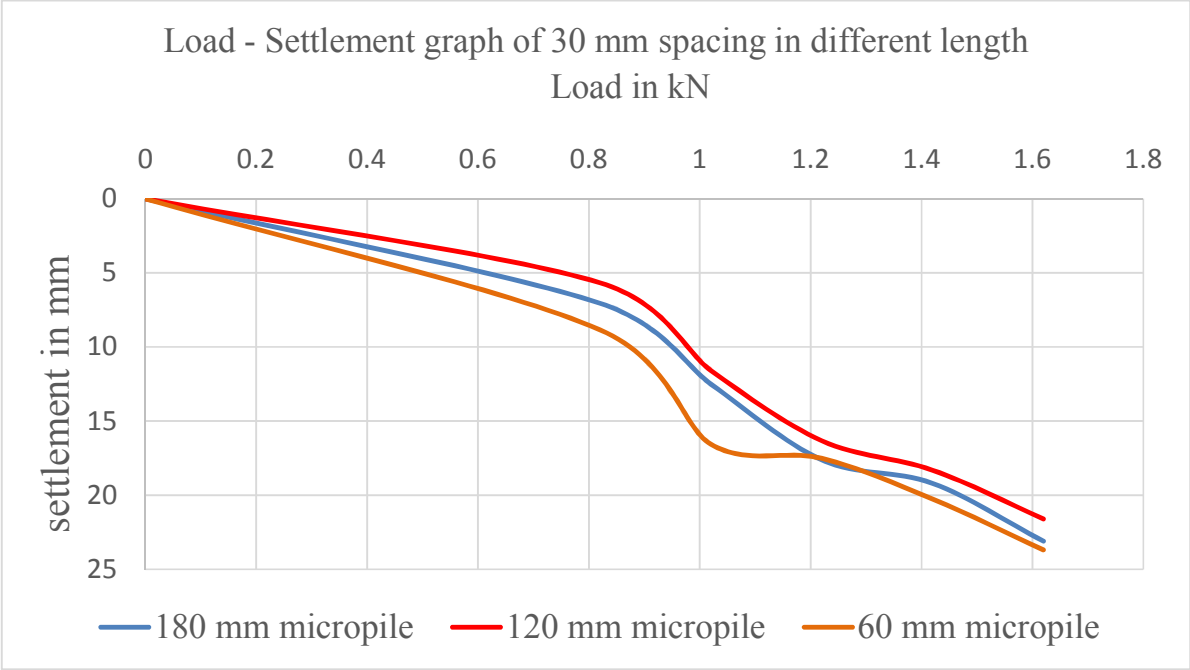

Fig 5 : load - settlement graph of 30 mm spacing in different length

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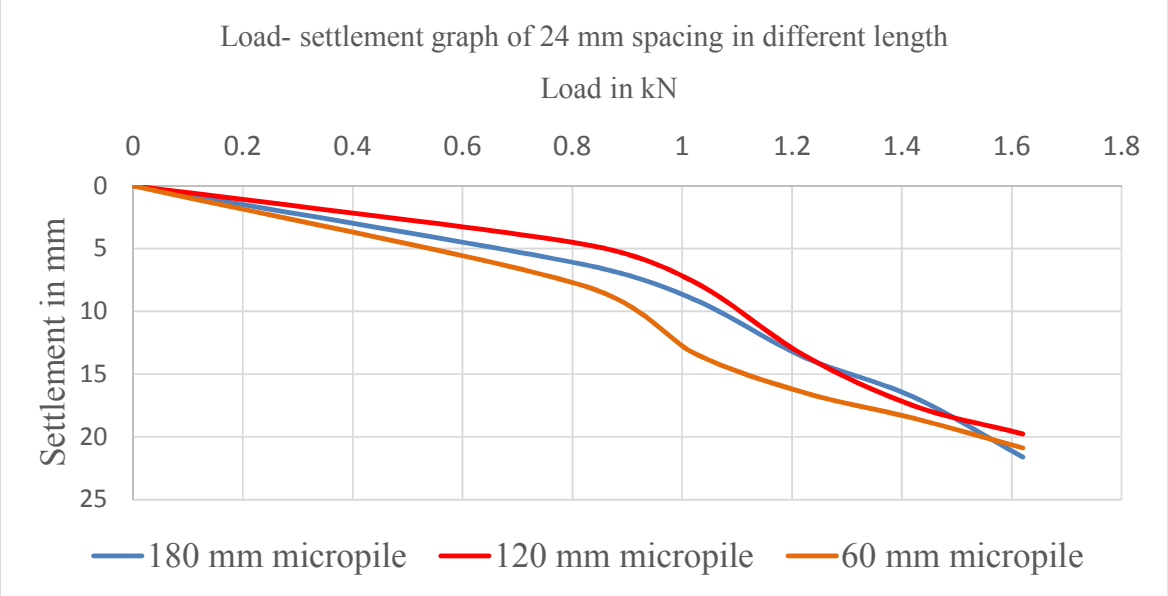

Fig 6 : Load - Settlement graph of 24 mm spacing in different length

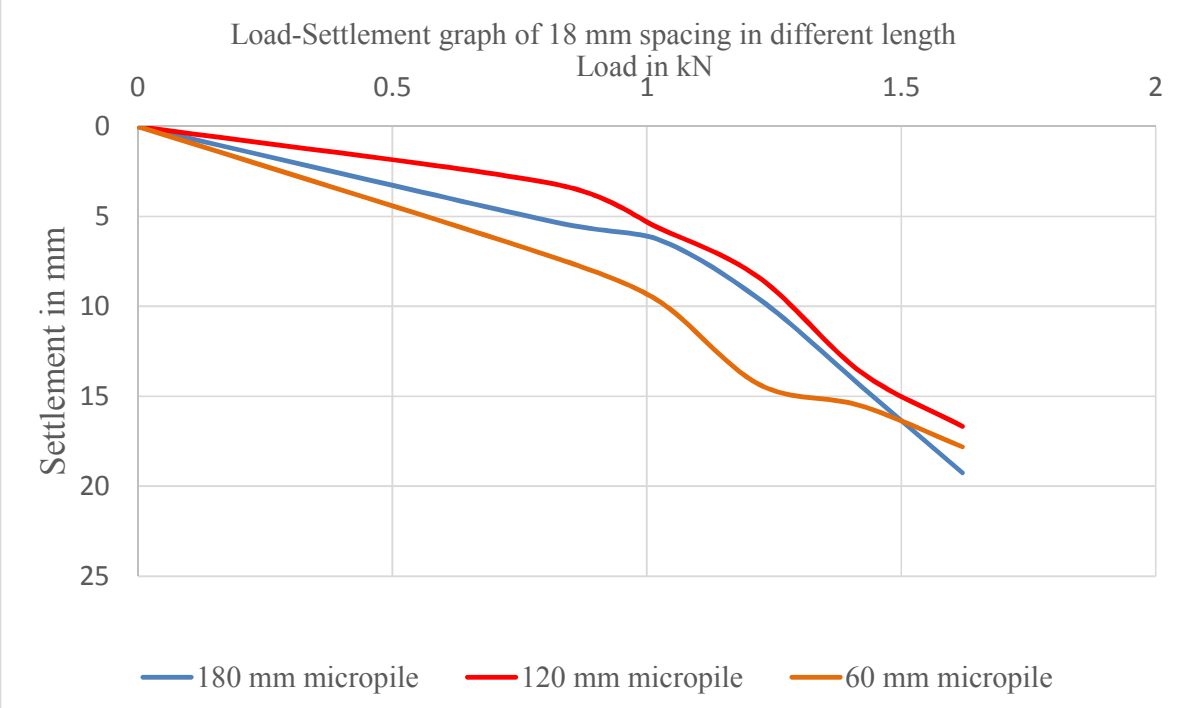

Fig 7 : Load - Settlement graph of 18 mm spacing in different length

Fig 5, 6 and 7 represents the variation in the settlement obtained from plate load test conducted in the square footing for different length of micropiles. It is clear from the graph that in the above three different spacings, the minimum settlement is obtained for 120 mm length micropile.

V. CONCLUSION

From the study conducted on square footing with micropiles of three different lengths and spacings, the following conclusions were made.

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- The settlement of the footing can be reduced considerably with the insertion of micropiles.
- From the test results and the corresponding analysis, the optimum length and the optimum spacing of the micropile were obtained as 20 D and 3 D ; where D is the diameter of the micropile.
- By increasing the length and reducing the spacing of the micropiles, the settlement of the footing gets reduced considerably.

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