

Experimental Study on Ground Improvement by using Concrete Piles

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Abstract – The foundations play a very important role in supporting the superstructure. The foundation is provided for any structure to transfer its load to the ground safely. Pile foundations classified as deep foundations, are an efficient means of supporting the structures when the soil in the layers near to the surface are weak or soils having adverse effects like expansive soils. At these conditions any types of shallow foundations fail to support the structure as the soil fails to withstand the load transferred from the foundations. Pile foundations transfer the load to a hard stratum available at any deeper depth below the structure.

Key Words: (SM, Ubc, Settlement, Concret Piles & Upvc Pipes)

1. INTRODUCTION

The Piles of diameter less than 300mm are known as Micro Piles (MP). The MP has a central steel reinforcement, which was covered by mortar. The pressure grouting was used for concreting. Combined pressure from 0.8Mpa to 1Mpa.

The black cotton soil is the problematic soil and it may not be capable for supporting the structures on shallow foundations. The deep foundation is to be preferred to carry the load to the extreme strata. The deep foundation is essential when the soil is unfitted for the shallow foundation and the consistent stratum is deep it cannot be reached economical by the shallow foundation. The pile & piers are the type of deep foundation.

Individual MP and groups of different lengths are used to study MP behavior. This study was also conducted on a group of MP on different spacing.

2. LITERATURE REVIEW

[1]NiharGogoi et. al.,(2014):

They have studied in the model study of group piles for different L/D ratio as well for different spacing between the piles in the group. These piles were inducted in sand bed of relative density with vertical load. The ultimate bearing capacity of the pile group, the Group efficiencies of micro piles groups were determined for L/D ratio and spacing between the piles. This experimental study concludes that load capacity increased with the increase in L/D ratio but the increase was not linear. The settlement before reaching the ultimate load capacity decreased with the increase in L/D

ratio. The maximum efficiency is dependent on L/D ratio and as the L/D ratio increases, it increases.

[2]Sonu Mathew .11, November-2014:

The experiments are modeled in groups with individual MP and different pile distances. The piles are mounted in clay and loaded vertically, and the efficiency of the 12.5mm stack group is determined. The group effect increases with distance from 2D to 3D and after that group efficiency found to be decreasing for 4D spacing. The upgrade of load bearing capacity was found to be increased for both single and group micro piles in clay.

3. OBJECTIVE AND SCOPE OF WORK

The model study of micro pile under vertical loading on single and group pile with the different length and spacing (single and 1D spacing) was carried out to determine the ultimate load carrying capacity and group efficiency of the pile.

Main purposes of the work are:

- To analyze the load settlement interaction of the single micro pile with different length.
- To analyze the load settlement interaction for the pile group micro piles with different length and spacing 1D.

4. MATERIAL AND METHODOLOGY

4.1Black cotton soil

The soil taken here was self-possessed from kalwadi region, Bhalki. Of the 1.5m underground prisoners, the excavator was destroyed; untouched clay was damaged and mined. That BC soil is systematically destroyed when receiving dry air. The bottom should be filtered through a 4.75mm filter. All tests are carried out in accordance with standard 2720. The properties of the earth are given in table 4.1.

Table -4.1: Properties of soil sample.

SL NO	PROPERTIES	VALUES
1.	Specific Gravity	2.60
1.	Water content	27.4%
2.	Liquid Limit	81.44%

3.	Plastic Limit	52.63%
4.	MDD	1.44g/cc
5.	OMC	16%
6.	UCS	1.06kg/cm ²

4.2 Cement, sand and aggregate

The micro piles used for tests were casted using 43 grade cement and the sand passing through 4.75mm IS. The cement, sand and aggregate were mixed in the ratio of 1:1.5:3, with the water cement ratio 0.45.

4.3 Technical Instruction reinforcement

In this, pile test was provided with a central reinforcement having a diameter of 2 mm.

4.4 Technical Instruction of UPVC Pipes

The UPVC pipes are magnificent reluctance to hostile environments. The UPVC (unplasticized polyvinylchloride) pipes are both chemical and electrochemical corrosion. The UPVC is non conductor, galvanic and electro chemical effects do not occur in UPVC pipes.

4.5 METHODOLOGY

The test was carried out in a tank which is of square shape which is of mild steel sheet(MSS) of size (300*300*300)mm, thick ness 3mm. The size of the test tank depends on the base size. The default width is 114mm and the thickness is 25mm. The model footing made up of MSS. The BC Soil was mixed with optimum water content of 16% and these was filled in the test tank in 3 layers and make a thimble to get the density we need. The MP's are thrown into the UPVC pipes. The MP's are made by mixing cement, sand and aggregate in a ratio of 1:1.5:3. By maintaining the reinforcement at the centre of UPVC pipe, MP was cured for 3days. On these MP's, the test model is made for various L/D ratios. The test tank is filled with BC Soil and the MP's were located at a distance. Install the MP's kit and place the load through the hopper on the base plate. The same procedure was repeated for L/d ratios.



Fig 4.4 Test Arrangements

4.5.1 Single Pile:

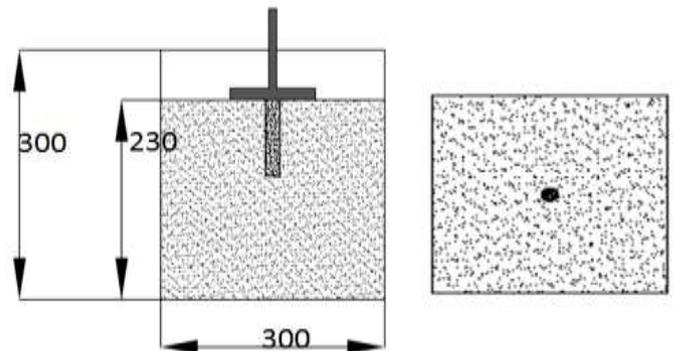


Fig 4.5 Typical diagram of 40% length of single pile resting on circular plate footing.

Note: also 60%, 80% lengths.

4.5.2 Group Piles:

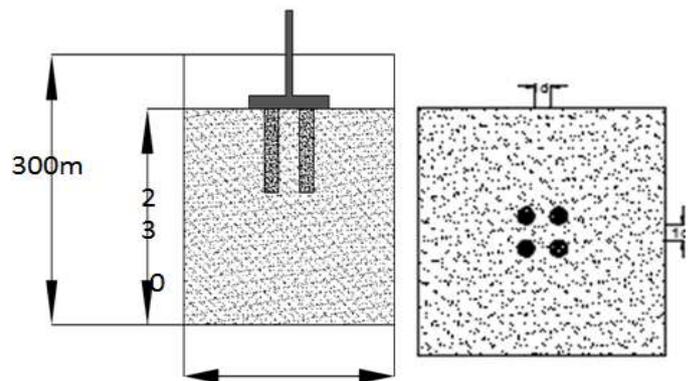


Fig 4.5 Typical diagram of 40% length of group piles resting on circular plate footing with 1D spacing.

Note: also 60%, 80% lengths.

5. EXPERIMENTAL PROCEDURE

The universal testing machine is set up in compressive movement at a strain control rate to ensure the load settlement interaction of single and 1D spacing's of micro piles inserted in black cotton soil. The rectangular tank is sufficiently large to take the footing size 114 and 24mm thick. The size of rectangular test tank taken for the investigation was equal to

Times the size of the 114 mm circular footing. The 40%, 60% & 80% length of the micro piles were used for the tests. The UPVC pipe was used for casting the micro pile, the inner diameter and external diameter of UPVC was 2 cm and 2.2 cm respectively. The load carried by the pile was recorded until the settlement reaches to 25mm. Dial gauge was fixed over the bottom edge of the motorized jack to record the settlement.

6. RESULTS & DISCUSSIONS:

6.1 single micro pile (SMP):

6.1 Concrete pile (40%,60%,80% lengths)

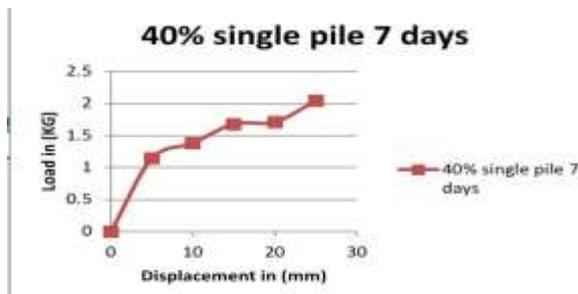
Load settlement behavior for 40% length mp:



In this model study, tests were conducted under different conditions of length and distance. The first test is performed on SMP for various L/d ratios.

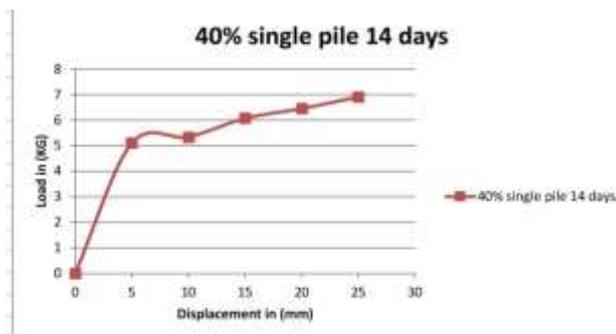
SMP tests of various lengths are also conducted.

The load settlement behavior was observed for the entire SMP test. The settlement was observed up to 25mm.



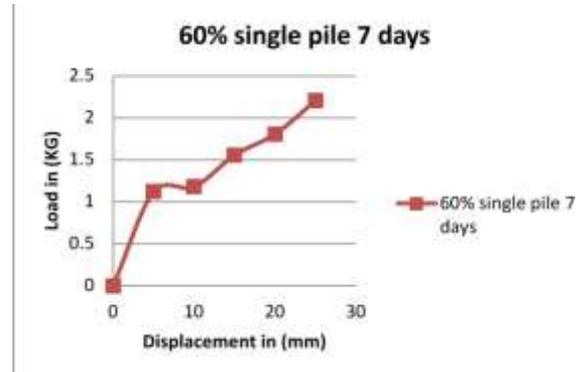
Graph 6.1 for l/d ratio 40%

The load-settlement graph was drawn from the recorded data. The ultimate load for the SMP of 40% L/d ratio of 7 days curing was 2.04 kN at 25 mm settlement.



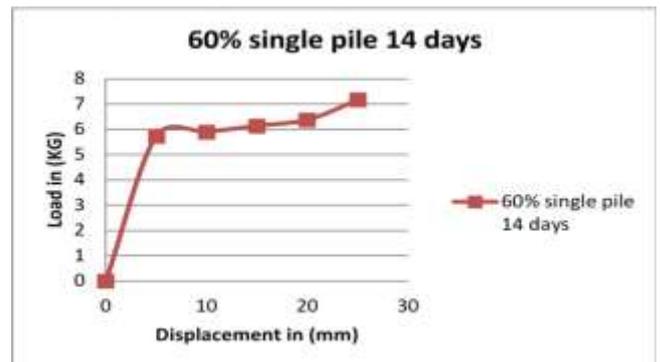
Graph 6.2 for l/d ratio 40%

The load-settlement graph was drawn from the recorded data. The ultimate load for the SMP of 40% L/d ratio of 14 days curing was 4.06 kN at 25 mm settlement.



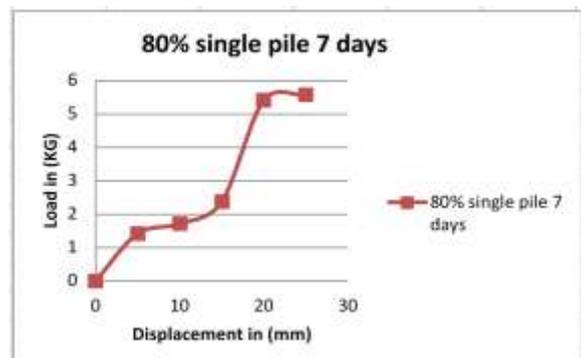
Graph 6.3 for l/d ratio 60%

The load-settlement graph was drawn from the recorded data. The ultimate load for the SMP of 60% L/d ratio of 7 days curing was 2.21kN at 25 mm settlement.



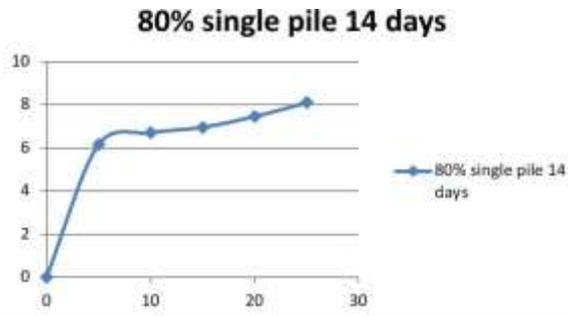
Graph 6.4 for l/d ratio 60%

The load-settlement graph was drawn from the recorded data. The ultimate load for the SMP of 60% L/d ratio of 7 days curing was 2.21kN at 25 mm settlement.



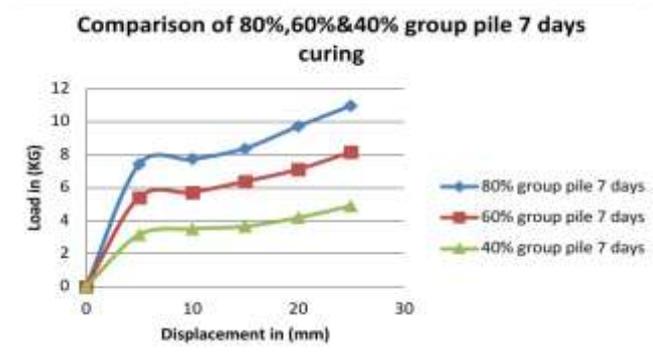
Graph 6.5 for l/d ratio 80%

The load-settlement graph was drawn from the recorded data. The ultimate load for the SMP of 80% L/d ratio of 7 days curing was 5.58kN at 25 mm settlement.



Graph 6.6 for l/d ratio 80%

The load-settlement graph was drawn from the recorded data. The ultimate load for the SMP of 80% L/d ratio of 14 days curing was 8.10 kN at 25 mm settlement.



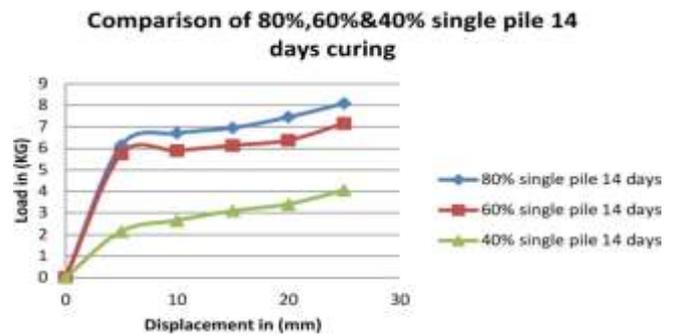
6.1 MICROPILE GROUPS:

Load settlement behavior of group micro pile for 40% length with 1D spacing: (7 and 14 days curing)

Type of Piles	Spacing and settlement in mm	Ultimate Load in kN	
		7 days	14 days
40% length	1D and 25mm	4.9kN	6.91kN
60% length	1D and 25mm	8.16kN	8.90kN
80% length	1D and 25mm	10.96kN	10.96kN

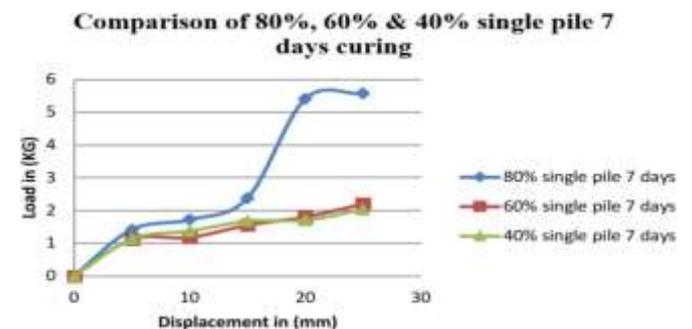
COMPARISONS OF SINGLE PILES:

The load-settlement graph was drawn from the recorded data. The ultimate load for the SMP of 40%, 60% & 80% L/d ratio of 7 days curing was 2.04, 2.21 & 5.58kN at 25 mm settlement.

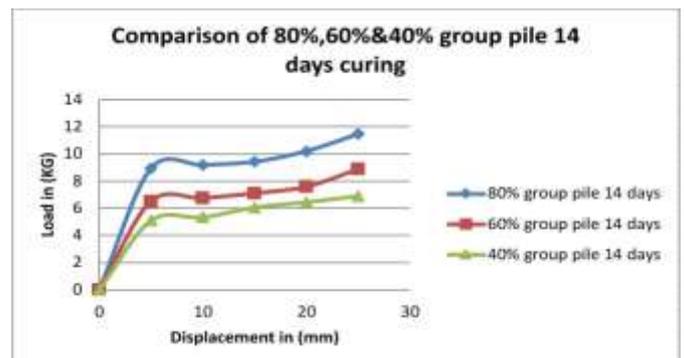


The load-settlement graph was drawn from the recorded data. The ultimate load for the SMP of 40% 60% & 80% L/d ratio of 14 days curing was 4.06 7.16 & 8.10 KN at 25 mm settlement.

COMPARISONS OF GROUP PILES:



The load-settlement graph was drawn from the recorded data. The ultimate load for the 40%, 60% & 80% (5 cm) length of piles with 1D (2.5 cm) of 7 days curing was 4.90kN, 8.16 & 10.96 at 25 mm settlement.



The load-settlement graph was drawn from the recorded data. The ultimate load for the 40%, 60% & 80% length of piles with 1D spacing of 14 days curing was 6.91kN, 8.90 & 11.46 at 25mm settlement.

7. CONCLUSIOS:

The model study was conducted to study the performances of single and group piles with a different length and spacing for 7 & 14 days curing. For vertical loads a round base is used. The load v/s settlement graph was plotted from the recorded data. From the load v/s settlement graphs the

ultimate bearing pressure of the group piles were determined.

The specified conclusions can be formed based on the experimental decision

The load carrying pressure for the group piles increases with in length. Hence the load carrying capacity of the micro piles is directly proportional to their length.

- The load carrying pressure of the piles also increases with their spacing's.
- The longer the pile length, the smaller the group effect.
- The assembling of group of MP's in the weaker floor is also a ground refinement technique.
- The load carried for the 40% length single micro piles is 2.04 kN for 7 days and 4.06 kN for 14 days for 25mm settlement.
- The load carried for the 60% length single micro piles is more than the load carried by the 40% length single micro pile is 2.21kN for 7 days and 7.16 kN for 14 days for 25mm settlement.
- The load carried for the 80% length single micro piles is more than the load carried by the 60% length single micro pile is 5.58kN for 7 days and 8.10kN for 14 days for 25mm settlement.
- The load carried for the 40% length group micro piles is 1D spacing is 4.90kN and 6.90kN for 7&14 days as compare to the load carried for the 40% length single micro pile is 2.04 kN and 4.06kN for 7&14 days for 25mm settlement (i.e 2.86 kN and 2.84kN improvement)
- The load carried for the 60% length group micro piles is 1D spacing 8.16kN and 8.90kN for 7&14 days as compare to the load carried for the 60% length single micro pile is 2.21kN and 7.16kN for 7&14 days for 25mm settlement (i.e 5.95kN and 1.74kN improvement)
- The load carried for the 80% length group micro piles is 1D spacing 10.96 kN and 10.96kN for 7&14 days as compare to the load carried for the 80% length single micro pile is 5.58 kN and 8.10 kN for 7&14 days for 25mm settlement (i.e 5.38 kN and 3.36 kN improvements)

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