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STUDY OF GROUP OF MICRO-PILES SUBJECTED TO LATERAL LOADING AND OBLIQUE PULL

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ABSTRACT

Micropiles are a relatively new deep foundation technology. As an alternative to driven piles or drilled shafts, micro piles can provide substantial support while minimizing cost, environmental impact, and harmful construction vibrations. In order to implement micro piles for new construction on bridges with unsupported lengths, a better understanding of the performance of micropile constituent materials and the structural performance of single micro piles and micropile groups is required.

This paper will give idea about the effect of length diameter ration and inclination to which micro piles are casted on the lateral load capacity of micro piles.

I. INTRODUCTION

Micropiles are nothing but, it is just small diameter piles. The use is that, they are very useful in many ground improvement problems and we know the difference between a big pile and a small pile, in the sense the diameter is quite, you know you try to design, get a diameter for the load. Here, we are trying to replace that bigger diameter with a small number of piles and the micro piles concept came in 1950's in Italy particularly, when people are trying to develop innovative techniques for underpinning, historic structures or monuments, which had some sort of damage in the World War 2. What happened was that, when you have certain buildings and structure, in structures which have some sort of inclination or something like that, because of some the problems we know that the existing load carrying capacity is less. So, you would like to improve the load carrying capacity by additional structural means. So, it may not be easy for you to put another pile foundation. So, the best would be to drive a small micropile, a couple of micro piles close to the site. So, that whatever is short fall in the load carrying capacity can be compensated by the micro piles. At that time, what they felt was that a reliable method to support structural loads with minimal movement and for installation access in restrictive environments. What happens is that in many places, when you already have a building and to its very, it is a very difficult to have a big pile install at the same place, because of the access restrictions and the damage that it can cause of the existing facilities and all that. So, what is the time, you know some people did in Italy was that, there was a company called fondedile, a particular contractor and there was also another engineer, doctor Lizzi and they felt that use of a small micro piles, may be simpler than trying to use big pile diameter, I mean diameters of large, the piles of large diameter. So, from that time onwards, the micro piles have been extensively used and it has been used mainly as elements for foundation support to resist static loading as well as seismic conditions, as well as in-situ reinforcement for slope stability and excavation stability.

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Micropiles have specific advantages compared to more conventional support systems. In general, micro piles may be feasible under the following project-specific conditions:

- Project has restricted access or is located in remote area;
- High load capacity in both tension and compression;
- Ability to install where elevated groundwater or caving soil conditions are present;

Tested to verify load carrying capacities;

- Required support system needs to be in closed pile proximity to existing structures;
- Ground and drilling conditions are difficult;
- Pile driving would result in soil liquefaction;
- Vibration or noise needs to be minimized;
- Hazardous or contaminated spoil material will be generated during construction
- Adaptation of support system to existing structures is required.

II. EXPERIMENTAL PROCEDURE

The present work consists of a model experimental study on single micropile having L/D ratio 10, 15, 20 installed in sand beds. The piles used in the study were of aluminum. These aluminum piles were hollow in cross section having internal diameter 20mm and 2mm thick. For pile caps mild steel plates were used. The piles used in every group were placed at 2.5 times diameter of pile centre to centre to each other in both direction and batter piles used had an inclination of 30° and 45° with the vertical. The micro piles were subjected to lateral loading conditions. Influence of embedment length to diameter ratio (L/D), influence of relative density on the ultimate lateral load, mode of failure of the piles and influence of relative density were investigated. Investigation on single and group of micro piles having different L/D ratio subjected to lateral loads were also done.

III. INSTALLATION OF THE MICROPILES

The micro piles were driven manually in the sand keeping the piles vertical. At the lower end of pile a conical wooden shoe was attached with a steel wire of 2mm fixed in the wood which will act as reinforcement. Then cement sand slurry with mix ratio of 1:2 (1 part of cement and 2 part of fine sand) with enough water added until the mixture reaches the consistency of thick mud. Then this cement sand slurry is filled in the micropile with the help of funnel. The piles were tested after an interval of 2 days.

IV. MEASUREMENT OF LOAD AND DEFLECTION

The dimension of the testing tank was kept large enough to avoid the boundary effect. The testing tank used was rectangular and had a length 120cm, width 90cm, height 90cm.Thickness of G.I. Sheet of testing tank was 4mm. The soil was filled up to 80 cm height from bottom of testing tank.

After driving required number of piles at the required spacing and inclination, the top of pile group was connected by pile cap. Now the free end of wire was attached gently to hook of the pile cap. The other end was

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attached to hanger and the wire passed over the pulley was attached at the outer part of the testing tank. A dial gauge was attached to the bottom of the hanger to note down the horizontal deflection of the pile group. Before the application of load reading on the dial gauge were noted. This is the initial reading and note down the readings after every application of load. The difference of these reading gave the horizontal deflection of pile or group of piles. The load on the hanger was increased in steps (2 kg each time for test series 1 to 14 and 4 kg each time for test series 15 to 18).

The increment of the load was applied up to the point till total horizontal deflection of group of piles exceeded 15-20 mm. After this, load was brought back to zero in similar steps. Correspondingly readings of dial gauges were noted. The reading of dial gauge was noted only after it had attained a constant value.

V. PROPERTIES OF SAND

The sand used in the present study was taken from the banks of river Yamuna from a village of Yamunanagar district in Haryana. According to the Indian standard on classification and identification of soils for general engineering purposes, as per IS: 1498 (1970), the soil is classified as poorly graded sand (SP). The various properties of sand are calculated and are shown below in tabular form:

S. No.	Property	Value
1.	Effective Size	0.130mm
2.	Uniformity Coefficient	2.00
3.	Coefficient of Curvature	3 .98
4.	IS Classification	SP
5.	Mean Specific Gravity	2.68
6.	Minimum Dry Density	1.45gm/cc
7.	Maximum Dry Density	1.70gm/cc
8.	Minimum Void Ratio	0.55
9.	Maximum Void Ratio	0.81

Table 1. Index Properties of Sand

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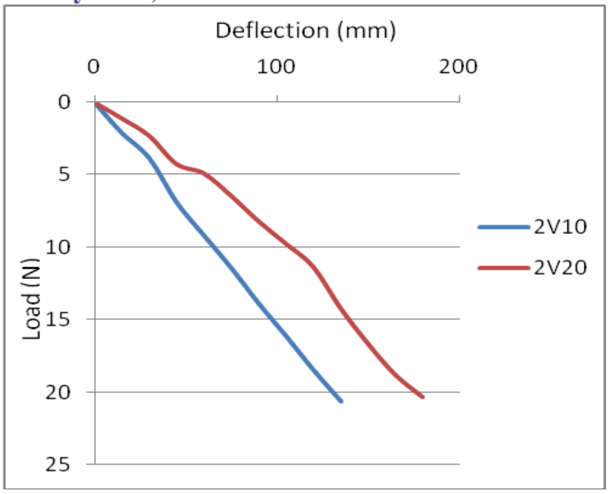

Fig.1

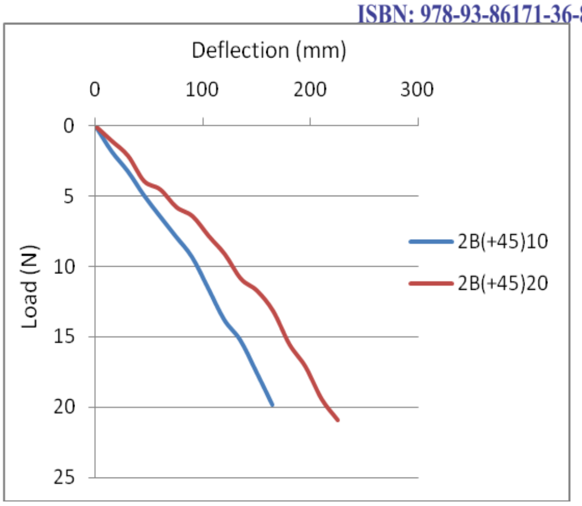

Fig.2

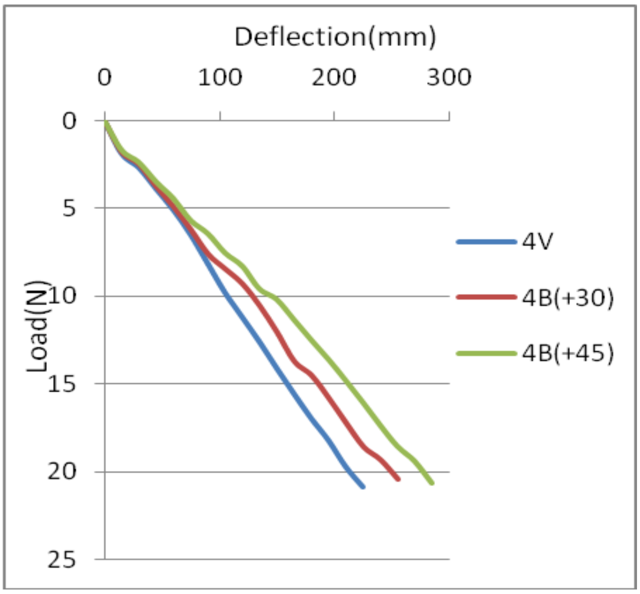

Fig.3

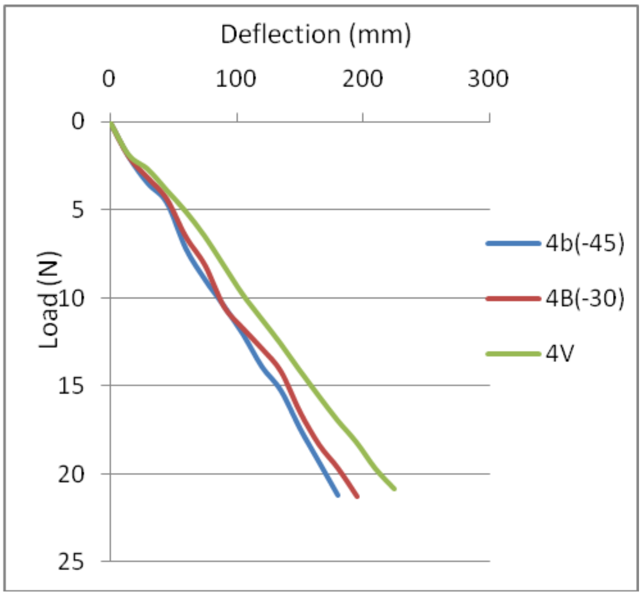

Fig.4

IV. NOTATIONS:

2V10 & 2V20: Here 2 is the no. of piles, V stands for vertical and 10 and represents L/D ratio

2B (+45)10: Here 2 is the no. of piles; B represents batter piles with a batter angle (+45) in this case with L/D ratio 10

4V: 4 represent no. of piles and v stands for vertical with L/D ratio 20

4B (+30) & (+45): 4 represent no. of piles, B represent batter piles with batter angle of (+30) and (+45)

4B (-30) & (-45): 4 represent no. of piles, B represent batter piles with batter angle of (-30) and (-45)

Fig.1 represents variation of lateral load capacity of 2 vertical micro piles w.r.t L/D ratio

Fig.2 represents variation of lateral load capacity of 2 batter piles w.r.t L/D ratio

Fig.3 represents variation of lateral load capacity of 4 piles w.r.t positive batter angle

Fig.4 represents variation of lateral load capacity of 4 piles w.r.t negative batter angle

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V. CONCLUSION:

1. Positive battered piles are more resistant to lateral loads.
2. Negative battered piles are less resistant to lateral loads.
3. It is clear that the behavior of pile groups containing batter piles mainly depends upon the disposition of the batter piles in the ground and the type of batter pile in the group. That is whether the load is applied in the direction of batter or against the batter.
4. Pile group having positive batter piles are more resistant than a pile group having a similar negative.
5. Pile groups having both batter and vertical piles are more resistant to lateral loads, than a pile group containing vertical piles only.
6. With increase in L/D ratio, lateral load capacity also increases.

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