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"OVERVIEW ON IMPROVING BEARING CAPACITY OF SOIL USING GROUND IMPROVEMENT TECHNIQUE MICROPILES"

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Abstract - Micro piles are used in many applications of ground improvement technique to increase the bearing capacity and reduce the settlements and strengthening of the foundations. Advantages of Micro piles are fast one step installation, simultaneous drilling and grouting, allows the use of smaller equipment at lower cost, allows low overhead, limited access installation, improves the ground (densification), offer higher skin friction, total single corrosion protection by design. This piling system is most economical to both the client and foundation Engineer. Micro pile installations can perforate to hundreds of feet in depth and also each of the piles can support tons of load. This paper deals with a review on Micro pile technology which is a reliable pile system that can withstand large capacity axial or lateral loads with minimum interference to the existing structures. Micro piles became most popular due to their capacity to carry loads efficiently through skin friction and also their installations advantages over conventional pile system. Micro piles have the potential of consolidate micro pile technology with one or more of the other ground improvement techniques to meet distinctive or complex project requirements economically and efficient.

Keywords: Micropiles, bearing capacity

1. INTRODUCTION

So often bearing capacity failures result in loss of money, increase in cost of rehabitation of existing building in some cases. A method that has been utilized to enhance the bearing capacity has been by means of the installation of micropiles. In many cases, steel pipes of 50 to 200 mm diameters are used as micropiles. The strengthened ground acts as coherent mass and behaves remarkably well, capable of sustaining very high compressive loads at defined settlement or alternatively defined loads at reduced movement [1]. The ultimate bearing capacity of foundations is usually estimated on the assumption that the soil is relatively uniform within the zones of shear deformation beneath the foundation [10]. Current paper is a review paper highlighting the performance of various micropiles techniques when used for improving bearing capacity of soil with minimal disturbance to the existing structure.

2. OBJECTIVE

1.To study an alternate cost effective and economical solution to prevent settlement of existing foundation.
2.To study behaviour of micro piles as strengthening technique of existing structure.

3. LITERATURE REVIEW

B. R. Srinivasa Murthy, et al. (2002) [1] The study also examines the contribution from each of the mechanisms, and shows that fixing the micropiles in the ground, close to the foundation, significantly improves the foundation's bearing capacity. A method for analysing the use of micropiles to improve the bearing pressure of foundations. Numerical simulations have been used to assess the improvement in terms of(a) the improvement due to densification of the soil surrounding the micropiles(b) the improvement due to interaction between the soil and the micropiles(c) fixing of the micropile to a micropile cap at ground level. The results clearly demonstrate that, for the case analysed, bearing capacity improvement of 30–45% is possible simply by driving the micropile.
K Miura, et al. (2000) [2] In this paper bearing capacity was decreased with increasing the inclination angle of load the footings were subjected to footing showed higher resistance to horizontal component of the load than to the vertical component. On the other hand, micropiles installed vertically can resist more in horizontal direction. Improvement of the bearing capacity was recognized also under inclined loads. The interaction between footing and a group of micropiles was not so effective under inclined loading compared with under vertical loading.
Kaiyang Wang, et al. (2018) [3] This paper deals with the technology of the double grouting improves the mechanical performance of the pile group and the horizontal bearing capacity of the steel floral tube pile. Compared with traditional single grouting, the horizontal bearing capacity of the single pile with double grouting increased by 24.4%. Moreover, the horizontal bearing capacity of the pile group with three piles was stronger, as demonstrated by an increase of 20.25% compared with the horizontal bearing capacity of the single pile.

W. R. Azzam, et al. (2018) [4] In this paper Micro-piles are one of the effective techniques used to increase the bearing capacity and reduce the settlement, particularly n strengthening existing foundations. In the current study the behaviour of a loaded strip footing strengthened by two rows of micro-piles fixed along each side which was investigated experimentally and numerically the ultimate bearing capacity enhanced. The micro-piles modified the bearing capacity failure of the strip footing from the general shear failure to the punching shear failure. The experimental results were verified using numerical analysis that helped in understanding the failure mechanism and the deformation behaviour of such technique.

G.L. Sivakumar Babu, et al. (2004) [5] This paper describes the case study, the method of treatment adopted in the field and the results of numerical analysis were carried out. The micropiles were inserted around the individual footings at inclinations of 70^0 with the horizontal in two story building which was constructed on a loose sandy soil. The bearing capacity of foundation soil improved using micropiles. The results confirm that the methodology used was effective in obtaining the desired level of improvement.

Nirmali Borthakur, et al. (2017) [6] The paper discusses the experimental observations on the behaviour of micropile groups under static axial vertical compressive load. The micropiles were constructed in the clayey soil of very soft consistency in a test pit of size 2.0m×4.0m×3.0m. The experimental results of load tests conducted on model micropile groups casted on highly plastic and soft clay bed with undrained shear strength (cu) in the range of 18–20kPa. To reduce the scaling effects, tests were conducted on a test pit of sufficiently large dimensions, such that results can reflect the actual load-settlement behaviour of the free standing micropile group as well as the micropile group with cap resting on the ground surface.

Young-Eun Jang, et al. (2018) [7] This paper explains new type of micropile, the waveform micropile, has been developed to provide improved load-bearing capacity compared with that of a conventional micropile. The waveform micropile has a wave-shaped grout with a partially enlarged shear key formed by the jet grouting method on the cylindrical shaft of the micropile. The test results showed that the ultimate bearing capacity of the waveform micropile was over two times greater than that of the conventional micropile. The rate of increase in the bearing capacities of each waveform micropile differed with the shape of the shear key. Furthermore, the characteristics of the load-sharing ratio due to the shaft resistance and end bearing varied depending on the shape of the waveform micropiles.

Doohyun Kyung, et al. (2016) [8] In the present study, the vertical load carrying behaviour of micropile foundations with various configuration conditions were investigated based on the results from model load tests. The ultimate load capacity of micropiled rafts was affected by both installation angle and micropile spacing. The group effect and interaction effect factors for group micropiles and micropiled rafts were proposed, respectively, all of which can be used to estimate the load carrying capacity of micropile foundations. Field load tests conducted and it was seen that estimated results using the proposed method were in good agreement with measured results. Additional comparison with cases examples from the literature also confirmed the validity of the proposed method.

G. G. Meyerhof, et al. (1978) [9] The ultimate bearing capacity of footings on a dense or stiff layer overlying a weak deposit under inclined load can be expressed by inclination factors in conjunction with punching shear coefficients, which depend on the shear strength parameters and bearing capacity ratio of the layers under vertical load. For foundations on a loose or soft layer overlying a firm deposit under inclined load the previous semi-empirical interaction relationship can be modified by inclination factors for homogeneous soils.

Saeed Hakimian, et al. (2015) [10] In this paper micro piles have been increased extensively in large project constructions because of the unique advantages of this method compared to concrete piles. This research is designed to use a numerical modelling using finite element software Plaxis 3d Foundation v1.6 and also the FHWA code for a comparative study between micropiles and micro bulbs. The results showed that the new microbulb system is an appropriate solution for improvement of mechanical properties of the soil, increase of bearing capacity and settlement decrease.

M. Sadek, et al. (2006) [11] This paper included analysis of the performance of a micropile network in a wall configuration under both lateral and vertical loadings. Analysis shows that the use of inclined micropiles results in an improvement of the performance of the micropile network under both lateral and inclined loadings. Under lateral loading, inclination of the micropiles allows for good mobilisation of the axial stiffness of the micropiles and consequently results in an increase in the lateral stiffness of the network and a reduction of both the shearing forces and the bending moment in the micropiles. Under vertical loads, inclination of the micropiles results in a reduction of the axial forces and consequently in an increase in the bearing capacity of the network.

Yukihiro Tsukada, et al. (2006) [12] In this paper series of model tests were carried out to clarify the mechanism for improvement of the bearing capacity of footings reinforced with a group of micropiles. Circular footings were reinforced with a group of micropiles and the arrangement of micropiles was varied as well as the inclination of the micropiles. The load displacement the behaviour of foundations was analysed and the features that influence the bearing capacity were identified.

K. Miura, et al. (2016) [13] In this paper investigation of the load bearing mechanism of micropile foundations in sand under vertical loads, this model study aims to further investigate the load bearing behaviour of micropile foundations under inclined loads in sand. It is found that micropiles can effectively improve the bearing capacity of surface footings under inclined loads. However, as expected, the improvement of bearing capacity decrease with the load inclination. A positive network effect is observed in the model tests under inclined loads as in the vertical loading tests in previous studies. The bearing capacity of micropile foundations is larger at small battered angles of micropiles under inclined loadings, and it decreases at large battered angles.

4. CONCLUSION

- This is one of the ground improvement technique used for improving the bearing capacity by using micropiles.
- Using micropiles we can improve the stability of the soil of existing building with minimal disturbance to the structure.
- By installing the micropiles with an inclination we can improve the bearing capacity as well as settlement of soil.
- Micropile can resist more load in horizontal direction when it installed vertically.

5. REFERNCES

1. B. R. Srinivasa Murthy, et al. (2002) "Analysis of bearing capacity improvement using Micropiles" ICE publication ground improvement, vol 6, No.3, pp 121–128.
2. K Miura, et al. (2000) "Bearing capacity during earthquake of the spread footing Reinforced with micropiles" World Conference on Earthquake Engineering, pp 1259 – 1268.
3. Kaiyang Wang, et al. (2018) "An Experimental Study of Horizontal Bearing Capacity of Vertical Steel Floral Tube Micropiles with Double Grouting "Advances in Civil Engineering vol 1, pp 1 – 11.
4. W. R. Azzam, et al. (2018) "Utilization of micro‐ piles for improving the sub‐ grade under the existing strip foundation: experimental and numerical study" Innovative infrastructure solutions vol 3, no 44, pp 1 – 11.
5. G.L. Sivakumar Babu, et al. (2004) "Bearing capacity improvement using micropiles a case study" Geotechnical Special Publication, pp 1 – 9.
6. Nirmali Borthakur, et al. (2017) "Experimental Investigation on Load Carrying Capacity of Micropiles in Soft Clay" civil engineering, pp 1 – 13.
7. Young-Eun Jang, et al. (2018) "Analysis of the shape effect on the axial performance of a wave form micropile by centrifuge model tests" Springer Acta Geotechnica, pp 1 – 14.
8. Doohyun Kyung, et al. (2016) "Vertical load carrying behaviour and design model for micropiles considering foundation configuration conditions", can. Geotech, pp 1 – 44.
9. G. G. Meyerhof, et al. (1978) "Ultimate bearing capacity of foundations on layered soils under inclined load" can. Geotech, vol 15, pp 565 –572.
10. Saeed Hakimian, et al. (2015) "Numerical Analysis and comparison of Micropiles Pressure Bearing Capacity With the new Microbulb system on clay in Shiraz, Iran" International Research Journal of Applied and Basic Sciences, Vol 9, pp 656 – 660.
11. M. Sadek, et al. (2006) "Influence of micropile inclination on the performance of a micropile network" institution of civil engineers – Ground improvement, vol 10, No.4, pp 165 – 172.
12. Yukihiro Tsukada, et al. (2006) "Mechanism of bearing capacity of spread footing reinforced with micropiles" Soil and foundation, vol 46, No.3, pp.367 – 376.
13. K. Miura, et al. (2006) "Behaviour of micropile foundations under inclined loads in laboratory tests" Lowland technology international vol 5, No.2, pp 16 – 26.