Finite Element Analysis for Axial Load Distribution in Pile in a Piled Raft Foundation in Medium Stiff Clay

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Abstract
In this paper piled raft foundation has been analysed by nonlinear finite element method..The three dimensional nonlinear finite element analysis predicts the actual behaviour of axial load distribution.The axial load variation is nonlinear for all the piles. The measurement of axial load distribution in pile in field is very difficult and costly.

Keywords: Raft, piled raft, pile, soil

1 INTRODUCTION

Piled raft foundation is a new type of foundation in which the total structural load is taken by pile through skin friction and the remaining load is taken by raft through contact with the soil. It is an economical foundation than the pile foundation and the settlement is less than the raft foundation.

2 LITERATURE REVIEW

Important papers which talk on piled raft foundations are Clancy and Randolph (1993) Prakoso and Kulhawy (2001), Lin and Zheng(2006), Sanctis and Mandolini (2006), Shukla et.al.(2010), Al-Mosawi et.al (2011),El-Garhy et.al (2013) , Raut et.al (2015).

Based on literature review it has been found that not much work has been done on piled raft foundation by finite element method specially three dimensional nonlinear finite element method to predict the axial load distribution in a pile in piled raft foundation.

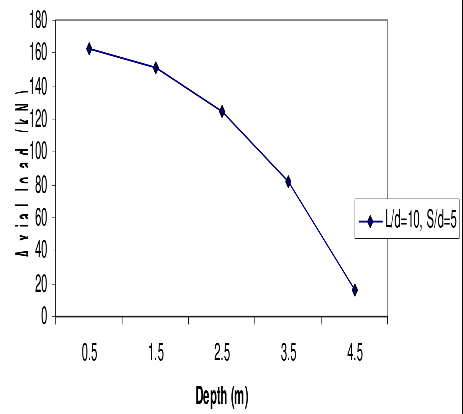

Fig.1. Axial load distribution in pile

RESULTS AND DISCUSSIONS

3 FINITE ELEMENT ANALYSIS

For finite element discretization one fourth of piled raft with equivalent area of raft taken from a single pile with equivalent area of raft from pile forest model. The bottom degrees of freedom are completely fixed. On the x-axis plane and the plane parallel to it z translation are fixed. Similarly on the z-axis plane and plane parallel to it the x translations are fixed. The soil, pile and raft have been discretized as eight noded brick elements. The material behaviour of pile and raft has been considered as linear elastic medium while the soil has been idealized as nonlinear material by Extended Drucker-Prager yield criterion. The total number of nodes is 1275 and the total number of elements is 800.

Fig.1 shows the axial load distribution for a single pile of length to diameter ratio of 10 for spacing to diameter ratio 5. The axial load is maximum in the top portion and then it decreases with depth. The variation of axial load distribution is nonlinear with depth.

Fig.2 shows the axial load distribution for a single pile of length to diameter ratio 20 and spacing to diameter ratio of 5. The axial load is maximum in the top portion and minimum at the bottom portion. The axial load distribution is nonlinear. When compared with the axial load distribution of pile of length to diameter ratio 10 it is found that at any depth, the axial load is greater for pile of length to diameter ratio 20. Thus the total load taken by pile of length to diameter ratio 20 is greater than the total load taken by pile of length to diameter ratio of

10.

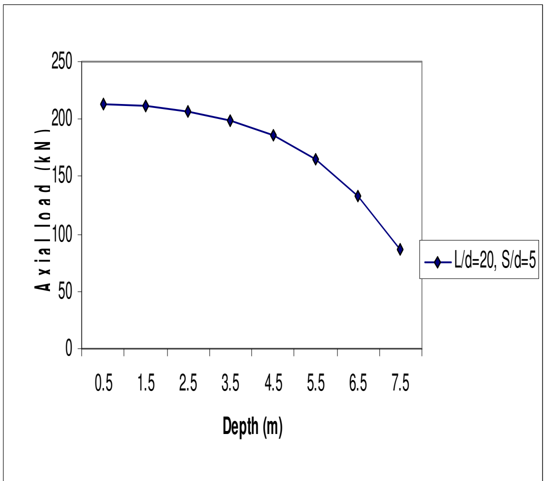

Fig.2 Axial load distribution in pile

Fig.3 shows the axial load distribution of pile of length to diameter ratio of 30. The variation of axial load distribution is nonlinear. At any depth the axial load distribution in a pile of length to diameter ratio 30 is greater than the axial load distribution of pile of length to diameter 10 and 20.

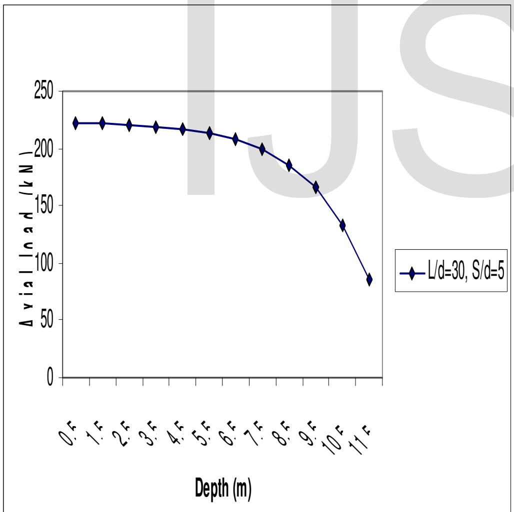

Fig.3 Axial load distribution in pile

Fig.4 shows the variation of axial load distribution in a pile of length to diameter ratio 40. The axial load distribution is maximum in the top portion and minimum at the bottom portion. The variation of axial load distribution is nonlinear. At any depth the axial load distribution is greater in pile of length to diameter ratio 40 than the piles of length to diameter ratio of 10,20 and 30.

Fig.5 shows the axial load distribution of pile of length to diameter ratio of 50. Behaviour is similar as for piles of length to diameter ratio of 10,20,30 and 40. At any depth the axial load distribution is greater than the piles of length to diameter ratio of 10,20,30 and 40.

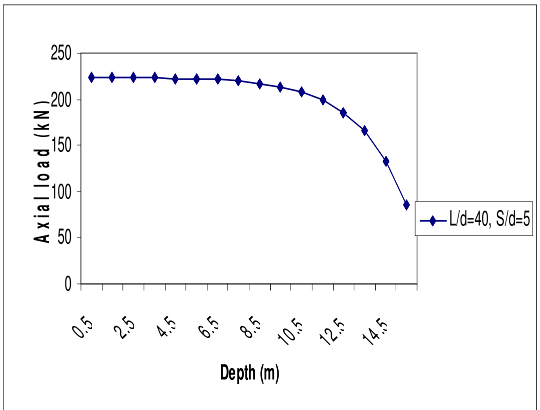

Fig.4 Axial load distribution in pile

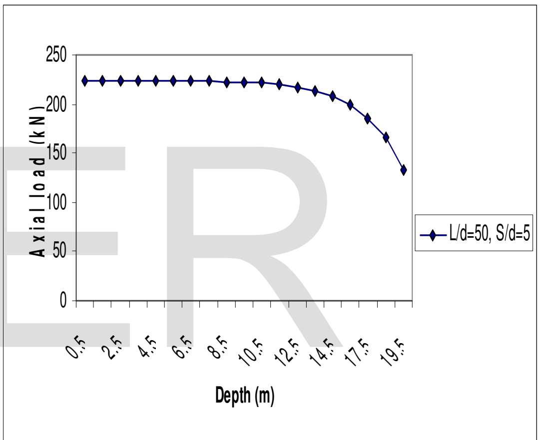

Fig.5 Axial load distribution in pile

4 CONCLUSIONS

The three dimensional nonlinear finite element analysis predicts the actual behaviour of axial load distribution in piles of different length to diameter ratio. The axial load distribution is maximum in the top portion of pile and minimum at the bottom portion of the pile for piles of length to diameter ratios 10,20,30,40 and 50. The axial load variation is nonlinear for all the piles. The measurement of axial load distribution in pile in field is very difficult and costly. The nonlinear finite element analysis solves this problem.

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