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ANALYSIS FOR AXIAL LOAD DISTRIBUTION IN PILE IN A PILED RAFT FOUNDATION STIFF CLAY BY FINITE ELEMENT

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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 analyses predict the actual behaviour of axial load distribution. The axial load variation is nonlinear for all the piles. For all pressure the element stress is more than the element stress. For any pressure the nodal deflection is maximum at top and minimum at bottom. Up to certain height the element stress is almost zero for all pressures. After that height the element stress increases with increase in height. The element stress increases with increase in pressure the measurement of axial load distribution in pile in field is very difficult and costly.

Keywords: Raft; Piled Raft; Pile; Soil.

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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

Tayabji et.al (1986) developed the program JSLAB for analyzing pavements resting on a Winkler foundation. The model incorporates features similar to ILLI-SLAB, utilizing plate elements to model the slab and a bonded or unbonded base. Dowels were modeled with modified beam elements that incorporated the effect of shear deformations and elastic support provided by the concrete. As in ILLI-SLAB, aggregate interlock and keyways were modeled with springs

Krauthammer and Western (1988) focus on the relationship between shear transfer capabilities across pavement joints and the effects on the behavior of the pavement. The approach of the present study is to develop a numerical model that could accurately represent the mechanism for shear transfer across reinforced concrete pavement joints and implement it in an existing finite element code. The tool is then used for the analysis of various pavements for which experimental data are available; the model is further refined until the numerical results are in good agreement with the experimental information.

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.

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.

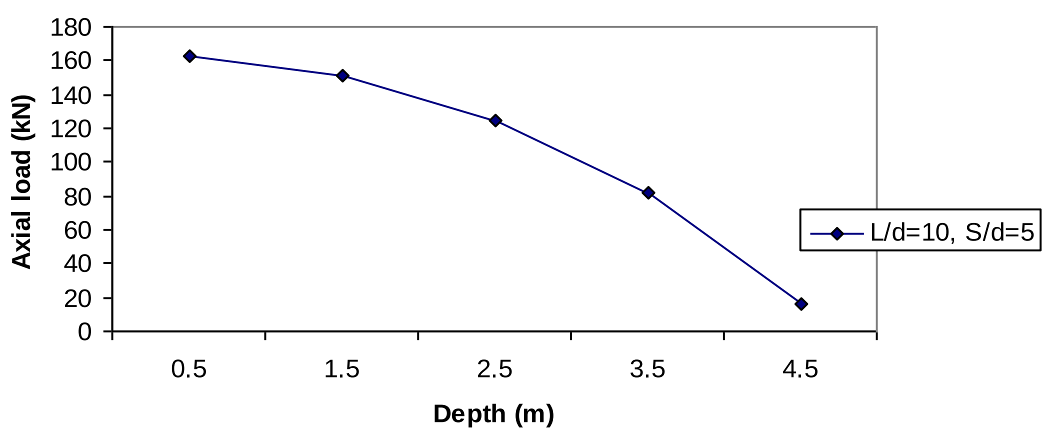

Fig.1. Axial load distribution in pile

4. Results and Discussions

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.

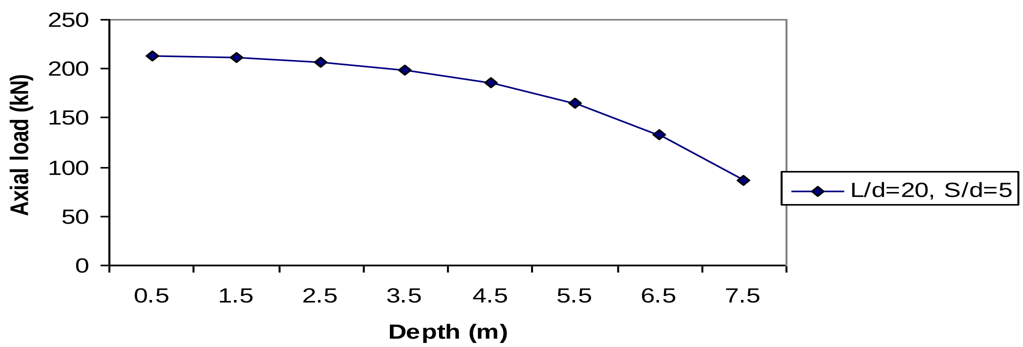

Fig.2 Axial load distribution in pile

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.

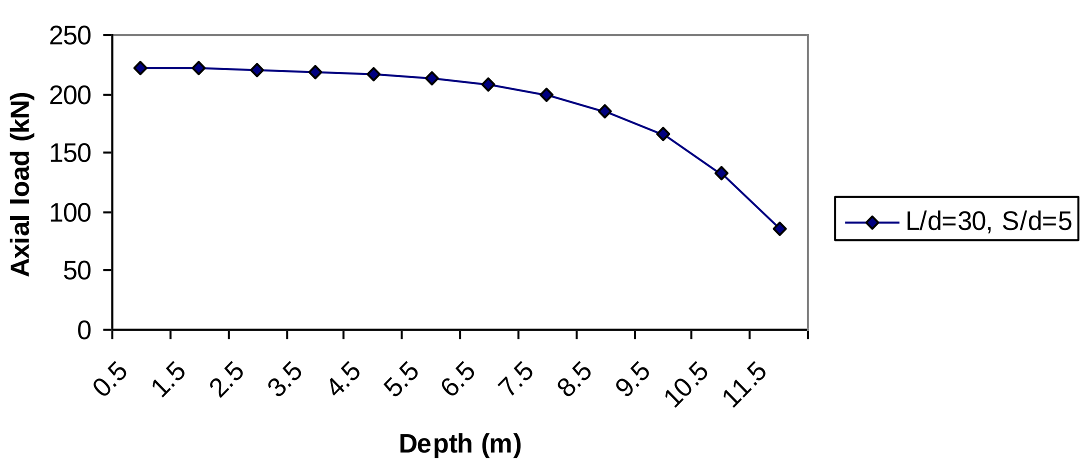

Fig.3 Axial load distribution in pile

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.

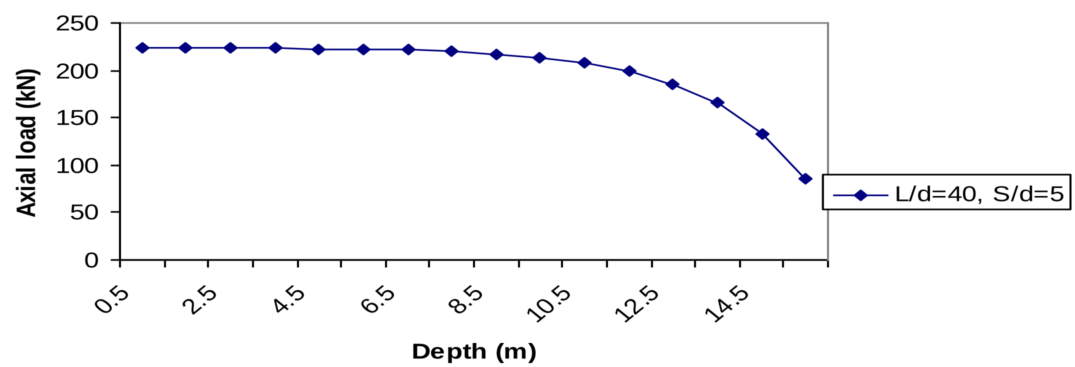

Fig.4 Axial load distribution in pile

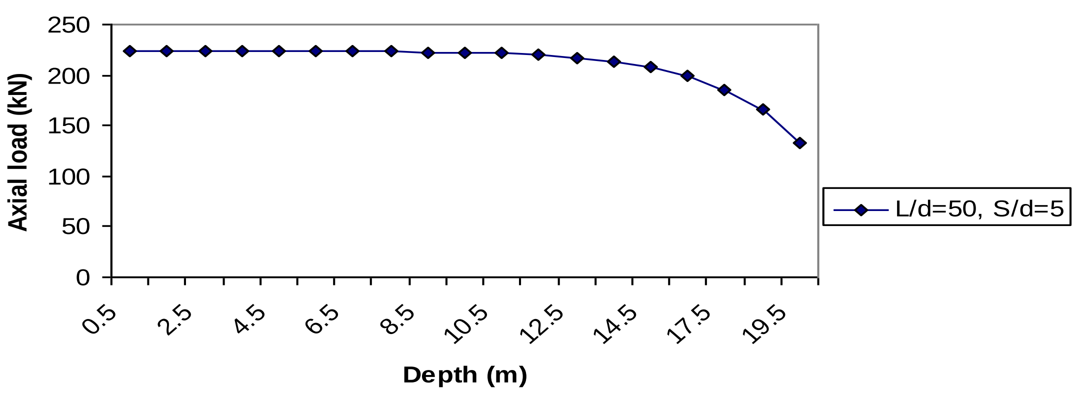

Fig.5 Axial load distribution in pile

5. Conclusions

The variation of deflection (settlement) with decreasing height is nonlinear the element stress is maximum in the top element and then it decreases in elements with decreasing height. The settlement obtained in the horizontal direction is almost uniform which shows the rigid behaviour of the pavement. The variation of nodal deflection with depth and the element stress with depth are nonlinear. 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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