ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

COMPARATIVE STUDY OF PILED RAFT FOUNDATION

Nitin Nandwani, Prof P.J.Salunke, Prof N.G.Gore
Department of civil engineering, MGM's College of Engineering & Technology, India.
Department of civil engineering, MGM's College of Engineering & Technology, India.
Department of civil engineering, MGM's College of Engineering & Technology, India.

ABSTRACT

The use of piled raft foundations has become more popular in recent years, as the combined action of the raft and the piles can increase the bearing capacity, reduce settlement, and the piles can be arranged so as to reduce differential deflection in the raft. Piled raft foundation is a new concept in which the total load coming from the superstructure is partly shared by the raft through contact with soil and the remaining load is shared by piles through skin friction. A piled raft foundation is economical compared to the pile foundation. Because piles do not have to penetrate the full depth of clay layer but it can be terminated at higher elevations. Such piled raft foundation undergoes more settlement than the pile foundation and less settlement than the raft foundation. In this paper the study of different parameters like size of the raft, thickness of the raft, diameter of the piles, length of piles, spacing of pilesetc., which affect the behavior of piled raft foundation. And its interdependency is also reviewed for G + 20 storey building. This study is useful to decide the various parameters required in the design of piled raft foundation and suggest the suitable combination of Pile Raft Foundation.

KEYWORDS: Pile Raft. Settlement, Deflection, Stiffness

INTRODUCTION

All engineered construction resting on the earth must be carried by some kind of interfacing element called a foundation. The term of foundation describes a structural element that connects a structure to the ground. Rafts are realized to be a reasonable foundation system for medium sized buildings, silos and Non-river bridges basically when the structural loads are so high or the soil condition regarding its stiffness and strength is poor. If a shallow foundation is not adequate, it is common in foundation engineering to design a fully piled foundation in which the entire loads are transferred to the subsoil by piles

Recently, by the improvement of accuracy in geotechnical engineering the beneficial utilization of construction materials should be considered in foundation design. In traditional methods of piled foundation design, because of the occurrence of large settlements under the pile cap resulted in the separation of the raft and soil, therefore in the calculations of bearing capacity of foundations only the piles were considered and no emphasis was made on the raft as a load sharing element.

To date, according to the advanced numerical analysis, one can consider the interaction between a raft and the soil in foundation design. Among such design improvements, it is common for a raft to be part of the foundation system. In recent years, there has been an increasing recognition that the use of piles to reduce rafts total and differential settlements, can lead to considerable economy without compromising the safety and performance of the foundation. Such a foundation makes use of both the raft and the piles, and is referred to as a piled raft foundation (PRF).

The piled raft foundation system is a type of composite foundation which involves the contribution of piles, raft, and soil to transmit heavy loads of the superstructure to the ground.

In the design of piled rafts the load sharing between the piles and raft is taken into account.

The use of PRF is an effective way of minimizing both total and differential settlements, improving the bearing capacity of a shallow foundation, and effectively reducing the internal stress levels and bending moments within a pile.

Moreover, utilizing foundations that share the contributions of both raft and piles in tall and heavy buildings, or otherwise when extraordinary environmental loadings such as earthquake, wind and wave loads exist or more generally, when the condition of soft and loose subsoil is observed, piled raft foundations seem to be a quite reasonableimplementation.

LITERATURE REVIEW

Historically, the pile raft analysis has its origin to the pile group analysis. The early work of Skempton (1953) and Meyerhof (1959) were empirical in nature and relates to the settlements of pile groups. The important work of Fraser and Wardle (1975), Poulos and Davis (1980), Randolph (2003), and Poulos (2006) are reviewed in relation to the pile group analysis, load transfer mechanism and other pertinent aspects related to the fundamentals of pile group analysis. The contributions from Tomlinson (1986), Coduto (1996), Poulos (1993) and Van Impe (1991) are also studied in relation to the equivalent raft methods of analysis.

The contributions from Poulos (1993), and Clancy and Randolph (1993) are reviewed in relation to the equivalent pier methods of analysis in piled raft foundations. The rapid developments

In the numerical analysis of pile behavior and piled raft foundations saw numerous. The more rigorous methods of piled raft analysis began with the contributions of Kuwabara (1989), and extended by Poulos (1993) with further contributions from Ta and Small (1996), Zhang and Small (2000), and Mendoca and Paiva (2003). Notably, Prakoso and Kulhawy (2001) used the PLAXIS software in the 2D analysis of piled raft foundations.

IN PARAMETERS TO BE CONSIDERED TO STUDY THE BEHAVIOR OF PILED RAFT FOUNDATION

Various researchers have examined some characteristics of behaviors of piled rafts and the effect of following factors on the

Behavior:-

- Number of piles
- Pile spacing
- Diameter of piles
- Pile length
- Raft thickness

METHODOLOGY

For the present research work, a 20 storey building with piled raft foundation is selected and analysis of the behavior for this structure in stratified soil deposits of the area of is carried out. For the analysis, finite element program Etabs v9 & safe v12 is used. A generalized soil profile of above specified area and the geometrical properties of the building are shown in preceding sections.

- Height – 66 m
- Building Plane – 32 x 42 m
- Column Dimension – 450 x 1200 mm
- Beam Dimension - 300mm x 650mm
- Length of piles – 12 m

Soil report:

Layer No. : 1

This layer from 0.00m to 1.5 m depth is observed to consist of yellowish brown colored silty sand. The soil is having percentage of silt and clay is 25%, Sand percentage is 62 and gravels is 13%.The soil is non plastic.

Layer No. : 2

This layer from 1.5 m to 10.50 m depth is observed to consist of yellowish brown colored stiff to hard silty clay with very high plasticity and swelling .The soil is having percentage of silt and clay varying from 92 to 95, Sand percentage varying from 04 to 06 and gravels is 01 to 02 %.The liquid limit varies from 79 to 83 and that in plasticity index varies from 49 to 54 and is classified as CH .The observed N value is varyingfrom 04 to refusal.

Layer No. : 3

This layer from 10.50 m to 15.0 m depth is observed to consist of blackish brown colored basalt rock having core recovery varying from nil to 39% and rock core recovery varies from nil to 29 %.

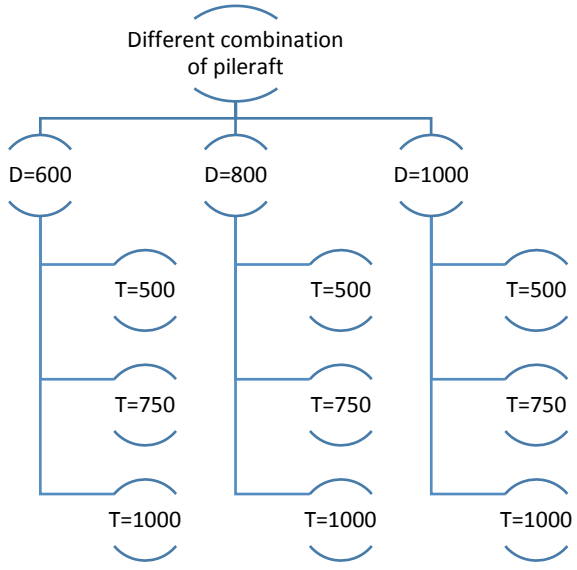
The main purpose of a parametric study is to investigate the piled raft performance under the changes of the geometry of the dimensions. Therefore, the numbers of cases are studied. It includes pile diameters, raft thickness, length of pile, and spacing of piles.

Different combination studied to analyses the behavior of piled raft:

1. Length of pile = 12 m , spacing = 4D
2. Length of pile = 12 m , spacing = 5D

Where D = diameter of pile.

T= Thickness of raft



Total 18 models have been analyzed by changing the spacing of pile and keeping length constant for above mentioned iteration. By analyzing 18 models 6 graphs have been made to compare and get appropriate results.

RESULTS AND DISCUSSION

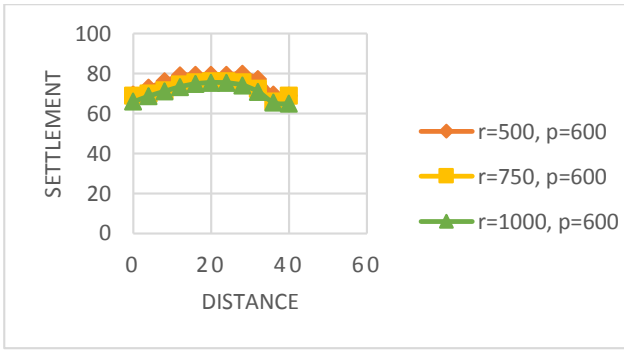


Fig 1 : Length = 12 m, s/d = 4 (total piles = 212)

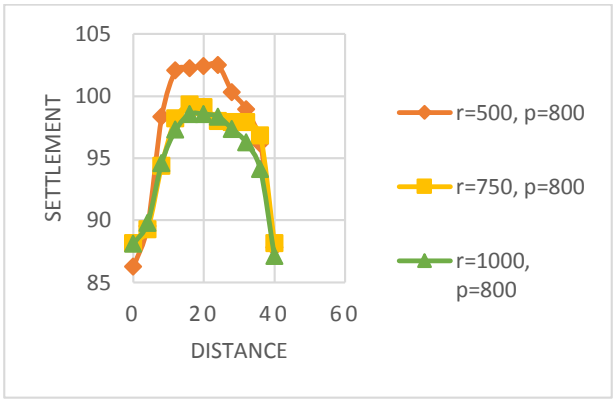


Fig 2 : Length = 12 m, s/d = 4 (total piles = 130)

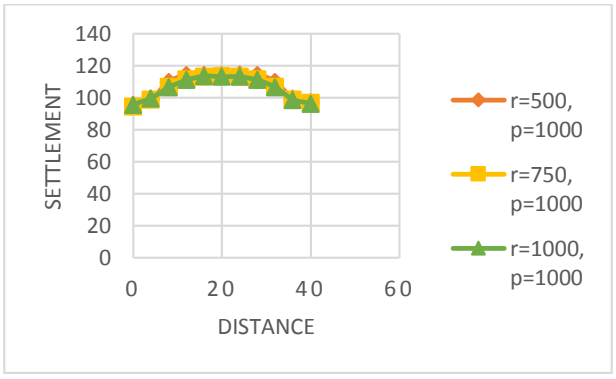


Fig 3 : Length = 12 m, s/d = 4 (total piles = 92)

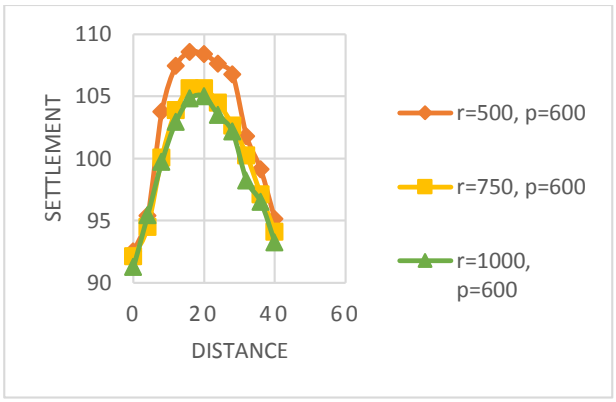


Fig 4: Length = 12 m, s/d = 5 (total piles = 155)

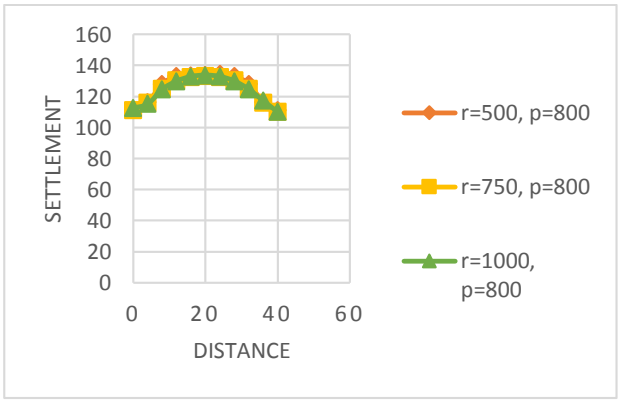


Fig 5: Length = 12 m, s/d = 5 (total piles = 92)

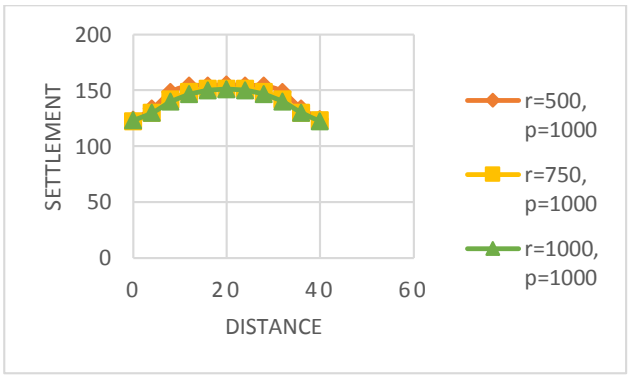


Fig 6: Length = 12 m, s/d = 5 (total piles = 63)

CONCLUSION

1. **Effect of Raft Thickness**: - As shown in chart 1-6 the study was carried out for different pile diameter with thickness of the raft. It was observed that maximum settlement of the raft decreases as the diameter of the pile increases.

2. **Effect of Pile Diameter**: - As shown in chart 1-6 as per the analysis as the pile diameter increases, the settlement reduces.
3. **Effect of pile spacing**: - As shown in chart 1-6 as per the analysis as spacing increases, settlement increases.
4. It has been observed that piled raft foundation concept has significant advantages in comparison to conventional foundation for some soft clay for high rise buildings.
5. The ultimate bearing capacity of Piles will be increased as the Pile diameter increases.
6. The settlement of Pile is reduced as the diameter of Pile increases.
7. To reduce the differential settlement and moment the piles should be place strategically using some trial and error or using parametric study.

REFERENCES

1. "BEHAVIOURAL STUDY OF PILED RAFT FOUNDATION IN LAYERED SOIL DEPOSITS"
2. S.J. Shukla, Dr.A.K.Desai, Dr. C.H.Solanki IJAET/Vol.II/ Issue IV/October-December, 2011/191-195
3. AnkaiShochi,Hiroyuki, Kato RieiIshida,Makato Nagata "The Load Bearing Mechanism of Piled Raf Foundation During Earthquake", Proceedings Third Ujnr Workshop on Soil Structure Interaction, March 29 – 30, 2004, Melono Park, California, USA
4. Bakholdin B.V. "Piled Raft Foundations Design and Characteristics of Construction Procedures", Soil Mechanics and Foundation Engineering, Vol 40, No 5, 2003
5. Balasurbamaniam S., Oh E.Y. N "Parametric Study on Piled Raft Foundation in Sand Using Numerical Modelling "eleventh east Asia pacific conference on structural engineering and construction,nov19-21,Taipei,taiwan.
6. Bhattacharya S., Madabhushi S.P.G. "A Critical Review of Methods For Pile Desing In Seismically Liquefiable Soils", Bull Earthquake Engineering, 2008,Vol 6 Pg:407-446.
7. Engin H.K., E.G. Septanika And R.B.J. "Estimation of Pile Group Behaviour Using Embedded Piles" ,Iacmag, 1-6 Oct. (2008),Goa,India.
8. George Gazettes "Analysis of Machine Foundation Vibration: State of Art" Soil Dynamics And Earthquake Engineering, 1983,Vol:2,No 1.
9. Kame .C.S., Sawant V.A. "A Parametric Study on Raft Foundation" The 12th International Conference of International Association for Computer Methods and Advances in Geomechanics (IACMAG) 1-6 October, 2008 Goa, India.
10. MackerleJaroslav , "Fem And Bem In Geomechanics: Foundations And Soil-Structure Interaction - A Bibliography (1992-1994) , Finite Elements In Analysis And Design, 22 (1996) 249-263.
11. Maharaj D.K. "Non Linear Finite Element Analysis of Piled Raft Foundations" Geotechnical Engineering, issue 157, GE3, PP: 107-113.
12. Maharaj D.K. "Analysis of Piled Raft Foundation" , Seminar on Design of Pile Group And Pile Cap ,IGS Madras Chapter , July 1994.
13. MaharajDilip Kumar, "Dimensional Nonlinear Finite Element Analysis To Study The Effect of Raft And Pile Stiffness on The Load-Settlement Behaviour of Piled Raft Foundations" EJGE Paper , 2004.
14. MaharajDilip Kumar, Lakshmi Desika P. "Finite Element Analysis of Axisymmetric Conical Shell Raft Foundation", EJGE Paper , 2004.
15. PastsakornKitiyodom ,Tatsunori Matsumoto , "A Simplified Analysis Method For Piled Raft and Pile Group Foundations With Batter Piles", International Journal For Numerical And Analytical Methods In Geomechanics, Vol.26,2002,1349-1369.
16. Pecker Alain , "Earth Quake Foundation Design, Soil Mechanics Laboratory ,Palaoseau ,France.
17. Poulos H.G. , "Simplified Design Procedure for Piled Raft Foundations" , Deep Foundations 2002.
18. Poulos Harry G, "Piled Raft and Compensated Piled Raft Foundations For Soft Soil Sites", Advances In Designing And Testing Deep Foundations.
19. Poulos Harry G, "The Piled Raft Foundation for the Burj Dubai, Design and Performance, IGC ferreco, terzaghi oration - 2008.
20. Sadrekarimi J. Et al. "Comparative Study of Methods of Determination of Coefficient of Subgrade Reaction" Vol. 14, Bund. E
21. Singh N, Singh B. "Interaction Analysis for Piled Rafts in Cohesive Soils" The 12th International Conference of International Association for Computer Methods and

Advances in Geomechanics (IACMAG)1-6 October, 2008 Goa, India.
22. Rabiei M "Parametric Study for Piled Raft Foundations" EJGE Vol. 14, Bund. A