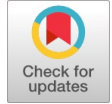


Behavior of Piles with Raft Foundation using Safe Software



Reshma T.V, Bhavya B S, Rashmi Mishra, Sankalpasri S S

Abstract: Piles with raft foundation are a hybrid type of foundation in which the loads coming from the super structure is partly shared by the raft foundation and partly by the piles. A G+20 Storey building is analysed and designed in ETABS software. The modelling and analysis of piles with raft foundation is done in SAFE Software by importing the building loads. The storey drift and story displacement of the structure has been studied for the superstructure loads using response spectrum analysis and time history analysis in both X and Y axes. Then behavior of piles with Raft foundation is studied in this work by considering different parameters. The Pile diameter, Spacing of piles, Number of piles, and raft thickness are varied and keeping height of the pile as constant, the behavior of pile with raft foundation is determined. Pile with Raft foundation is economical when compared to a single pile foundation or Raft foundation. In the present work of piled with raft foundation, the load is shared between pile and raft. Hence Soil settlement is gradually reduced when the piles are introduced below the raft. Finally the optimum dimensions of pile diameter and thickness of the raft are obtained for minimum settlement.

Keywords: Piles with Raft foundation, Response Spectrum, Time History, Settlement.

In the design of foundations, shallow foundation is the first option where the topsoil has sufficient bearing strength to carry the superstructure load without any significant total and differential settlements to prevent damage of infrastructure and superstructure. A Pile is a long cylindrical strong material made up of Concrete, Steel, And timber driven into the ground to support the excessive loads coming from the superstructure. Pile foundations are probably taking higher loads comparing to spread OR mat foundations. To carry the excessive loads that come from the superstructures like high-rise buildings, bridges, power plants or other civil structures and to prevent excessive settlements, piled foundations have been developed and widely used in recent decades. However, it is observed that the design of foundations considering only the pile or raft is not a feasible solution because of the load sharing mechanism of the pile-raft-soil. Therefore, the combination of two separate systems, namely "Piled Raft Foundations" has been developed (Clancy and Randolph (1993)).

I. INTRODUCTION

The Foundation is the function to transmit the burden load coming from the superstructure must be transferred to the subsoil by way of presenting safety, reliability, and serviceability to the structure. Now the existing thesis work is to offer deep foundation when the shallow foundation is insufficient to provide adequate safety. However the combination of the shallow foundation and deep foundation can be a cost effective design approach. The pile and raft foundation is such a combination of a deep pile and a shallow raft foundation. Raft foundation is a structure which supports the number of columns in rows and transmits the total load coming from the superstructure to the subsoil by means of a continuous slab. The raft foundation reduces the Differential settlement and often the raft foundation is required in soft soil as they can spread the loads over a large area.

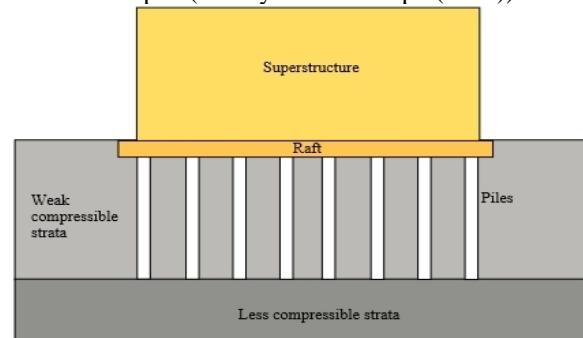


Fig.1 Piles with Raft Foundation

II. METHOD OF MODELING AND ANALYSIS

To examine the behavior of piled raft foundation Etabs 2013 and safe 2012 is used. First Investigation of the site location is done where the bearing capacity of soil is poor and taking the SBC of soil in that area and basic tests are carried out to study the properties of the soil. Using Etabs software the 25 storey building is analysed and designed by taking the super structure loads

Using the safe software the piled raft foundation is modelled and taking the results of piled raft foundation and finally Optimum combination of pile and raft dimensions is selected.

Here piles are assigned as pile spring value by calculating the spring value that is K and assigned in SAFE software.

A. Analysis and Design of G+20 storey building using Etabs 2013

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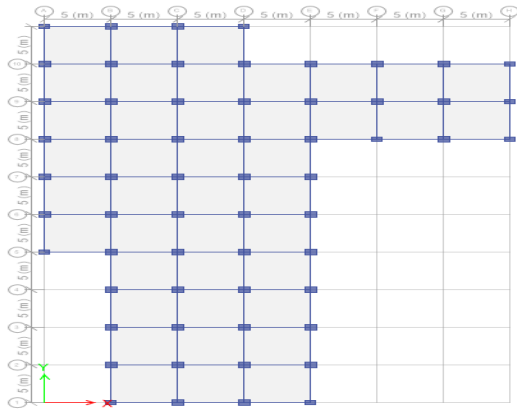


Fig. 1 Plan of building

Table. 1: List of Sections Properties of Columns, Beams & Slabs

No.	Column in mm	Beams in mm	Slabs in mm
1	600 × 750	300 × 450	200
2	750 × 900	450 × 600	200

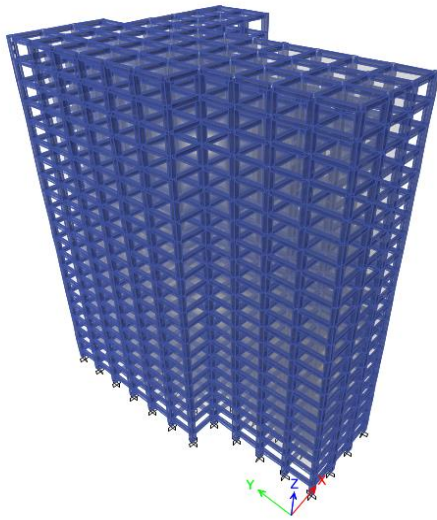


Fig.3. 3D Model of the building

Table 2: Loads on building assigned

Live Load As per IS – 875 Part 2	4 kN/m ²
Wall Thickness	200mm
Wall load	10.2 kN/m ²
Floor Finish	1.5 kN/m ²

B. Piled raft foundation in safe software

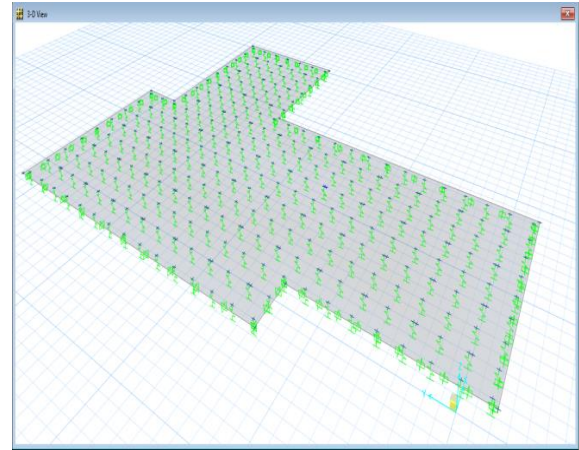


Fig 4. Assignments of piles as pile springs
C. Calculation of pile springs K

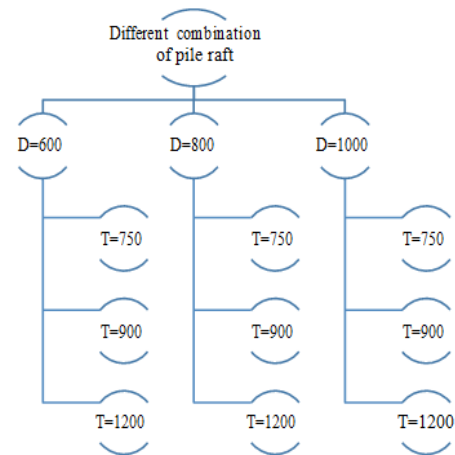
Stiffness of the column $K = \frac{EA}{L}$
 Where E=young's modulus of concrete
 A=Area of the pile
 L=Length of the pile
 Length of the pile taken=15m

III. PARAMETERS CONSIDERED TO STUDY THE BEHAVIOR OF PILED RAFT FOUNDATION

A. Geometrical properties of the Piled raft foundation model is given below:

1. Height = 62m
2. Building plan = 35 × 50 m
3. Length of piles = 15m

B. Different combination of piled raft foundation:



IV. RESULTS AND DISCUSSIONS

A. Response Spectrum Analysis

Storey Displacement

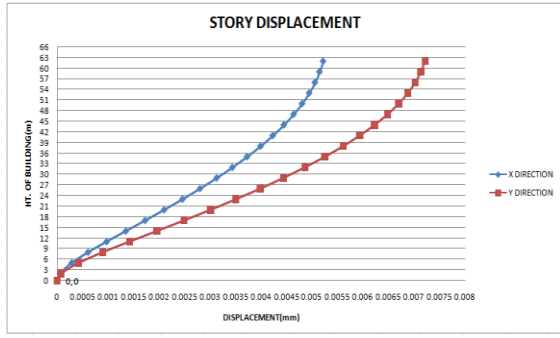


Fig. 5 Storey Displacement along X and Y Direction for Response Spectrum Method Storey Drift

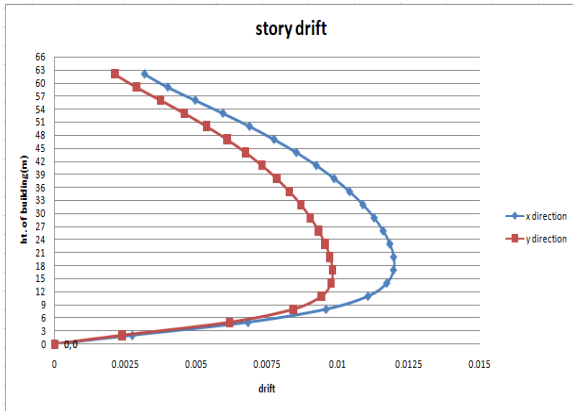


Fig.6 Storey drift along X & Y direction for response spectrum method

B. Time History Analysis

Storey Displacement

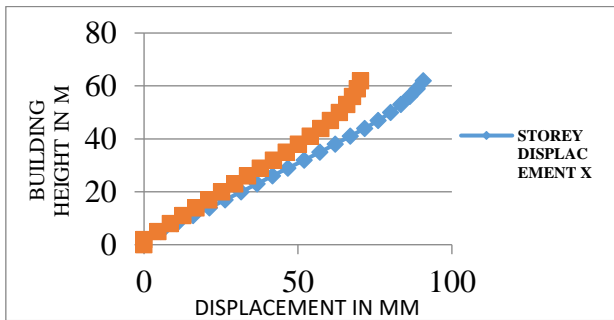


Fig.7 Storey drift along X & Y direction for response spectrum method

Storey Drift

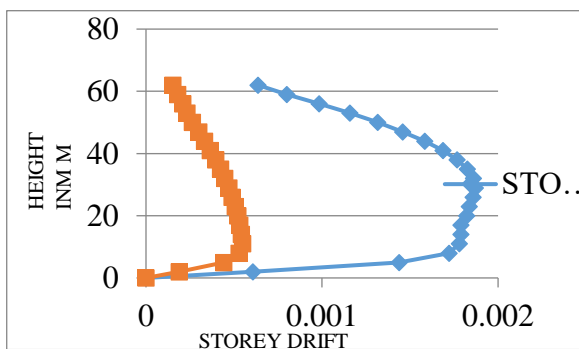


Fig.8 Storey drift along X & Y direction for response spectrum method

C. Raft Foundation Settlement

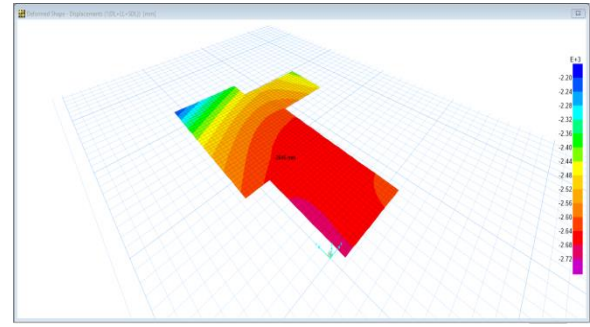


Fig.9 single Raft soil settlement

As per the analysis of the soil report the soil permissible settlement of the foundation is 5mm to 10mm. Actual settlement of raft is much more than the permissible limit. Hence it is necessary to provide piles below the raft to reduce the settlement.

To control the settlement of the raft, pile foundation is introducing below the raft at 15m depth and to know the behavior of piles and raft the parameters of the piles and raft are varied depending upon the parameter the optimum one is verified.

D. Pile Diameter 600mm

Pile diameter 600mm and raft thickness 750mm

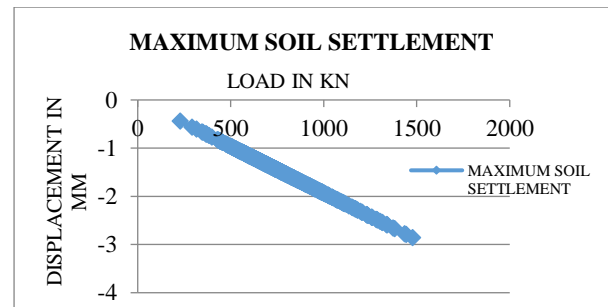


Fig.10 Piled with raft foundation settlement with pile dia 600mm & raft thickness 750mm

Pile diameter 600mm and Raft thickness 900mm

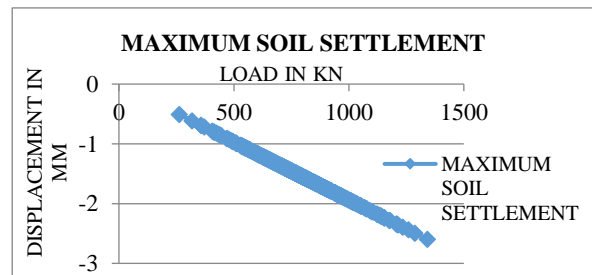


Fig.11 Piled with raft foundation settlement with pile dia 600mm & raft thickness 900mm

Pile diameter 600mm and Raft thickness 1200mm



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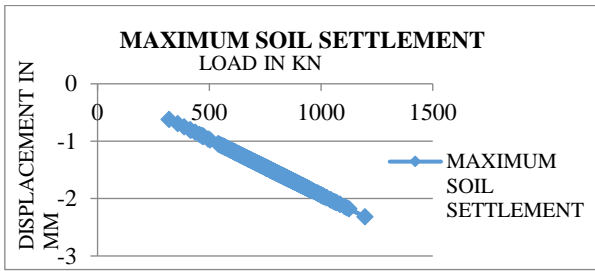


Fig.13 Piled with raft foundation settlement with pile dia 600mm & raft thickness 1200mm

E. Pile Diameter 800mm

Pile diameter 800mm and raft thickness 750mm

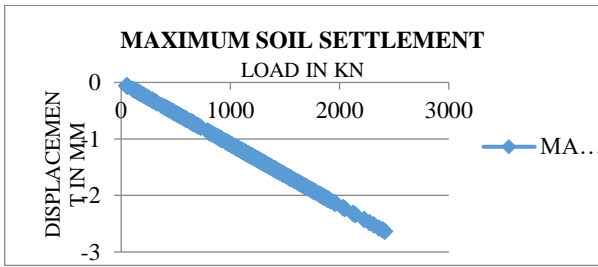


Fig.14 Piled with raft foundation settlement with pile dia 800mm & raft thickness 750mm

Pile diameter 800mm and Raft thickness 900mm

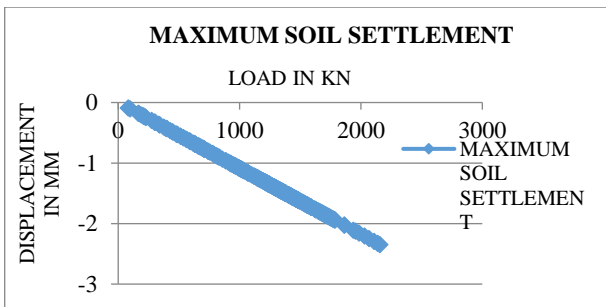


Fig.15 Piled with raft foundation settlement with pile dia 800mm & raft thickness 900mm

Pile diameter 600mm and Raft thickness 1200mm

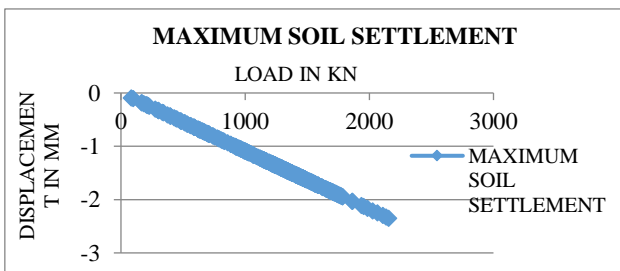


Fig.16 Piled with raft foundation settlement with pile dia 800mm & raft thickness 1200mm

F. Pile Diameter 1200mm

Pile diameter 1000mm and raft thickness 750mm

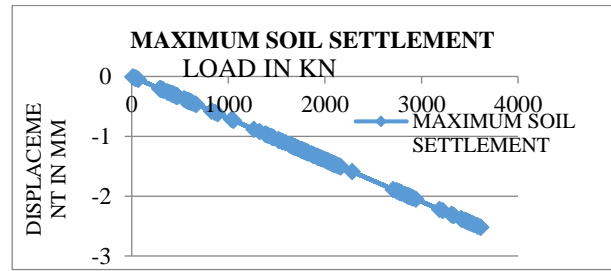


Fig.17 Piled with raft foundation settlement with pile dia 1000mm & raft thickness 750mm

Pile diameter 600mm and Raft thickness 900mm

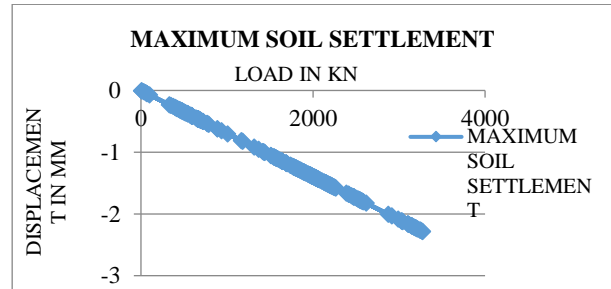


Fig.18 Piled with raft foundation settlement with pile dia 1000mm & raft thickness 900mm

Pile diameter 1000mm and Raft thickness 1200mm

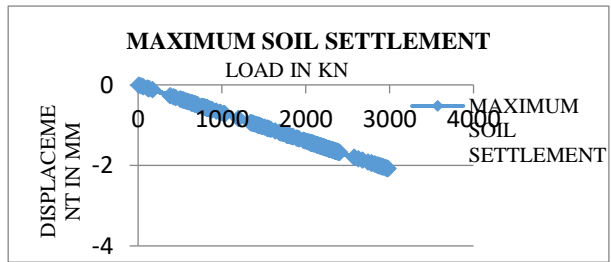


Fig.20 Piled with raft foundation settlement with pile dia 1000mm & raft thickness 1200mm

Table.4 Maximum and Minimum settlement of Pile with Raft foundation

SL. N O.	Pile diameter in mm	Raft Thickness in mm	Maximum settlement in mm	Minimum Settlement in mm
1	600	750	3	0.485
		900	2.5	0.5
		1200	2.4	0.61
2	800	750	2.7	0.2
		900	2.45	0.3
		1200	2.2	0.145
3	1000	750	2.6	0.1104
		1200	2.1	0.1

V. CONCLUSION

Pile with Raft foundation is economical when compared to a single pile foundation or Raft foundation. In the present work piled with raft foundation, the load sharing of pile and raft results in gradual reduction of soil settlement when the piles are introduced below the raft. From this study, the following conclusions can be made



- From the above study it was found that the maximum soil settlement was reached to 5.67mm using 600mm pile diameter and 750mm raft thickness.
- On increasing the diameter of piles, the number of piles also be varied and hence load carrying capacity of the piles increases and settlement of the soil will be decreased.
- Use of 1000mm pile diameter and 1200mm raft thickness lead to reduction of soil settlement to 3mm.
- Finally optimum size for the piled with raft foundation to be used in silty clayey soil is obtained as 1000mm pile diameter with 1200mm raft thickness.

monitoring. I have 2 International publication and presented 2 technical paper in International conference.



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