International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 05 | May 2019 www.irjet.net p-ISSN: 2395-0072

COMPARISON BETWEEN PILE AND COMBINED PILED RAFT FOUNDATION

Shweta Mishra[1], Renisha Mistry[2]

[1]Lecturer, Civil Engineering & Parul University, Gujarat, India
[2] Lecturer, Civil Engineering & Parul University, Gujarat, India

---

Abstract – The important question related to the design of high-rise buildings on the settlement-sensitive soil (clays) is the cost-optimised reduction of settlements to minimise possible damage and to reduce deformations of high-rise building. An old method for reducing settlement of foundation where the presence of loose soil and high depth of water table co-exists is to construct a pile foundation on a hard layer. In the case of a deep stiff seated layer, a pile foundation is connected to a large amount of long and large diameter piles which results in huge construction costs.

***Keywords*: Combined piled raft foundation, differential settlement, displacement, high rise building, shear parameters**

1. INTRODUCTION

To handle issues encountered in the designing of foundations for high-rise buildings for certain conditions, the development of new technical and economically optimized foundation designs needs to be advance. One method or solution is to combine deep piles with a raft foundation resulting in combined pile raft foundation (CPRF). A pile is a long foundation member, which might be cast-in-situ or driven and acts as a structural member to transfer the load of the super structure to a required depth in deep foundations carrying a load which may be vertical, lateral or lateral plus vertical. The Combined Piled Raft Foundation (CPRF) is a geotechnical composite construction in which combination of bearing effects of both foundation elements i.e. raft and piles by taking into account interactions between the foundation elements and the subsoil strata.

1.1 PROBLEM SPECIFICATIONS

I. We have considered 20 storey building having soil properties and foundation parameters as follows

II. DATA

III. Size of raft=15*15m2

IV. Diameter of pile = 1.2m

V. Thickness of raft= 5m

VI. Length of pile=42m

VII. Soft clay=15m

VIII. Stiff clay=15m

IX. Sandy clay=30m

X. Surrounding soil size= 25m*25m

XI. Sometimes unsatisfactory control of concrete placement leads to the formwork failure.

TABLE-1

Soil type	**Depth (m)**	**Unit weight (KN/m^3**	**Estimated S_u (KPa)**	**Estimated SPT (N)**
Soft clay	0-15	16.4	33	-
Stiff clay	15-30	20	50	-
Sandy clay	30-60	21	-	34

TABLE-2

Soil type	**Modulus of Elasticity (KN/m^2)**	**Poisson's ratio N_u**
Soft clay	E_s= 500*S_u = 16500	0.3(For Soil) 0.2 (For raft)
Stiff clay	E_s=5000*S_u= 250000	0.3
Sandy clay	E_s=6000*N = 204000	0.3

TABLE-3-Input parameters of pile-soil interface and raft-soil interface

Pile-soil interface (soil type)	Normal stiffness, K_n (KN/m^2)	Angle of internal friction, Φ_n	Cohesive strength, C_n (KN/m)
Soft clay	$6.258*10^7$	0	$2.376*10^5$
Stiff clay	$9.63*10^7$	0	$1.29*10^6$
Sandy clay	$2.76*10^8$	21	0
Raft-soft clay	$6.258*10^7$	0	$2.376*10^5$

Interface pile
Ultimate SF = 333 KN/m^2
K_t = 5670000 KN/m^3
K_n = 62580000 KN/m^3

Pile tip
Tip bearing capacity=2000 KN
Stiffness= 10^6 KN/m
Calculated load of high rise building = 76710 KN

1.2 METHODOLOGY

We decided to do analysis of the problem in Midas GTS NX.

I. The following steps in Midas GTS-NX are as follows
II. File name, planes and name of use.
III. Draw Rectangle for raft and soils.
IV. Extrude raft, top soil, medium soil and bottom soil.
V. Create pile and translate it.
VI. Give material property to raft, top soil, medium soil and bottom soil.
VII. Define type of element.
VIII. Mesh all objects.
IX. Auto connects it and checks mesh quality.
X. Create interface pile and pile tip at bottom end nodes.
XI. Give boundary condition of soft analysis.
XII. Constraint pile by (option) advance.
XIII. Constraint all object by (option) auto.
XIV. Change properties.
XV. Define construction stage.
XVI. Perform analysis

2. ANALYSIS OF CPRF AND MIDAS GTS NX

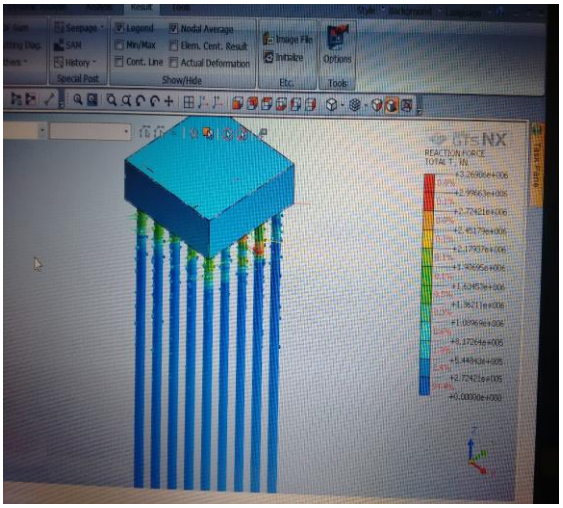

Fig -1: Total reaction in downward direction

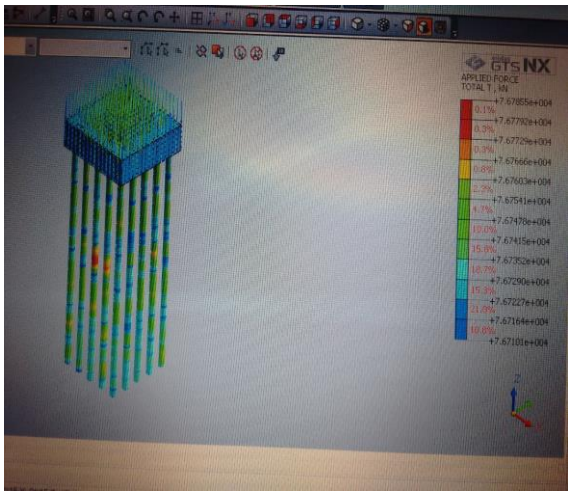

Fig 2: Total applied forces

3. CONCLUSION

The pictures on foundation design are showing usual foundation systems for high-rise buildings like raft and pile foundation. In addition to this foundation system of combined piled raft foundation is introduced. For this, settlement has been reduced by pile foundation. The calculation of the pile foundation is an idea, where only the piles are carrying the loads of the structure. Where piles are primarily used to reduce settlements and where an adequate factor of safety against failure (e.g. base failure) is provided, the combined piled raft foundation (CPRF) has been put forward. In this case the loads of the structure are transferred into the ground by Piles and raft both. This approach is able to solve the realistic soil-structure behavior.

Calculations can be carried out with numerical methods, like the Finite-Element -Method. This successful design and construction has been verified. by many structures including many high-rise buildings and bridges.

4. REFERANCES

I. Slovak journal of civil engineering which is written by R Kalzenbach .This paper gives an overview of the theoretical and practical development of CPRF.

II. ISSMGE Combined Pile-Raft Foundation Guideline which is written by Prof. Dr.-Ing. Rolf Katzenbach.it gives an overview of Derived formula for internal and external bearing capacity Interaction between pile-pile, pile-soil, raft-soil and raft-pile to see the bearing behaviour of soil and foundation.

III. Manual on estimating soil properties for foundation design which is done by Cornell University it gives an overview about Simple test for soil properties.