Investigation on R.C.C Super Structure Resting On A Combined Pile Raft Sub Structure

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Abstract- *In recent earthquakes have pointed out that the damages caused by seismic behavior of structure are highly affected not only by superstructure but also by the foundation and ground.Raft foundation is the most favorable decision for the greater part of the planners yet presently days due to obliges of the cost increase, decreasing accessibility of land a result of quick industrialization and urbanization there is development in vertical course bringing about numerous tall structures coming up. This has come about in substantial load, complicated pressure conditions, and confinement of bearing capacity of the soil. This outcome in the settlement of elevated structures. As an answer for the settlement issue of tall structures number of piles are utilized and a new sort of the foundation called piled raft foundation is coming up in a major manner.The Combined pile raft substructure gives a practical substructure choice to conditions where the raft substructure can fulfill the bearing limit requirement however neglects to keep differential just as most extreme settlement beneath the maximum allowable limit. Piled raft substructure is significant for tall structures that have to end up being an important option in contrast to conventional pile substructure or raft substructure. The idea of utilizing a piled raft substructure is that the combined substructure can support the applied axial loading with a proper factor of security and that the settlement of the piled raft substructure at the working load is tolerable. A combined pile raft substructure comprises a thick concrete slab reinforced with steel which covers the whole contact region of the structure, in which the raft is supported by a gathering of the pile or various individual piles. Bending moment on the raft, differential, and normal settlement, pile, and raft geometries are the affecting parameters of the piled raft substructure framework.In the proposed work analysis and design was carried out with a residential RC building of 16 storeys (G + 15), located in seismic zone II, modeled using software STAAD-PRO CONNECT Edition V22. And perform dynamic analysis using the response spectrum method. The analysis and design of the combined pile raft substructure were manually calculated.*

Keywords- Combined pile raft substructure , Plan of Building, Elevation of Building , Raft substructure, pile raft substructure, Soil-Structure Interaction.

I. INTRODUCTION

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The shortage of land for future development has made the man to manufacture tall structures. These structures will give heavy axial and horizontal loads to the soils underneath their substructures. The load move system from the superstructure to the base is generally done by giving appropriate substructures. The substructure is the principal component of the structure where construction begins, however when it fails; it can cause numerous defects in the structure including failure or collapse of the structure. The fix of imperfection in the substructures is generally troublesome and expensive, so it is generally imperative to structure the substructure to maintain a strategic distance from such failure of the building. There are various sorts of substructures to upgrade the load move system. Raft or pile substructure alone can be abstained from utilizing the blend of both which is commonly known as the combined pile raft substructure (CPRF) framework. In the piled raft, the raft directly interfaces with soil and it is upheld by gathering of piles of different designs. The ongoing projects demonstrated that the piled raft substructure will give the most affordable length of piles with the least differential settlement.

1.1 Types of substructures

There are two types of substructure

1. Shallow substructure
2. Deep substructure

1.1.1 Shallow substructure:-

It transfers loads to the very near the surface. The Shallow substructure has a depth to width ratio is less than 1 and the depth of substructure is less than five times the substructure. Depth of substructure bed of shallow substructure doesn’t exceed 5m.

Followings are the types of shallow substructure:-

1. Isolated footing
2. Combined footing
3. Cantilever or strap footing
4. Raft or mat footing
5. Wall footing

II. LITERATURE SURVEY

XII. Chaithra T P, Manogna H N (2015), has been carried out the investigation evaluates the seismic performance of the fifteen stories, reinforced concrete building with piled raft substructure using linear time history analysis and various factors are compared such as period time, displacements, base, shear, and settlements. The behavior of the piled raft substructure studied. It concludes that the soil-structure interaction in hard and dense soil are give the almost same effect with raft andpiled raft substructure. And in soft soil, the building vibrates longer with raft substructure than piled raft substructure. Displacement and settlement in soft soil reduced by providing a pile raft substructure than a raft substructure.

Nirmal John Joy, Hashifa Hassan (2014), studies the permuted arrangement of piles was adopted rather than uniform arrangements such that an improved performance of combined pile raft substructure system. Piled Rafts with various combinations of piles were modeled and analyzed. It is concluded that installing high capacity piles in regions with maximum load concentration and reinforcing the rest of the raft with medium capacity piles have the most important effect on significantly reducing maximum settlement and the differential settlement.

A. K. Singh, A. N. Singh (2011)The present study is focused on the experimental investigation on the performance of piled raft substructure on sand. Wooden rafts of different sizes with wooden piles (single or double) of three different diameters and lengths have been used for experimental study. In particular, the experimental results have shown that the number of piles below the rafts and its locations play a vital role in improving the load-carrying capacity of the piled rafts and the elastic settlement response of the soil. When the load is taken by piles only under the raft, the settlement is quite faster with little load on the piled raft. The load- carrying capacity increases considerably when the load is transferred to the soil through raft and pile combined while the settlement per unit load is quite less.

R. R. Chaudhari, Dr. K. N. Kadam (2013), studies the effect of pile length, pile distance, pile arrangement, and cap thickness are determined under vertical or horizontal static and dynamic loading. In the present paper the influence of pile length configurations on the behavior of multi- storied is evaluated under vertical loading. It concludes that the values of maximum moments are less for the V-shape and U-shape models than the other models for all the soil types. Hence, the V-shape and U- shape models are an optimum combination of pile length in terms of moments and also in terms of concrete quantity.It is also observed that the optimum configuration of the pile is soil dependent. The best configuration varies from soil-to-soil

Issues on Design of Piled Raft Substructure”[5] Padmanaban M S, Sreerambabu J (2017),In this paper, a detailed review has been carried out on the issues on the raft substructure design. Also, the existing design procedure was explained.Piled raft substructure can minimize the settlement even for relatively stiff and relatively dense sand. Spacing, diameter, depth, head, butt load, and capacity of the pile, geometry, and capacity of the raft influence the settlement. As for spacing between the piles decreases, settlement decreases. Further, relative settlement can be minimized when the diameter of the pile and depth of the pileis more.

"Parametric study on the behavior of combined pile Raft substructure founded on multi- layered soil Using plaxi s 3d"[6] Riya T Johnson, Renjitha Mary Varghese, Jerin Joseph (2016), The present study aims to find out the effect of pile raft in multi-layered soil. The current parametric study includes the effect of the diameter and spacing of piles with varying raft thickness on the settlement. It is observed that the raft substructure undergoes more settlement than a pile raft substructure. The effect of raft thickness has very little effect on reducing total and differential settlements. The effect of pile diameter and pile spacing was also given a useful insight into the behavior of multi-layered soil.

"Behavior of large piled raft substructure on different soil profiles for different loadings and different pile raft configurations"[7]

Shivanand Mali, Baleshwar Singh (2018), In the present study, the 3D numerical model is employed to understand the settlement, load- sharing, bending moment and shear force behavior of large piled rafts, founded on homogeneous soil profile and varying soil profile for different load configurations and different piled raft configurations and the effect of pile spacing and the number of piles are studied. Results of the study show that as the pile spacing increases, average settlement decreases significantly for varying soil profile as that of the homogeneous soil profile and it is noted to be lesser for uniform piled raft configurations. It is observed to be more for varying soil profile and equivalent point loads as compared to homogeneous soil profile and uniformly distributed load, respectively. Maximum bending moment and maximum shear force are noted to be lesser for varying soil profile and homogeneous soil profile, respectively.

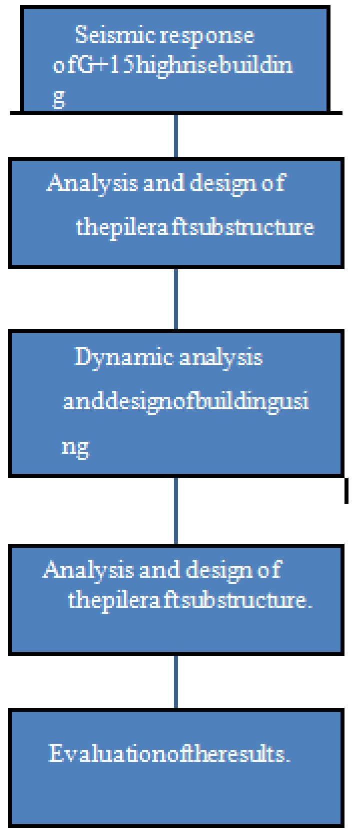
III. SCOPEANDOBJECTIVES

1. To investigate the seismic response of G+15 high rise building.
2. To develop a model of G+15 building and perform response spectrum analysis of building using STAAD Pro. to study the seismic response of buildings.
3. Analysis and design of the pile raft substructure.

Methodology

1. Modeling of G+15 high rise building in STAAD Pro.
2. Dynamic analysis and design of building using STAAD Pro.
3. Design of isolated footing.
4. Analysis and design of the pile raft substructure.
5. Evaluation of the results.

IV. METHODOLOGY



Conveniences mandatory for projected work:

Structural software STAAD pro or SAP2000

V. RESULTS

For design of suitable substructure building model is analyses using software STAAD Substructure for raft substructure and pile raft substructure following comparative results are obtained.

Variation of Maximum Displacement

45 The displacement of building is very high in building resting on raft substructure. The combined piled raft substructure reduces displacement as compare to raft substructure. The results and variations shown in table 1. The

displacement with raft substructure is 60mm which can be reduces to 1.11mm by pile raft substructure.

Table No.6.1: Variations in Displacements

	MaximumdisplacementatvariousNodes(mm)	
	BuildingwithRaftSubstructure	BuildingwithPiledRaftSubstructure
MaxDx	60.15	1.11
MaxDy	54.26	0.95
MaxDz	50.38	1.2
MinDx	48.92	0.023
MinDy	40.94	0.7
MinDz	34.96	0.5

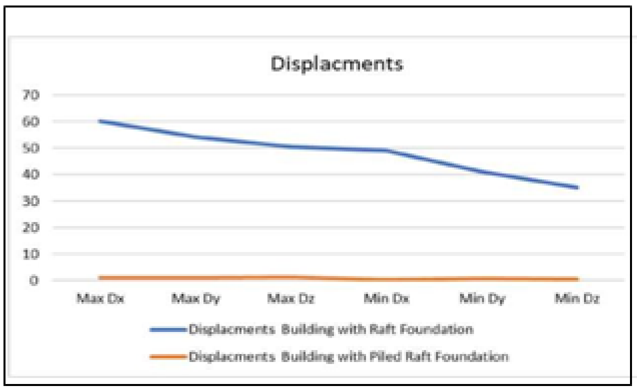


Fig no. 6.1: Maximum displacement at various Nodes(mm)

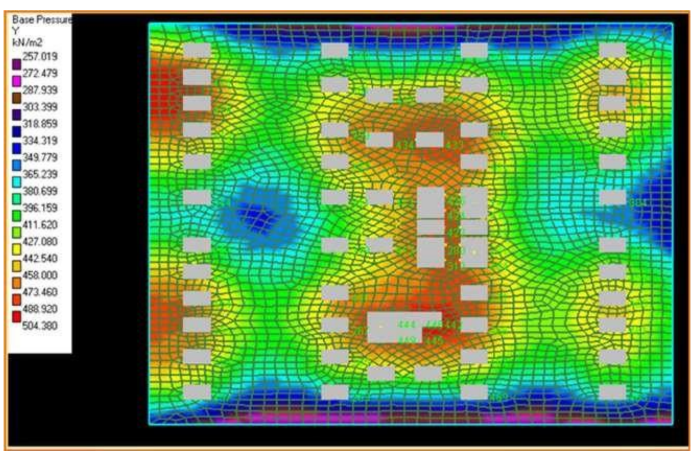


Figure 6.2: Base Pressure in raft substructure

Table 6.2: Variation of base pressure

	BasePressure(kN/m²)	
	RaftSubstructure	PiledRaftSubstructure
MaximumBase Pressure	487.21	62.097
MinimumBase Pressure	283.15	35.204

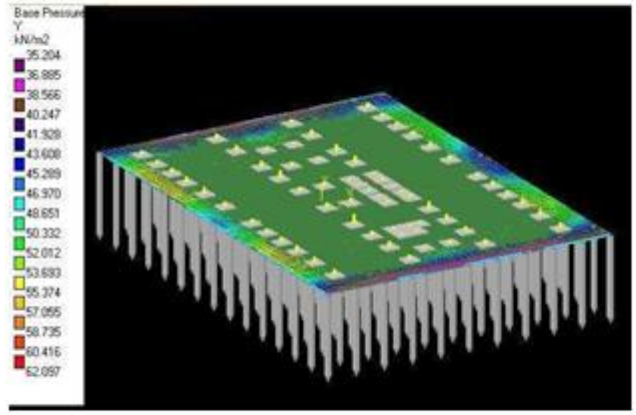


Figure 6.3: Base pressure in pile draft substructure

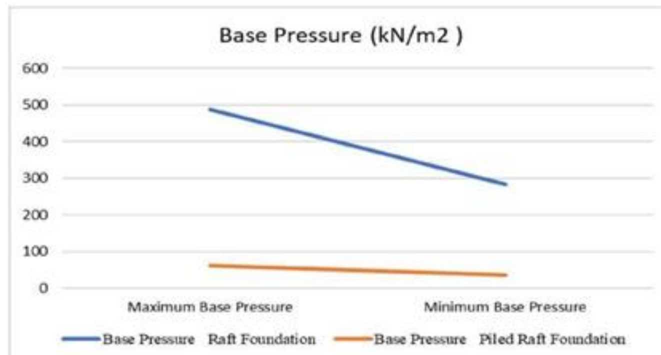


Fig no 6.4.Variation of BasePressure

Variation of Stresses

Stresses are more in building resting on raft substructure. Stresses are reducer in building rest on piled raft substructure. Following figures are shows the variation of stresses. This results are obtained from software.

VI. CONCLUSION

From the above study, it is concluded that

1. The isolated footing was an uneconomical substructure where loads are heavy, bearing capacity of the soil is low and columns are closer.
2. If a single raft was used than its chance of tilting of raft and chances of the settlement of raft. So a single raft was not provided at the site. Than the pile was provided to enhance the performance of raft piles are provide below the raft.
3. A combined pile raft was the best choice for a tall building with heavy loads.
4. In case the plot area was restricted and bearing capacity of the soil is low in that situation pile raft substructure was the best option.

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