

# REVIEW ON STUDY OF PILE & RAFT FOUNDATION FOR DIFFERENT SBC

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**Abstract:** In the recent years, there has been tremendous increase in high rise buildings due to scarcity of space available and requirement of amenities in major cities. Nowadays, construction are even done on refilled areas. But, however, it is a matter of great concern that what foundation will be proposed on such type of natural or man-made refills. Foundation can be classified as shallow and deep foundation, deep foundation are rapidly increasing as that of shallow foundation due to lack of space. The foundation of building is depend on the height, soil properties, testing of soil, loading condition and site investigation. This determines the selection of the foundation for the proposed structure. In the analysis and design of economic foundation for high rise building both geotechnical and structural design aspect are taken into account. Quantitative study has been carried out for different values of Soil Bearing Capacity (SBC). The behavior of structure also depends on soil strata. Sometimes the strata surface is very loose but below it may consist of rock or solid soil. High rise buildings require stronger foundation while short buildings spreads the load over the area of the structure.

This work includes the design and analysis of Pile & Raft foundation on different SBC that has been discussed in detail on the basis of geotechnical analysis. The design of pile foundation as well as raft foundation is carried out and then the results is compare in manual calculation and software. Programming is prepare in MS-EXCEL. The main aim of the program is to check the manual designing and then comparing the result by putting different values.

**Keywords -** High rise buildings, refilled areas, geotechnical and structural design, pile & raft foundation.

## I. INTRODUCTION

Building foundation is structural component between building and supporting ground which performs an important function of transmitting the building loads to supporting soil strata. The selection of suitable foundation systems for high rise building includes several factors like building loads, ground profile and water table conditions, allowable bearing pressure of soils.

### 1.1 Pile foundation

A steel or reinforced concrete post is used as a structural element for transferring loads at required depth is called pile. When loads to be transferred from structure are very high and soil bearing capacity too low, pile foundation are adopted to take heavy loads to a depth(1). It is a long and slender structural element which transfer load to some firm stratum at a considerable depth below ground surface. Thick slabs are used to tie a group of piles together to support and transmit column loads to piles. The choice of appropriate pile type in any given circumstance is influenced by subsurface soil conditions, location and topography of site. Subsurface soil and water conditions usually represent the most significant factors while design a pile. Pile foundation has many advantages, such as high capacity, small uneven settlement, broad applicable condition,.....etc.(2)



Figure 1 showing pile foundation

### 1.2 Raft foundation

A raft foundation is continuous in two direction and covers an area equal to or greater than base area of structure. It is suitable when underlying soil have a low bearing capacity are anticipated. It is suitable for ground containing pockets of loose and soft soils.(3) It is used on ground such as very soft clays, alluvial deposits and compressible fill materials. It spreads weight of building over whole ground floor area of that building. It laid on hardcore, or scalping bed and usually thickened at the edges, especially in very poor ground. The foundation may stiffened by ribs or beams built in during construction which will add extra strength and rigidity. For building with ground basement storey in high water table condition, raft foundations are provided.



Figure 2 showing raft foundation

### 1.3 Soil bearing capacity (SBC)

The conventional method of foundation design is based on the concept of bearing capacity. Soil when stressed due to loading tends to deform. The resistance to deformation of the soil depends upon factors like water content, angle of internal friction and the manner in which load is applied on the soil. The maximum pressure and load that a soil bears without shear failure and displacement is known as safe bearing capacity. Depending on whether the soil is hard or soft, a specific type of foundation is adopted. Ground condition gives different failure modes that are needed to be adopted in the design process of foundation. (4) The bearing capacity of foundation is needed for dimensioning the foundation of any structure. If the bearing capacity of soil at shallow depth is sufficient then shallow foundation is provided. Deep foundation are provided when soil immediately below the structure does not have the adequate bearing capacity.

## II. LITERATURE REVIEW

A broad review of literature is necessary to appreciate the benefits and challenges comes under construction of raft foundation and pile foundation are discussed. There are several studies done on the raft and pile foundation but there is little reported work on the same. This literature review reveals the amount of research work done in India

*Suman M. Sharma[1]* provides analysis and design of foundation for high rise building considering geotechnical and structural design aspect. Raft foundation are preferred for soils that have low load bearing capacities. It reduces the bearing pressure to a minimum. Beam and slab raft foundation is used to support the heavier loads of columns a solid slab raft would require considerable thickness. To make the economical use of reinforced concrete in a raft foundation supporting heavier loads it is practice to form a beam and slab raft. Different approaches are available for analysis of the raft foundation like rigid approach and flexible approach. In flexible approach finite element method is used to analyze the structure.

*Nabanita Sharma[2]* gives an attempt to design a raft foundation based on its geotechnical analysis. A detailed survey of research works had been done to study the geotechnical parameters affecting the behavior of raft foundation. The site investigation for parking lot is done which is situated in Guwahati, Assam. Geotechnical properties are examined by performing different tests. Calculation of loads and bearing capacity of soil are done. Then calculation of supporting beams, shear reinforcement and design of slab had carried out. A study and observation of the soil for shear failure are made. Safety requirements are considered while constructing the design of the foundation for different types of soil.

*V. Suneetha[3]* provides a design of foundation in black cotton clay. The foundation of any structure must satisfy 2 independent design criteria. First, it must have an acceptable factor of safety against bearing failure in soils. Second, settlements during life of the structure must not be of a magnitude. An effective foundation system is develop in which it is found that under-reamed piles provide an ideal solution. It is also used for providing safe and economical foundation in expansive soils. In these type of foundation the structure is anchored to the ground at a depth where ground movement due to changes in moisture content are negligible.

*B.K. Maheshwari[4]* provides model for pore pressure response on undrained tests has been study for liquefaction phenomenon. The excess pore pressure generated during liquefaction gives effective stresses in soil and changes its behavior. During strong ground motion, piles are prone to severe cracking or even fracture. The moving soil can exert damaging pressures against the piles which may lead to failure. The pile foundation are subjected to axial vibration in many situations such as loading and during earthquake. It is observed that the response of a single pile due to axial vibration in liquefiable soil is greater than that of non-liquefiable soil, specially at higher frequencies.

## III. OBJECTIVE

- To study structural design of raft and pile foundation.
- To analyse the foundation by using software as well manually.
- To determine which foundation is more suitable for different strata of structure.
- To determine effect of settlement, bending moment and shear force on foundation.
- To determine the soil pressure in a foundation for high rise building.
- To analyse and design of economic foundation for high rise building.

## IV. METHODOLOGY

Raft and Pile foundation will be manually design by using the limit state method based on IS:456-2000, IS:2911-1-1:2010 and IS:2950(1)-1981. Module of G+7 to G+20 will be taken for analysis and design purpose. Based on the steps and formulae involve in design program will be prepare in MS Excel. The veracity of the program will be check by first designing the manually design of both the foundation using the program and compare the results. While StaadPro were also use in the analysis and designing purpose. Design of pile and raft foundation will be consider from 50KN/mm<sup>3</sup> and above SBC.

## V. CONCLUSION

The above paper gives the following conclusions:

- Size of the pile and length of the pile is inversely proportional.
- In raft foundation, deflection increases with increase in thickness.

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