National Journal of Multidisciplinary Research and Development
ISSN: 2455-9040; Impact Factor: RJIF 5.22
Received: 20-12-2018; Accepted: 23-01-2019
www.nationaljournals.com
Volume 4; Issue 1; January 2019; Page No. 75-78

Study of raft foundation: An overview of piled raft foundation

SN Khaliya[1], Jatin Malhotra[2]
[1] Associate Professor, Department of Civil Engineering, Manda Institute of Technology, Raisar, Bikaner, Rajasthan, India
[2] Student, Department of Civil Engineering, Manda Institute of Technology, Raisar, Bikaner, Rajasthan, India

Abstract
Raft foundation is otherwise called mat foundation. Mat foundation is utilized, when load bearing limit of soil (SBC) is exceptionally low and segments are firmly dispersed with one another. It is additionally utilized instead of pile foundation, where it diminishes the expense and spare the season of development. Raft foundations are basically vast arrangement region establishments assembled either solidly or in cell structure. They might be utilized for delicately stacked structures on delicate regular ground or on other ground where powerless zones exist. For this situation the raft is intended to range crosswise over such zones with decent bearing pressures and satisfactory settlements.

Keywords: raft foundation, mat, soil, ground

1. Introduction
The Raft foundation is a normally utilized type of foundation. Raft foundation is otherwise called Mat foundation.

Fig 1: Raft foundation

Raft foundation is really a thick solid slab laying on an expansive region of soil fortified with steel, supporting columns or walls and exchange loads from the structure to the soil. Normally, mat foundation is spread over the whole zone of the structure it is supporting.
Raft foundation is commonly used to help structures like private or business structures where soil condition is poor, storage tanks, storehouses, establishments for substantial mechanical gear and so on [1].

They are suitable where
- Floor areas are small and structural loadings are low, for example, in a couple of storey household development.
- A basement is required.
- Ground conditions are poor and strip or pad foundations would require huge unearthing, for instance on delicate clay, alluvial stores, compressible fill, etc.
- Settlement or differential settlement is likely.
- Where it might be unrealistic to make singular strip or pad foundations for an extensive number of individual loads. As rule terms, if strip or pad foundations would cover half or a greater amount of the floor zone, at that point a raft might be increasingly suitable [2].

Here are some materials used for the erection of Raft foundation
1. Formwork
2. Spacer
3. Reinforcement
4. Concrete.

Rafts are frequently utilized nowadays when the strata is unstable or (along these lines) an ordinary strip foundation would cover over half of the ground territory underneath the building. There are likewise circumstances (normally in regions where mining has happened) where there might be territories of development in the strata.
They are significantly more normally utilized in the development of business working in the UK that they are for local homes, however can be utilized exceptionally effective in the two circumstances. To comprehend when it is smarter to utilize Raft foundations [5].

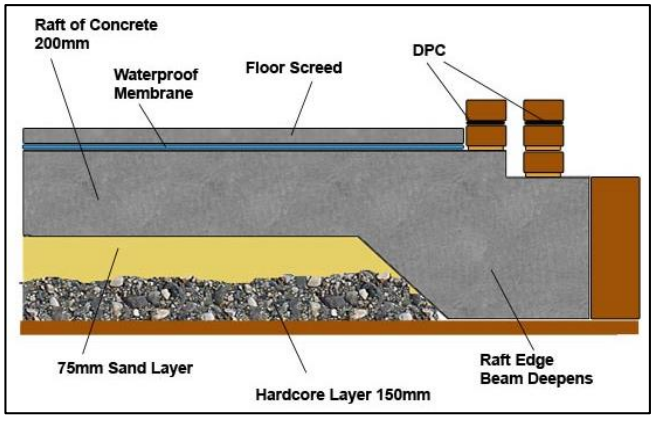

Fig 2: How to make raft foundations are made.

2. Types of raft foundation [3]
Here are the different types of raft foundation are given below:

i) Flat Slab Type Raft Foundation
At the point when column arranged at equivalent separation and column loads are similarly conveyed on the foundation,

in such cases raft might be planned as having the uniform piece thickness. This sort of foundation is known as flat slab type Raft foundation. The foundation slabs are reinforced, with two steel meshes. One set at the lower faces and another at the upper face.

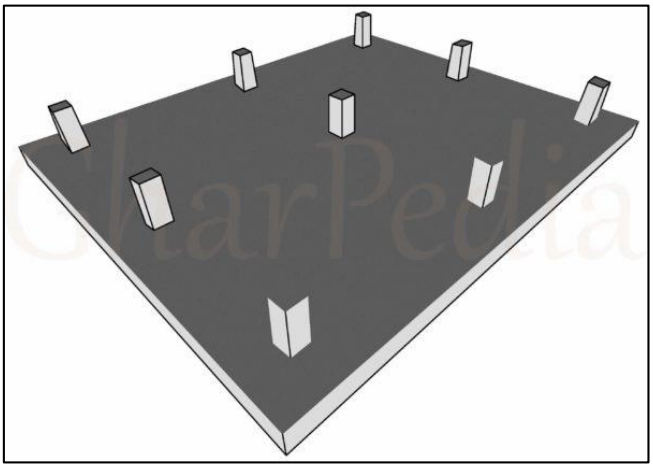

Fig 3: Flat Slab Type Raft Foundation

ii) Slab-Beam Type Raft Foundation

At the point when column loads are unequally dispersed or where the foundation is an exceptionally substantial structure where stiffness is vital prerequisite to avoid intemperate mutilation of the structure because of variety in the load appropriation on the pontoon, in such case slab and beam type Raft foundation is given. In this kind of Raft foundation beams are furnished with the flat slabs. The beams add solidness to the Raft foundation. The foundation slabs are strengthened with two more steel networks. One put on the lower face and another at the upper essences of the Raft foundation. The beams are strengthened with solid stirrups and bars set at the upper and lower faces.

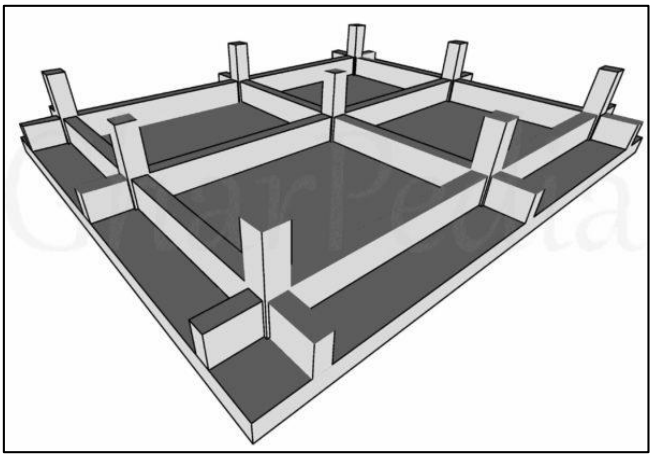

Fig 4: Slab-Beam Type Raft Foundation

iii) Cellular Type Raft Foundation

At the point when the foundation is built for heavy loads and on free soil or where soil tends for uneven settlement. In such case, the thickness of the raft slab may surpass 1 meter. In such case, cellular Raft foundation is more ideal than normal Raft foundation.

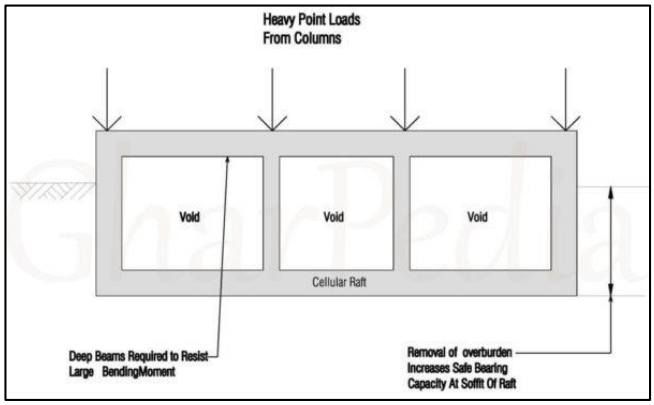

Fig 5: Cellular Type Raft Foundation

iv) Wide toe raft

This sort of solid slab is utilized where the poor compressibility of the ground would require an uneconomically thick slab. To take the load at the outside leaf of cavity walls a fortified solid toe stretches out as a base. This is thrown from a hardening edge beam, and is normally taken to a base profundity of 750 mm. The state of the all-inclusive toe permits the outside block external leaf of the whole divider to be done subterranean.

v) Slip plane raft

This sort of Raft foundation includes a slip plane layer (normally made of sand) situated between the raft and the sub-strata. The slip plane layer stretches out past the raft, and the space between the surface and the slip plane is loaded up with a compressible material.

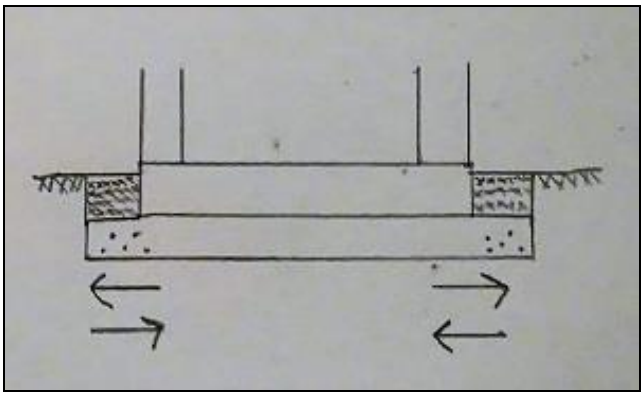

Fig 6: slip plane raft

The slip plane should be of sufficient thickness to resist tensile or compressive ground strains, as well as accommodating potential frost heave.

vi) Blanket raft

This kind of raft is utilized to accomplish a composite activity that can disperse edge loads or imbalanced loads. It includes a stone blanket layer being developed from the diminished sub-strata level. This can be developed in restricted weaknesses or depressions. The concrete raft is poured over the blanket, The connection of the raft and blanket helps range the stacking over the especially powerless territories.

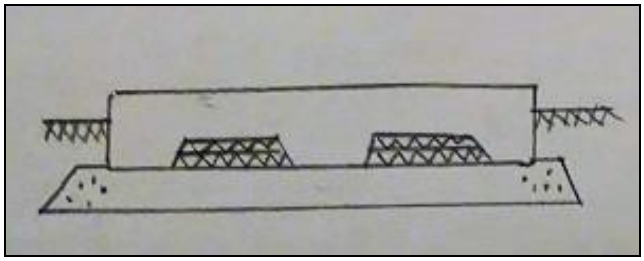

Fig 7: blanket raft

3. Process for constructing a raft foundation

- **Step 1:** Normally utilized sort of raft is the solid slab raft without downstand beam. To start developing the solid slab raft foundation, the vegetative top soil (unique soil) is evacuated then the dirt deserted is compressed. Now and then, hardcore (broken shakes or stones) possibly be added to raise the ground floor level.
- **Step 2:** To give a dimension bed that will get the reinforcement and cement, a layer of blinding (powerless cement) is added to the outside of the hardcore or specifically to the compacted soil.
- **Step 3:** After the blinding has been permitted to cure for some days, at that point the brief formwork (wood) is then raised over it all around that will fill in as the help to for the reinforced steel bars and concrete work. Shape oil can be utilized on the surfaces and sides of the formwork. This makes the completed solid work to have a spotless look or surface by keeping the solid from sticking to the wood utilized.
- **Step 4:** The reinforced steel bars will at that point be set into the formwork following the bending schedule the auxiliary architect has given. After this is done the solid which is blended to a given proportion is then poured in and spread all over to cover the reinforcement.
- **Step 5:** At the point when the concrete has been permitted to remedy for some days. A layer of damp verification membrane is spread around the whole zone of the establishment and after that over it strengthened work wire is laid, which will get the solid for the fundamental floor slab (German floor). Before the solid is poured all important pipes funneling is finished. After the solid has been relieved the fundamental walling for the building can start [6].

4. Analysis of piled and piled raft foundations

Over the most recent couple of years the quantity of piled Raft foundations particularly those with few heaps, has expanded. Not at all like the ordinary heaped establishment structure in which the load are intended to convey most of the load, the plan of a piled Raft foundation enables the load to be shared between the raft and load and piles it is important to consider the complex soil-structure collaboration impacts [7].

The idea of piled Raft foundation was right off the bat proposed by Davis and Poulos in 1972 and is presently utilized broadly in Europe, especially to help the load of high structures or towers. The ideal use of piled raft happens when the raft has sufficient stacking limits, however the settlement or differential settlement surpass suitable qualities. For this situation, the basic role of the pile is to go about as settlement reducer.

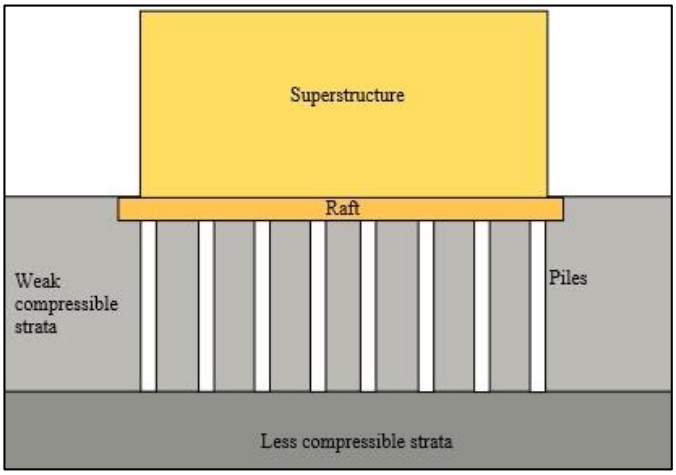

Fig 8: Piled raft foundation

With the coming of high rises or tall structures there was have to consider and enhance deep foundation framework to lessen cost of foundation and make it increasingly solid Development of Deep foundation framework began from bearing piles, skin friction piles, blend of both and in the long run pile Raft foundation. As of now pile Raft foundation framework is generally utilized. There are for the most part three structure methods of insight in pile Raft foundation proposed by Randolph [8] are as per the following.

1. Conventional methodology in which pile are structured as gathering to convey the significant load, while offering some leniency for the commitment of the raft essentially to extreme load limit
2. Creep pilling in which piles are intended to work at working load at which huge creep begin to happen (around three-fourth of a definitive load limit). Adequate load are incorporated to diminish the net contact pressure among raft and soil.
3. Differential settlement control, in which piles are found deliberately to diminish the differential settlement instead of to decrease by and large settlement significantly.

5. Connected pile raft foundation

Zhuang and Lee [9] utilized finite element technique to ponder the load sharing among pile and raft. They saw that load sharing between piles in pile raft framework was influenced by pile stiffness, raft unbending nature and pile length to distance across proportion. They likewise seen that as the pile length builds the pile unbending nature diminishes and the pile rigidity turns out to be increasingly uniform. Ta and Small [10], built up a strategy which depended on finite layer technique, for the examination of pile Raft foundation in layered soil. They found that piles sharing between piles in the pile raft framework was affected by thickness and firmness of soil layer. Load shared by piles increments as the bearing strata ends up stiffer. Russo [11] built up a numerical strategy for piled raft framework, which thinks about non-linearity of the uni-lateral contact at the raft– soil interface and the nonlinear load– settlement relationship. They expressed that non-linear examination ought to be considered for the piled raft framework since piles go about as settlement reducers and their definitive load limit might be come to. Reul and Randolph [12] saw that pile raft collaboration

prompts an expansion in the pile friction with an increment of the load or increment of the settlement.

6. Advantages in combined pile and raft foundation

The foundations system of the combined pile raft foundation (CPRF) can prompt the accompanying focal points in contrast with a raft or pile foundation:

1. Decrease of settlements and differential settlements of structures
2. Decrease of tilt regarding flighty eccentric or inhomogeneous soil conditions
3. In instance of hybrid foundation it is conceivable to keep away from joints in the raft
4. Decrease of number of piles and pile length in contrast with a pile foundation
5. Decrease of forces, stresses inside the raft in the event of an ideal position of the piles

7. Design and Construction

The structure of the piled Raft foundation typically is unpredictable and is performed by draftsmen or architects after soil testing. Arrangement of the piles isn't constantly uniform or normal. A few plans call for explicit position of the piles to exploit stable subsoils or bedrock. Computing the load bearing limit of the piled Raft foundation requires information of the position and quality of the piles, the solidness and thickness of the raft and soil properties.

8. Conclusion

Raft foundations (here and there known as Mat Foundations) are an expansive solid section which can bolster various columns and walls.

The slab is spread out under the whole building or possibly an extensive piece of it which brings down the contact pressure contrasted with the customarily utilized strip or trench footings.

The Raft foundation was less expensive, simpler to introduce and in particular, did not require as much uncovering as the typical strip establishments [5].

Manufacturers use piled Raft foundations when the solidness of the material that stays the piles is faulty or when stable material does not stretch out under the whole building. The piled Raft foundation offers the floating foundation mostly anchored for help [13].

9. References

1. https://civiltoday.com/geotechnical-engineering/foundation-engineering/167-raft-mat-foundation-use-types-construction.
2. https://www.designingbuildings.co.uk/wiki/Raft_foundation.
3. https://gharpedia.com/different-types-of-raft-foundation/.
4. Raft Foundation,British Electricity International, in Station Planning and Design (Third Edition), 1991.
5. https://www.diydoctor.org.uk/projects/rafts.htm.
6. https://www.quora.com/What-is-the-process-for-constructing-a-raft-foundation.
7. Jean-Sébastien LEBEAU, "FE-Analysis of piled and piled raft foundations", April - August 2008.
8. Randolph MF. Design methods for pile groups and piled rafts:stateof-the-art report. Proc. 13th Int. Conf. Soil Mech. Found. Engng, New Delhi. 1994; 5:61-82.
9. Zhuang GM, Lee IK. An elastic analysis of load distribution of pile raft systems. Finite element Anal Des 1994; 18:259-72.
10. Ta LD, Small JC. Analysis raft systems in layered soils. Int JNAM Geomech. 1996; 2:57-72.
11. Russo. Numerical analysis of pile rafts. Int J Numer Anal Meth Geomech. 1998; 22(6):477-93.
12. Reu O, Randoph M. Design strategies for pile rafts subjected to non-uniform vertical loading. J Geotech Geoenviron Eng. 2004; 130(1):1-13.
13. Keith Allen. What Is a Piled Raft Foundation?, www.ehow.com.