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ANALYSIS AND STUDY OF PILED RAFT FOUNDATION

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Abstract:* All engineered construction resting on the earth must be carried by some kind of interfacing element called a foundation. The term of foundation describes a structural element that connects a structure to the ground. When a strong stratum is too deep to be reached cheaply by shallow foundation, a pile foundation is utilised. This is the case when the surface soil is inadequate for shallow foundation. It's significantly more costly to build a deep foundation on piles than it is to use a shallow one. If a shallow foundation is not adequate, it is common in foundation engineering to design a fully piled foundation in which the entire loads are transferred to the subsoil by piles Recently, by the improvement of accuracy in geotechnical engineering the beneficial utilization of construction materials should be considered in foundation design. In traditional methods of piled foundation design, because of the occurrence of large settlements under the pile cap resulted in the separation of the raft and soil, therefore in the calculations of bearing capacity of foundations only the piles were considered and no emphasis was made on the raft as a load sharing element.

***Keywords: Pile Raft. Settlement, Deflection, Stiffnes*s**

1. INTRODUCTION

Rather of being used as load-bearing parts, the piled raft's foundation is based on the idea that the piles function more as settlement-reducing features. Because the piles are spaced further apart, fewer heaps are required in these situations. The piles are projected to settle to the point where friction will produce their maximum capacity.

Figure 1.1 depicts a schematic representation of the new design paradigm. An elastic solution to the problem of the contact pressure is shown in Figure 1.1.1a. Although the contact pressure is consistent, the non-uniform settling of the flexible raft seen in Figure 1.1 b is possible (i.e. differential settlement). As long as the contact pressure can be transformed to a uniform contact pressure and the total settlement is kept within the legal limit by using a modest number of piles spaced out over the raft or over a specified portion of the raft, the foundation design becomes economically viable.

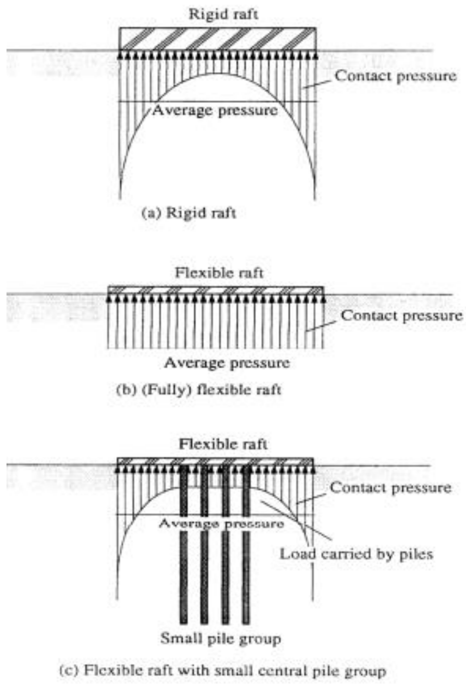

Figure 1.1 the basic idea of a stacked raft (Poulos, 2001)

Clay and sand both have a settling issue, and it's important to point this up. When it comes to sand, the amount of settling allowed is lower than when it comes to clay. Controlling settling in sand, especially in the case of storage tanks and thin, but strongly laden structures, is thus of fundamental significance. Even in the case of massive settlement, the idea of using pile pieces as settlement reducers is appropriate. Pile installation, especially driven piles that compress sandy strata, is a significant factor to keep in mind when assessing pile-raft interactions in sandy strata.

2. LITERATURE REVIEW

Historically, the pile raft analysis has its origin to the pile group analysis. The early work of Skempton (1953) and Meyerhof (1959) were empirical in nature and relates to the settlements of pile groups. The important work of Fraser and Wardle (1975), Poulos and Davis (1980), Randolph (2003), and Poulos (2006) are reviewed in relation to the pile group analysis, load transfer mechanism and other pertinent aspects related to the fundamentals of pile group analysis. The contributions from Tomlinson (1986), Coduto (1996), Poulos (1993) and Van Impe (1991) are also studied in relation to the equivalent raft methods of analysis. The contributions from Poulos (1993), and Clancy and Randolph (1993) are reviewed in relation to the equivalent pier methods of analysis in piled raft foundations. The rapid developments In the numerical analysis of pile behavior and piled raft foundations saw numerous. The more rigorous methods of piled raft analysis began with the contributions of Kuwabara (1989), and extended by Poulos (1993) with further contributions from Ta and Small (1996), Zhang and Small (2000), and Mendoca and Paiva (2003). Notably, Prakoso and Kulhawy (2001) used the PLAXIS software in the 2D analysis of piled raft foundations.

3. PARAMETERS TO BE CONSIDERED TO STUDY THE BEHAVIOR OF PILED RAFT FOUNDATION

Various researchers have examined some characteristics of behaviors of piled rafts and the effect of following factors on the Behavior:- Number of piles Pile spacing Diameter of piles Pile length Raft thickness

4. ANALYTICAL AND NUMERICAL MODELING

Only a strong numerical model that accurately depicts the actual field conditions may be used to construct complex three-dimensional foundation systems that include complex interactions among their constituent pieces. In order to comprehend the mechanism of the stacked raft and to construct a dependable raft foundation, one must conduct thorough study of the complicated soil structure interaction issue. For the last several years, geotechnical engineers have been required to establish a suitable approach for the optimum design of a stacked raft because of the growing usage of this foundation to support high-rise structures. The International Society's Technical Committee (TC 18) has been studying stacked raft foundations since 1994 and has amassed a substantial amount of data, including case studies, on the various techniques of analysis and design.

5. RESEARCH METHODOLOGY

At nodal sites and interesting springs of each soil and piling are represented by an elastic plate, respectively, in the suggested technique (Fig. 3.1). The foundation system is analyzed using the finite difference approach. Assuming that a certain load situation causes the raft to deflect at each node, the stiffness of the pile and the soil must be taken into account. Hazarika and Ramasamy's approach for estimating pile stiffness (2000). For sands, the approach of De-beer and Martens (1957) is used to estimate soil stiffness. Instant settling and the e-log p curve are used to estimate the same for clays.

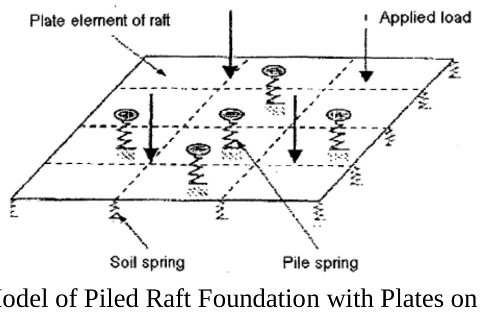

Fig 3.1 Model of Piled Raft Foundation with Plates on Springs

As a result, we've included the most important phases in our investigation below. The finite difference method is used to analyses the raft. Stiffness estimation for a stacked raft foundation system's separate components.

6. ANALYSIS OF RAFT BY FINITE DIFFERENCE TECHNIQUE

The input data required by the finite difference method (FDM) is the smallest of any discrete approach. As a result of the lengthy calculations required to construct the stiffness array, it has some flexibility and can accommodate rectangular borders with some success.

It is assumed that a bed of evenly distributed coil springs with a spring constant of km may replace the sub grade in the FDM model. The simplest assumption for analyzing a vertically laden raft sitting on an elastic foundation is that the sub grade's response intensity q is proportional to the raft's deflection w1. If w1 is positive, the upward response of the soil has an intensity of k w'.

7. RESULT AND DISCUSSION

A stacked raft foundation has been examined and designed in this work. For the purpose of verification, a few numerical foundational problems have been solved, and the results are shown in Figure 1.

1. Soil and piling stiffness have a significant impact on the design;
2. In compared to raft foundations, the piled foundation has a greater impact

Designing the raft as though it were a flat slab using the Limit state approach and IS code requirements has resulted in an effective raft. IS 2911:1979 specifies the pile as a bored pile. various likely values of k are selected and the issue presented in Table 6.3 is solved.

8. EFFECTOFCOEFFICIENTOFSUBGRDER EACTIONONDEFLECTION

Deflections of nodes with various k values are shown in Table 6.11. For k =10 kN/m3, the deflection of nodes 1 and 438 is 102.61 mm and 36.372 mm. The deflection at node 1 and 438 drops by 56.4% and 74.29 percent, respectively, when k is multiplied by four.

For various values of k, the deflection of nodes along sections A-A and B-B may be seen in figures 6.8.a and 6.8.b. According to the figures 6.8.a and 6.8.b, the deflection of typical nodes 301 and 13 is 66.369 mm and 91.27 mm, respectively, in these figures. A 71.4 percent reduction in deflection is obtained when the value of k is multiplied by four, whereas a 58.5 percent drop is obtained when the value of k is multiplied by four.

Maximum deflection ranges from55 percent to 75 percent as a consequence of the three- to fourfold fluctuation in k value.

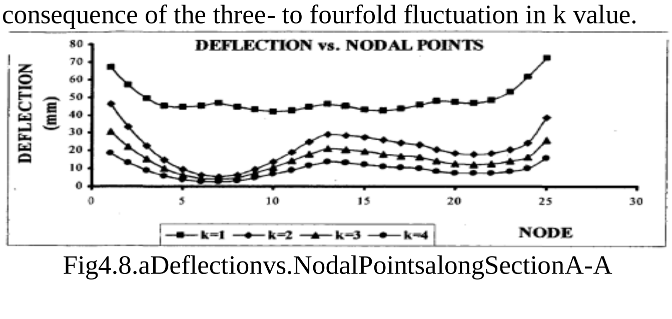

Fig4.8.aDeflectionvs.NodalPointsalongSectionA-A

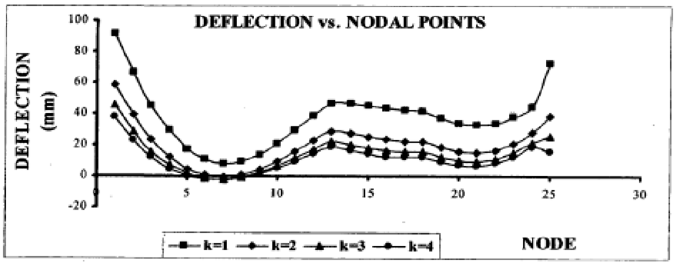

Fig4.8.bDeflectionvs.NodalPointsalongSectionB-B

9. CONCLUSION

Pile rafting is used to decrease the total and differential foundation settlement, and as such, estimating the pile raft settlement profile is an essential part of the design process. It follows that an approach to determining the settlement profile of a pile-raft foundation is put forward. The raft is treated as an elastic plate, whereas the soil and piles are modeled as beds of comparable spring at nodal points and intersecting springs, respectively, in this suggested technique. MATLAB is used to create raft and pile structural design software, as well as software for finite difference raft analysis, soil stiffness estimate, and stiffness estimation for piles. Comparing estimated settlement values with observed values from a case study is done. Using the recommended approach to analyze a stacked raft foundation proved to be a success in this case study.

A common piled raft foundation issue is handled in order to examine the effects of different factors on the system's behavior,

(i) The maximum deflection changes by 55% to 75% when the modulus of sub grade response is increased by three to four times, and the equivalent change in moments is 9.5% to 20.25 percent.
(ii) Effect of Raft Thickness: - the study was carried out for different pile diameter with thickness of the raft. It was observed that maximum settlement of the raft decreases as the diameter of the pile increases.
(iii) The differential settlement may be lowered from 1 in 206.42 in the case of a raft foundation to 1 in 1050 when using a stacked raft system.
(iv) Effect of Pile Diameter: - as per the analysis as the pile diameter increases, the settlement reduces
(v) In the issue under consideration, an increase in C value of 600 times caused a 78–8 Effect of pile spacing: - as per the analysis as spacing increases, settlement increases.3% change in maximum deflection and a 68–78% change in moments.
(vi) To reduce the differential settlement and moment the piles should be place strategically using some
(vii) Pile tilting is more likely to occur at boundary corners than internal nodes.

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