Investigation on the Effect of Raft Thickness and Pile Length Changes in Piled Raft Foundations Analysis

Vahed Ghiasi[*1], Mobin Moradi[2]
1, 2. Department of Civil Engineering, Malayer University
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Extended Abstract

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Introduction

Raft foundations are generally used to support buildings and structures, with or without basements, in dry or high ground water table conditions. When the shallow subsoil conditions are unfavorable (unsafe bearing capacity or excessive settlements) then load bearing piles can be used for transferring the total loads to more competent soil layers. In many cases, the maximum and differential settlements are the controlling factors to the selection of composite foundations systems including piles and raft. The piled raft foundation contains three elements of load-bearing; namely piles, raft and the underlying soil mass. Matching their relative stiffness, raft foundation distributes the whole load is transferred from the superstructure to the top soil and the connected piles. In foundation design, the idea of combining mat foundation and deep foundations as a new option in the topic of foundation engineering has been raised in recent years. The use of deep foundations under mat foundations (Piled-raft Foundation) can leads to reduce the settlement and the effect of bearing capacity. In conventional design of piled foundations, it was usually postulated that the overall load is supported by the piles. In composite foundation systems, raft contribution is taken to confirm the bearing capacity in ultimate moment and the serviceability of all over system.

Material and methods

Composite piled-raft foundations including pile and raft have been considered in this research. Knowing the performance of composite piled

raft systems is important because of the fact that the decreasing role of differential settlement and piles plays the role of supporting the underlying soil and increasing the load bearing capacity of the soil. A case study has been used to analyzing the performance of piles and shallow foundation systems in this study. For this purpose, the finite element PLAXIS 3D foundation software is used to analyze the foundation deformation. Raft foundation with a thickness of 0.3m and dimensions of 6 × 6m, which is located on a uniform sandy soil mass, and depth of raft from the soil surface is 2 m. Piles with a circular section of length 10 m, a thickness of 0.5 m and with 9 numbers below and within soil are located. Groundwater level is not considered, which actually indicates that the water level is outside of the 25m thick layer of the sand. In this research, deformation of foundation, moment applied on foundation and also the contribution of piles in the bearing of combined system under static loading in sandy soil for the various of pile lengths 7m to 13m and different thickness of raft 0.3m to 1m in the piled-raft foundations regarding connection of raft and piles, has been analyzed.

Results and discussion

The obtained results indicate that the first to third layouts in the optimal system where the central piles are longer, the settlement has had a maximum decline. A comparison of the default composite system with a 10 meter pile length and an optimal proposed system illustrates that the optimal system in the first and fourth layouts reduces differential settlement of raft in relation to the default system. Applying variations in pile lengths the optimal system has led to a reduction in the amount of bending moment applied to the raft in all layouts. Composite systems with the first, second and third layout, optimize system utilization effect on increasing the share of piles bearing. But in the fourth, with the optimum layout of the composite piled-raft system share of piles bearing to the total load on the same analogy in the basic system, the less value has been raised this argument that the position of the scattered placement of piles are the reason for this issue. The raft thickness of the composite system is another parameter whose performance has been measured against the raft

settlement. With the increase in the maximum amount of raft thickness increases the settlement which of course this increasing is small and very different thickness is not notable. By increasing the raft thickness, reducing the differential settlement is sensible but the major settlement reduction in the thickness of 0.3m to 0.5m has been occurred. With increasing the raft thickness the value of the moment has been increased. This moment increasing in the piled-raft system with disconnected piles over other systems in the primary thickness, moment is created about 60 kN and the raft thickness 1m, this moment value has reached more than 100 kN, as well as, by increasing the raft thicknesses, the amount of load share of the piles to the total load increased, significantly.

Conclusion

The following conclusions were drawn from this research.

-Use a long piles in the center and the shorter piles about the raft reduce the maximum settlement, differential settlement and significant reduction of the raft foundation moment, and beside these, piles bearing the composite piled-raft system is increased.

By increasing the raft thickness increases the maximum settlement, mean settlement, bending moment of raft has been increased. The positive effects of increasing the thickness of raft foundation is reducing the differential settlements and increasing the pile contributions in the bearing. This result has been expected due to increasing the raft mass and rigidity.

-The combined piled-raft system utilizes connected and disconnected piles to the raft and detached from it simultaneously to improve the expected indices.

Keywords: numerical analysis, raft thickness changes, pile length changes, piled raft foundations.

*Corresponding Author: V.ghiasi.@Malayeru.ac.ir