International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 4, Issue 7, July-2018

# STUDY ON INTRODUCTION OF PILES IN RAFT FOUNDATIONS USING MIDAS GTS NX

Prashant Thakur[1], Vinod K. Sonthwal[2], Ajay K Duggal[3]

[1]*M.E. Student, Civil Engineering Department, NITTTR Chandigarh,*
[2,3]*Associate Professor, Civil Engineering Department, NITTTR Chandigarh,*

***Abstract— A combination of piles and a raft, called the piled raft foundation helps to reduce the settlements and differential settlements of the foundation system in addition to reducing the raft thickness. Midas GTS NX is a Finite Element Modelling based software that analyses the performance of a piled raft foundation system. Finite element method works by dividing the body to be studied into a large number of interconnected smaller elements that fulfil continuity, compatibility and stability. This paper discusses the various aspects of modelling a piled raft on the software and analysing the displacements.***

***Keywords— Foundation design, Piled-raft, Finite element Modelling, 3-D Modelling, Midas GTS NX.***

## I. INTRODUCTION

In the design of a foundation, the general practice is to consider first the use of a shallow foundation system such as a raft. If the shallow foundation was not adequate, a fully piled foundation is designed. In case the raft is taking the structural loads efficiently but cannot control the settlements or differential settlements, a combined piled-raft foundation system can be adopted. The piles and raft act as a single unit in a piled-raft system. A piled raft can take the same amount of pressure load but with reduced raft thickness and settlements. In a piled-raft system the raft takes most of the load while the pile controls the settlement or differential settlement [1]. The finite element method of analysis is a numerical method for solving problems with complex geometries, material properties and loadings. FEM analysis is useful in situations where analytical solutions cannot be obtained. It can be used to solve complicated problems with higher accuracy [2]. Midas GTS NX is a FEM based modelling software that uses digital maps and data to generate 3D models that more closely resemble in-situ conditions and will consequently yield more realistic results. GTS NX analyses foundation stability subjected to lateral pressure and differential settlements.

## II. RELATED WORKS

The use of piles for the reduction in raft settlements has been found to be economical without any compromise with the safety and performance of the foundation. This was observed by Poulos [1] after comparisons between measured and computed foundation behaviour. Koch *et al.* [3] established that in order to calculate the benefits of combined foundation systems 3-D modelling is required. This can be achieved by using various computer programs such as Midas-GTS NX. Rapid calculations enable the engineer to review the structural design and make suitable changes. Sharma *et.al* [4] also emphasised that the piled-raft finds its favourable application when the raft has adequate loading capacity but the settlement or differential settlement exceeds the allowable values.

## III. METHODOLOGY

The analysis was done after performing laboratory investigations for the soil samples collected from the site. The methodology details are given below:

- Soil Sample Collection: The sample was collected from the site and the soil properties were obtained which are shown in Table I.

TABLE I
SOIL ENGINEERING PROPERTIES OF SOIL SAMPLES

| S. No. | Property | Sample 1 | Sample 2 | Sample 3 |
|---|---|---|---|---|
| 1 | Bulk unit weight ($KN/m^3$) | 18.94 | 18.83 | 17.47 |
| 2 | Saturated unit weight ($KN/m^3$) | 21.1 | 20.84 | 19.38 |
| 3 | Cohesion ($KN/m^2$) | 25.1 | 27.8 | 22.9 |
| 4 | Angle of internal friction ($^O$) | 40 | 36.7 | 37.52 |
| 5 | Modulus of Elasticity ($KN/m^2$) | 50 | 30 | 30 |

- A 3D model of the foundation system was prepared using Finite Element Modelling on Midas GTS NX software and the above properties were assigned to the soil.

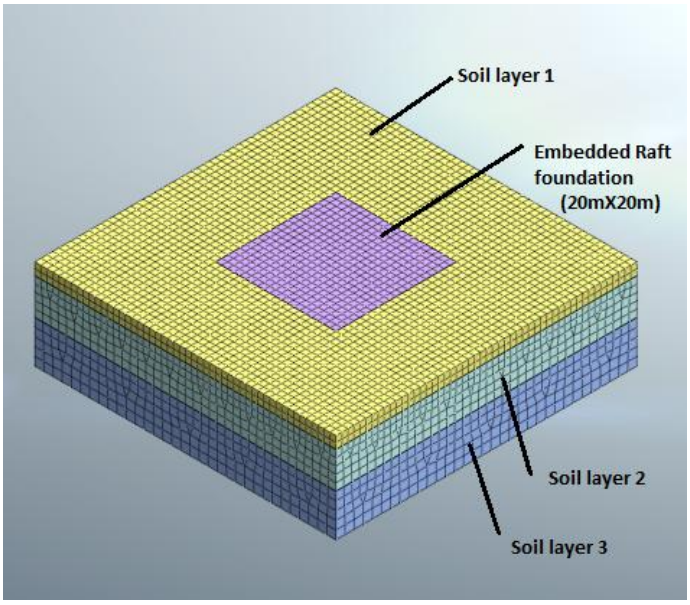


*Fig.1: 3-D geometry of the foundation system with raft (20mX20m).*

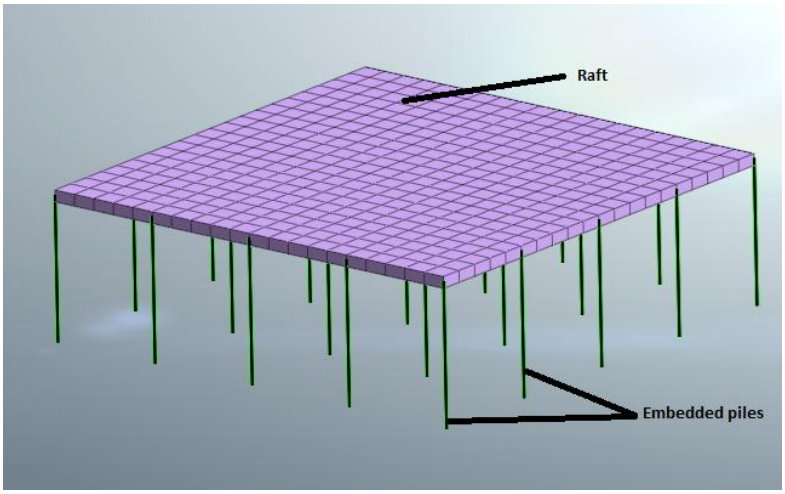


*Fig.2: Piled-raft system with 6m long piles.*

- After modelling, hybrid meshes were generated and properties were assigned to all the elements. Analysis was performed and simulation results were obtained.

## IV. RESULTS

In first case the analysis was performed on the raft foundation system without considering the piles. The displacements of the raft were obtained as follows:

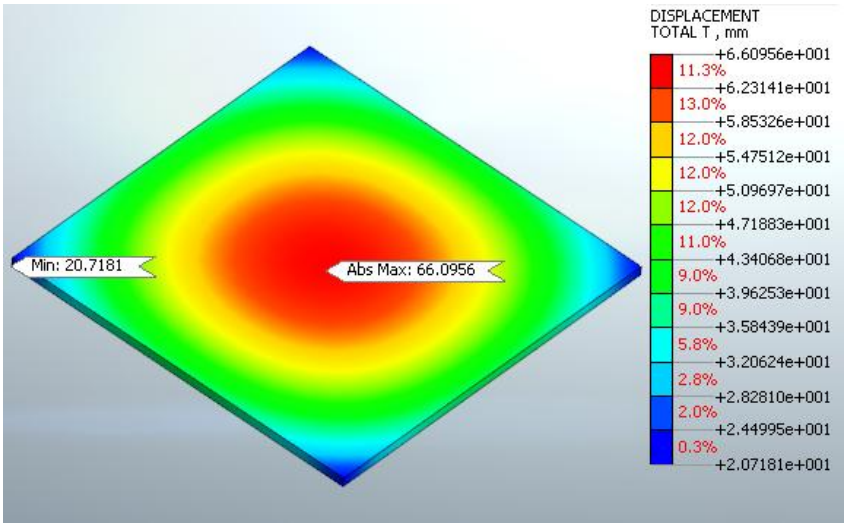


*Fig 3: Displacements of the raft foundation without piles.*

In the second case analysis was performed on the combined piled-raft system. The displacements of the combined piled-raft were obtained as follows:

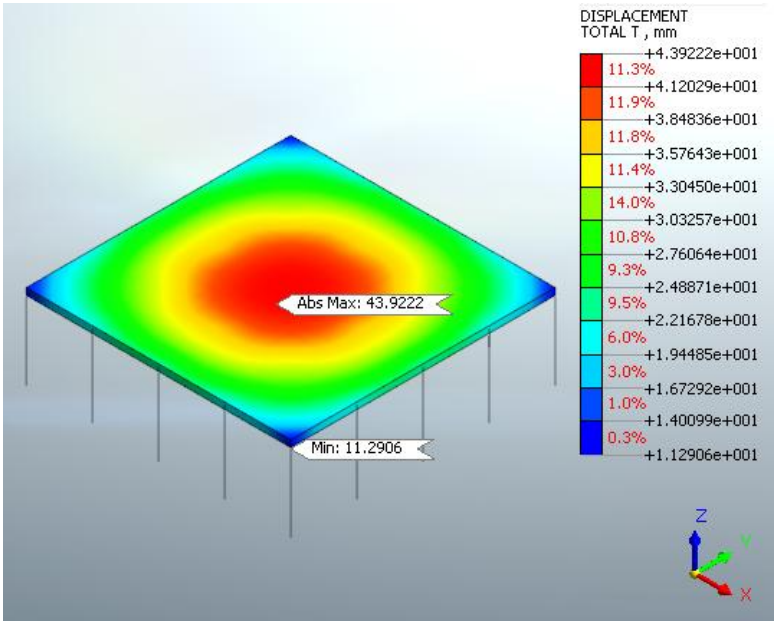


*Fig 4: Displacements of the piled-raft foundation.*

After performing the analysis in Midas GTS NX the comparison between the displacements with raft and piled-raft foundation is shown as follows:

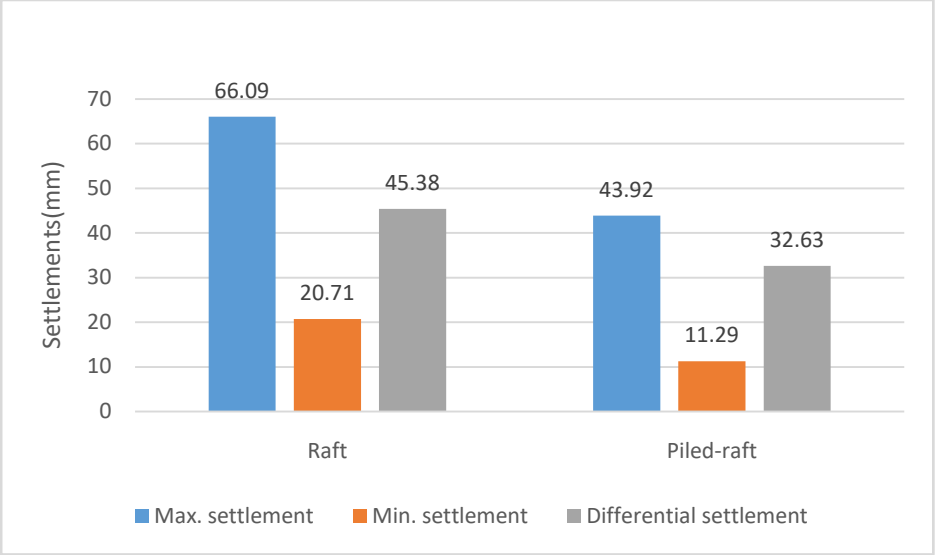


*Fig.5: Variation in settlements of foundation with raft and piled-raft.*

## V. CONCLUSIONS

Through this study it, it is established that the use of combined piled-raft foundation in place of a raft foundation results in significant decrease in the settlements and differential settlements of the foundation system. Furthermore Midas GTS NX is an efficient tool in modelling and analysis foundations.

## REFERENCES

[1] Poulos, H. G. "Piled raft foundations: design and applications'' *Geotechnique* 51, No. 2, 95-113 (2001).

[2] Introduction to Finite Element Analysis (FEA) or Finite Element Method (FEM).[Online]. Available at : https://www.engr.uvic.ca/~mech410/lectures/FEA_Theory.pdf

[3] Koch Edina, Szep Janos, Ray Richard "Modeling of Combined Pile Raft Foundation by Midas-GTS and Axis 3-D Software" (2011)

[4] Sharma V.J, Vansanvala S.A, Solanki C.H "Composite piled raft foundation with intermediate cushion in layered soil under seismic forces" *Computational Methods in Civil Eng*., Vol. 3, 2 (2012) 15-28 (2012)