UDC 642.154:624.131

INVESTIGATING THE BEHAVIOR OF AXIALLY LOADED BORED PILES EMBEDDED IN SOIL USED ING FINITE ELEMENTS METHOD

SAADOON SURA ALI SAADOON
Al-Qadisiyia University, Al-Qadisiyia, Iraq

This comparative study is performed on bored piles by varying the basic problem parameters that are expected to affect pile carrying capacity and comparing the obtained results with those of the original basic problems, in order to get more knowledge about the behavior of bored piles under compressive load, and to include the best design for future pile construction.

The advancement of digital computers makes possible the development of sophisticated numerical solution techniques such as (F.E.M) for solving boundary value problems in geotechnical engineering. The advantages of the (F.E.M**)** is that it can be systematically programmed to accommodate such complex and default material properties usually accruing in soils such as, non-homogenous, anisotropic, non-linear, time dependent and difficult boundary conditions. Many investigations have employed the (F.E.M) to analyze the behavior of the pile–soil system.

The major objective of this study is to extend the application of the (F.E.M) to analyze the behavior of axially loaded bored piles embedded in soil.

Methodology

The basic problem was analyzed in nine stages of construction including two stages of excavation, two stages of concrete casting and five stages of incremental loading.

To assess the effects of changing construction sequence three different cases of construction are adopted:

– First case consists of five stages of loading only; there are no excavation and filling stages.

– Second case consists of one stage of excavation in natural soil then followed by one stage of concrete casting and five loading stages.

– Third case consists of four stages of excavation and concrete casting and five stages of loading.

Results

The load–displacement curves of the basic problem (nine stages of construction) is shown in Fig.1 together with other different cases of simulation. It is clear that construction simulation has a very limited effect on the load–settlement behavior.

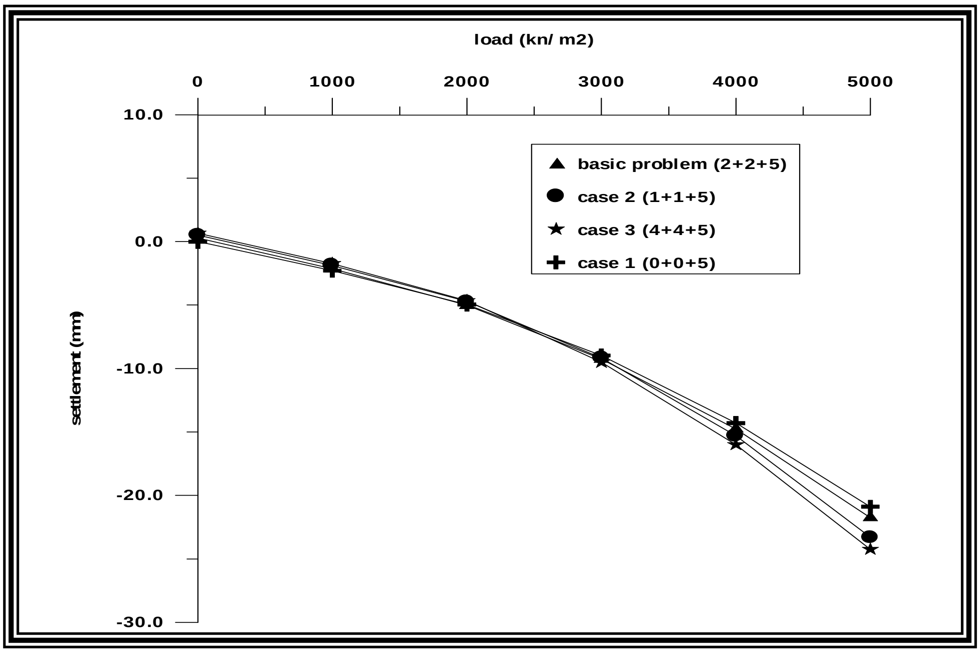

Fig. 1. Effect of construction simulation on load –displacement relationship

The vertical displacements of ground surface are shown in Fig.2, and the lateral displacements for interface elements are shown in Fig.3. It is obvious that construction simulation has a very limited effect on the vertical and lateral displacements.

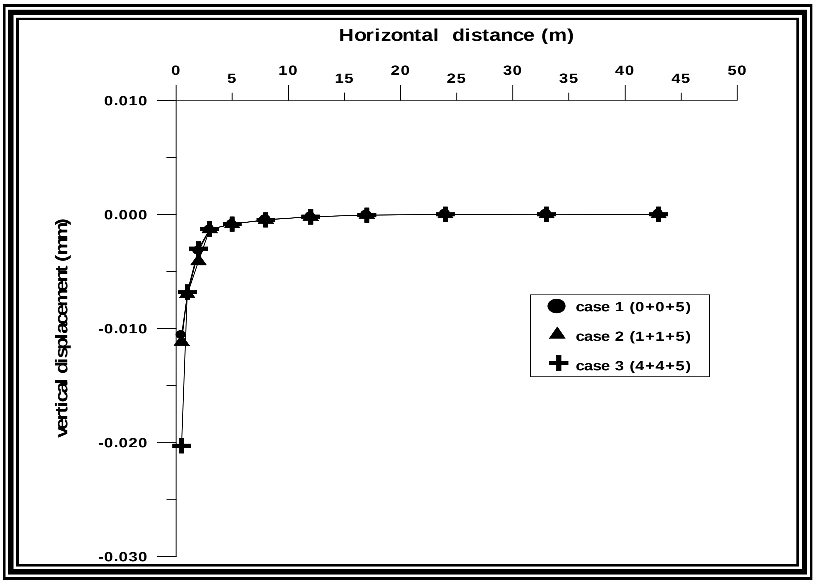

Fig. 2. Effect of construction simulation on vertical displacements of ground surface

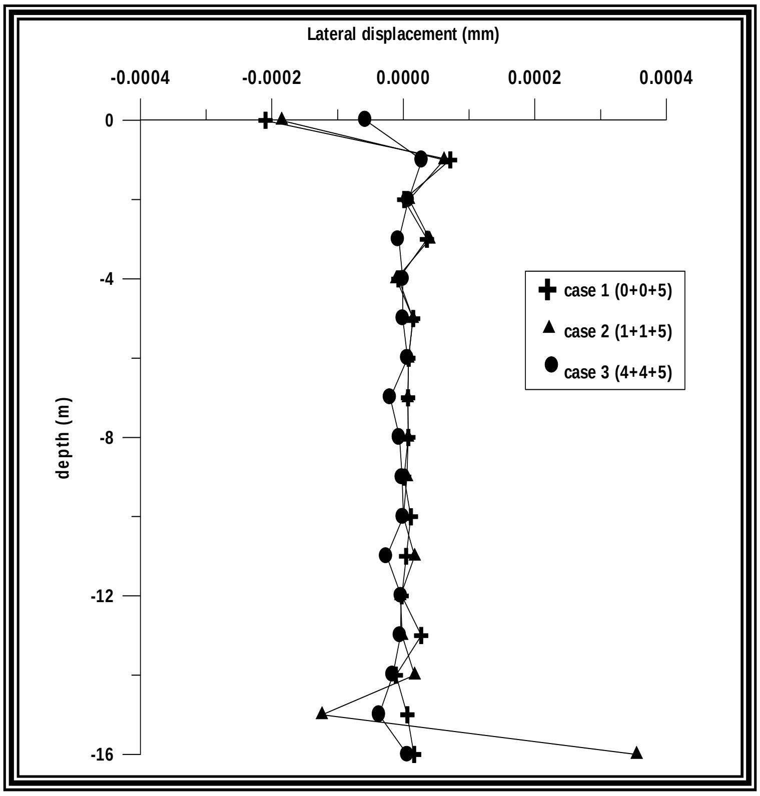

Fig. 3. Effect of construction simulation on lateral displacements of interface

Figigure 4 shows the simulation of the failed elements at the last increment of each case of construction. These figures indicate that the number of failed elements increases as a result of decreasing the number of stages. The elements have failed gradually throughout the incremental loading.

Figigure 5 shows the effect of construction simulation on the shear stresses generated in the surrounding soil. It can be seen that the effect is very limited.

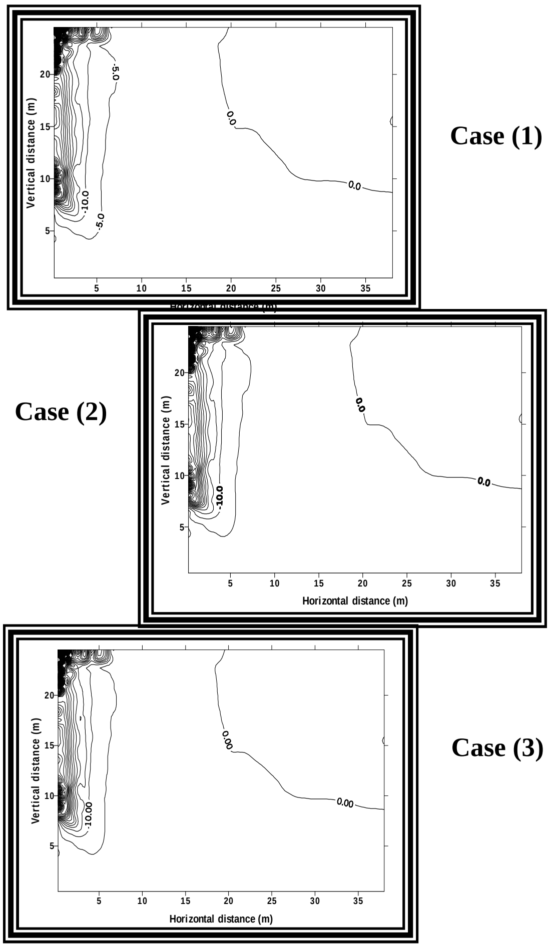

Fig. 4. Effect of construction simulation on the propagation of failure zone around pile

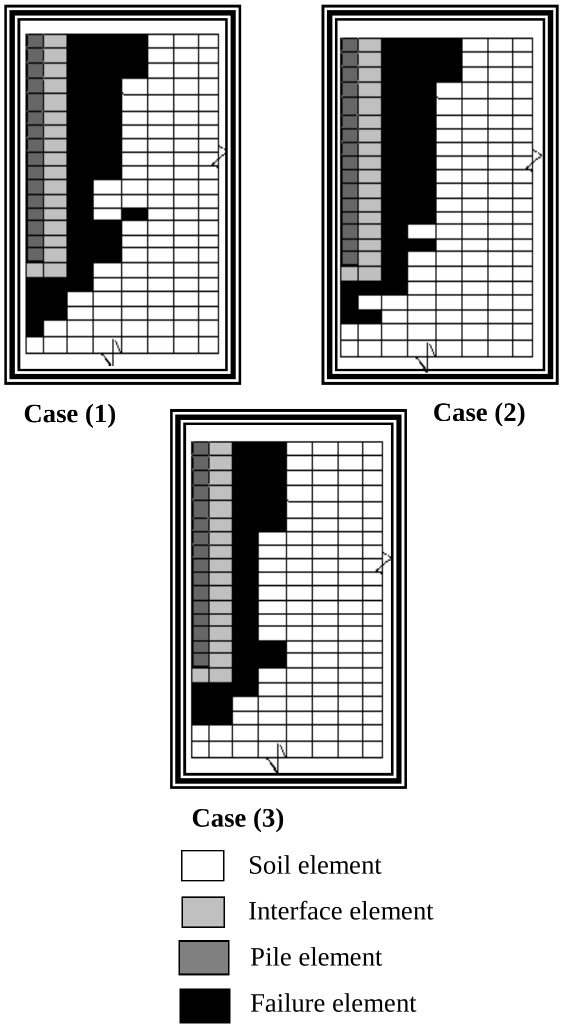

Fig. 5. Effect of construction simulation on shear stresses in soil around pile

Conclusions

From the results and the parametric study; the following conclusions can be drown:

1. First of all the importance of interface elements was shown. Especially for the shaft resistance the results of a calculation without interface elements were heavily mesh dependant. When using interface elements the mesh dependency is negligible. For the base resistance, one needs at least two or three elements at the pile tip to get rid of the mesh dependency.
2. The best results of load-displacement curve are obtained by using the non linear behavior for both soil and interface elements.
3. The construction simulation has a very limited effect on the load- displacement curve and has a similar effect on the shear stresses, while the number of failed elements is very sensitive to construction simulation, its increase as a result of decreasing the number of stages.

REFERENCES

1. Abdelrahman, G.E. Three-Dimensional Analysis of Single Pile in Sand Using Drager-Prager Model / G.E. Abdelrahman, A.F. Elragi. – Civil Department, Faculty of Engineering, Cairo University, Fayoum Branch. – Egypt. 1997. – 297 p.
2. Smith, I.M., A Survey of Numerical Methods in Offshore Piling / I.M. Smith // First International Conference of Numerical Mathematics in Offshore Piling, Institute of Civil Engineers, London, 1980. – P. 1–8.
3. Soltani, A., A FEM Model to Investigate the Lateral Behavior of Cylindrical Piles in Saturated Clay / A. Soltani // Electronic Journal of Geotechnical Engineering. – 2010. – Vol. 15. – P. 373–384.