ANALYSIS OF THE BEHAVIOR OF ACIP PILES IN DENSE SAND

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Abstract: The load-settlement and load transfer behavior of ACIP was modeled using the finite element code PLAXIS. The development of skin friction in compression and tension for the load test pile and reaction piles respectively were also investigated from load test and PLAXIS.

1 Introduction

Augered cast-in-place piles (ACIP) are drilled foundation installed by drilling a hole with a continuous flight auger. ACIP piles are typically installed with diameters ranging from 0.3 to 1.0 m and lengths up to 30 m, although longer lengths have occasionally been installed. The behavior of ACIP pile under axial loading in very dense sand was studied by conducting a full scale load test on an instrumented ACIP pile designed to support a highway bridge in Central Texas. Compression load test was conducted on a 30 in. (760 mm) diameter and 33.1 feet long pile in East Cochino Bayou (ECB) by using 8 reaction piles. The diameter of the reaction pile was 18 in. and the piles were 40 ft long.

2 Objectives

The objective of this study was to study the behavior of load displacement and load transfer behavior of ACIP pile in tension and compression.

3 Geotechnical properties

The bridge site consisted of sandy soil profiles from loose to very dense sand. Based on the TCP blow counts, the top layer was loose sand to a depth of 17 ft and was under lied by a 9 ft thick very dense sand layer. Test pile was 33.1 ft long and almost 10 ft of the pile was socketed into the very dense sand layer starting from a depth of 26 ft.

4 Load Test

Full-scale axial load test was performed in accordance with the ASTM D1143,"Standard Method of Testing Piles under Static Axial Compression Load". Load was applied to the piles by hydraulic jack acting against anchored reaction frame consisting of 8 reaction piles. The test pile was loaded in 10 tons increments up to 200 tons and the increments were then increased to 20 tons up to 320 tons. The pile was unloaded in four equal steps. The load settlement curve of the test pile is shown in Fig. 1. The test pile was not failed according to the Davisson criteria (Davisson, 1972). The ultimate capacity of the pile was estimated as 417 tons based on the hyperbolic approach (Vipulanandan, et al. 2005). Strain values were measured using the vibrating wire gages at four levels along the test pile and three levels along the reaction piles and the applied load at the head of the pile was measured using a load cell. Measured strains were converted into loads by multiplying with the axial rigidity which was back calculated using the measured data at the top of the test pile. Axial rigidity was assumed to be constant all along the length of the test pile. Load on the reaction pile was determined by measuring the strain in the reinforcing bar.

5 Finite Element Analysis

The behavior of test pile and reaction pile was modeled as an axisymmetric model with 15 noded triangular elements using PLAXIS 2D. Linear elastic-perfectly plastic soil model with

Mohr Coulomb yield criterion was used for the soil layers and the pile was modeled as a linear elastic material. Soil parameters were back calculated by fitting FEM results to the field measurements of head load-displacement (Fig. 2) and load distribution along the pile (Fig. 3). A parametric study was performed to match the measured values with a reasonable range. The back calculated values were used for the analysis of the reaction pile in tension. The load distribution along the reaction pile for the maximum applied load was compared to the FEM prediction in Fig. 4 and the agreement was good.

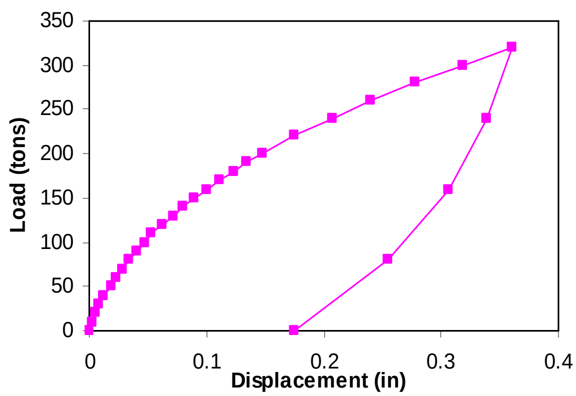

Fig. 1 Load-Settlement relationship for the test pile

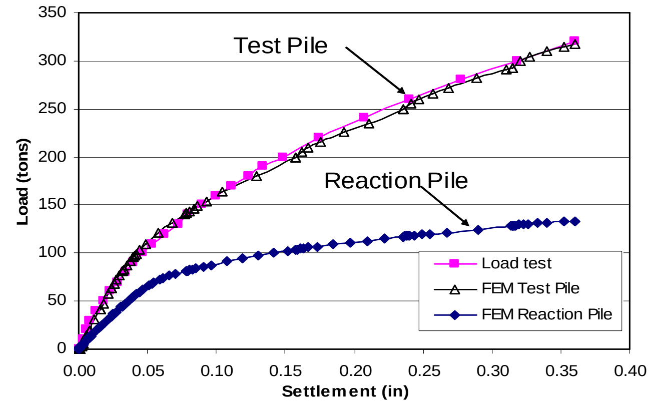

Fig. 2 Load-settlement relationship of the test pile and reaction pile

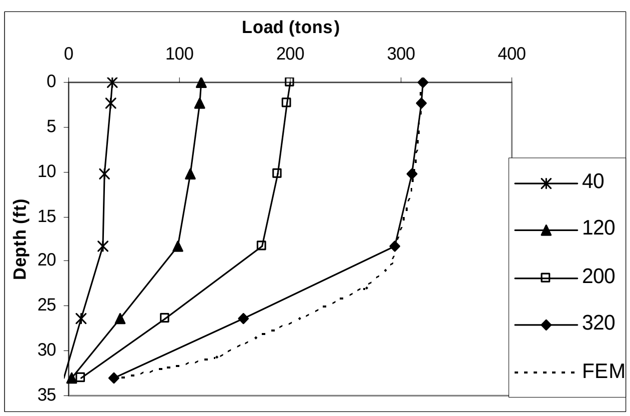

Fig. 3 Load Distribution along the test pile

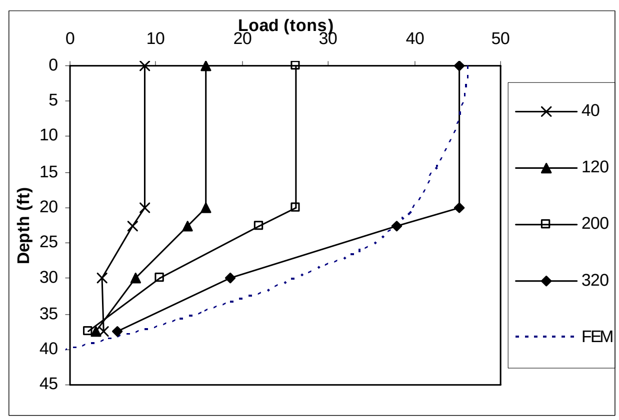

Fig. 4 Load-distribution along the reaction pile

6 Conclusion

FEM predictions of the load-settlement and load transfer of the ACIP piles in dense sand were comparable to the measured data.

7 Acknowledgement

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8 References

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