Side Friction Development in ACIP Test Pile and Reaction Piles in Very Dense Sand

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Abstract: Development of side friction in a test pile (compression) and reaction pile (tension) during a load test in Auger-cast pile in very dense sand was investigated. The ratio of skin friction in tension to skin friction in compression varied from 0.20 to 0.4 while the theoretical estimate was 0.21.

1 Introduction

Augered cast-in-place pile (ACIP) is a drilled deep foundation in which the pile is drilled to depth in one continuous process using 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. In order to better characterize the behavior of ACIP under axial loading, a full scale load test on instrumented ACIP piles were performed at SH-7 near Lufkin, 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 investigate the skin friction development in ACIP piles in tension and compression in very dense sand.

3 Load Test

The test pile was loaded in 10 tons/5 minutes increments up to 200 tons and then the increment was increased to 20 tons up to 320 tons. The pile was unloaded in four equal steps. Based on the hyperbolic approach the ultimate capacity of the pile was estimated as 417 tons (Chin 1970). 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.

4 Analysis of Side Friction

Side friction developed in the test pile and reaction piles were compared for the dense sand layers as shown in Fig. 1. Maximum measured side friction for dense sand in the test pile was 2.2 tsf which was three fold greater than maximum skin friction developed in the reaction piles. The ratio of side friction developed in the reaction pile (tensile) to the and test piles (compressive) remained constant, after the initial loading stage, around 0.25 as shown in Fig. 2. The theoretical estimation of side friction is as follows

$$8\Pi dLf_t = \Pi DLf_c$$

$$\Rightarrow \quad f_t/f_c = 0.21$$

where

d & D = Diameter of the reaction and test piles.
L = Length of the pile
f_t & f_c = Skin friction in tension and compression.

The skin friction developed in the test pile was greater than the limiting capacities predicted by Wright & Reese (1979), Reese & O' Neill (1988) and Neely (1991) for sand layers as shown in Fig 3. Skin friction developed in the reaction piles are compared with tension tests on ACIP piles discussed by Mc Vay et al (1994). Figure 4 shows the skin friction in reaction piles and skin friction corresponding to the capacity at a deflection of 2% diameter of the pile.

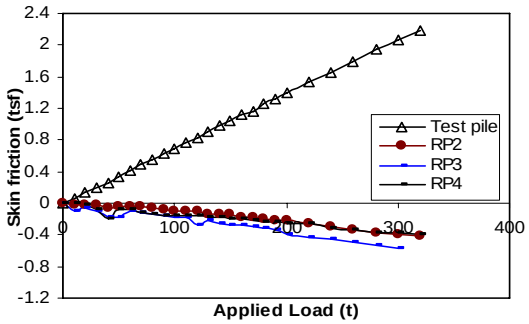

Fig. 1 Side Friction in Dense sand

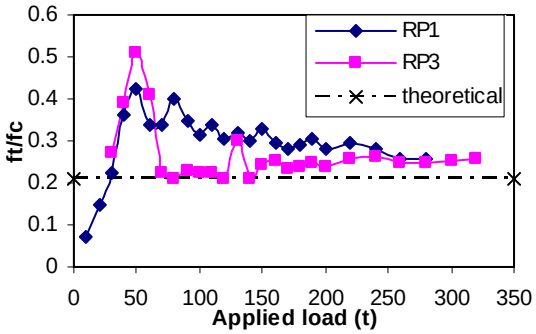

Fig. 2 Skin Friction ratio in sand

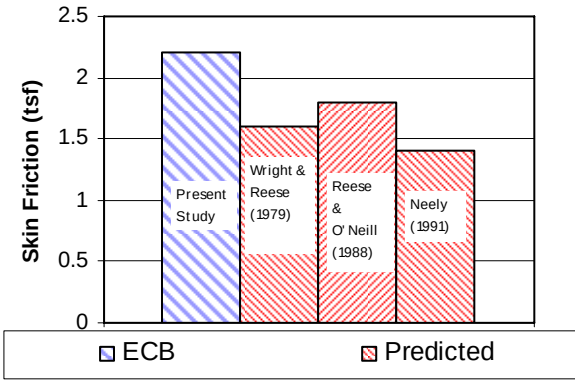

Fig. 3 Measured and predicted Skin friction in test pile

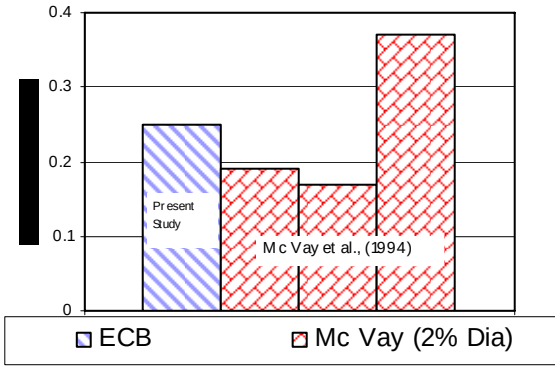

Fig. 4 Skin friction in reaction pile and tension piles

5 Conclusion

The maximum side friction at the peak load in compression and tension were 2.2 and 0.6 tsf. The ratio of the side friction was higher than what was estimated theoretically.

6 Acknowledgement

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7 References

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