International Journal of Civil Engineering (IJCE)
ISSN(P): 2278-9987; ISSN(E): 2278-9995
Vol. 3, Issue 1, Jan 2014, 17-30

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

EFFECT OF SAND DENSIFICATION DUE TO PILE-DRIVING ON PILE RESISTANCE

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ABSTRACT

Bearing capacity of pile foundation depends on pile side (skin) resistance and tip (end-bearing) resistance. Side resistance of piles in sands is usually evaluated based on the angle of friction between the pile and sand which depends on sand and pile material frictional properties. In literature, the angle of internal friction of sand is mostly evaluated based on SPT (Standard Penetration Test) or CPT (Cone Penetration Test) data. For pile side resistance, the obtained SPT or CPT results are not precisely considering the effect of sand densification around the pile as a result of pile driving, which is expected to increase the angle of internal friction of initially loose sand. In this work, an attempt was made to evaluate pile side and tip resistances based on the actual density of the densified sand as a result of pile driving. Medium scale laboratory tests using sand box were performed on different pile materials and different sands at different initial relative densities. The lateral deformation of the sand due to pile driving was measured using embedded extensometers connected with external LVDTs. The final density of the sand around the driven pile and the corresponding pile side resistance were then evaluated based on the lateral sand movement and the new sand density around the pile. The results show that most of the sand lateral movement due to pile driving is concentrated in a zone extended almost three times the pile diameter from the pile centerline, and the extent of this zone increases as the sand initial density increases. Also, the results show that as the sand relative density increases, the ratio of the pile side resistance to the total resistance decreases and the side resistance increases linearly with the increase in sand initial relative density. By considering the void ratio, the results of this work show that the initial void ratio of the sand is a key factor and it is correlated very well with the side and tip resistances of the driven piles with a correlation coefficient factor, R^2 of 0.95 and 0.90 for the side and tip resistances, respectively. Considering the change in sand relative density due to pile driving, it was found that the normalized change in pile side resistance due to the change in sand relative density decreases with the increase in the percentage change in the sand relative density.

KEYWORDS: Driven Pile, Resistance, Sand, Lateral Densification