ABSTRACT

BEHAVIOR OF PILE SUBJECTED TO AXIAL AND CYCLIC LATERAL LOADS IN SANDY SOIL

By

Muqdad Abdullah Khraibet

Supervisor by:

Assist. Prof. Dr. Jasim M. Abbas

ABSTRACT

Offshore foundations are often subjected to huge environmental cyclic lateral loads due to ocean waves, current and wind, which could exceed their capacity, in addition to its fundamental function to transmit the vertical loads of self-weight of structures into the deep soil strata. The repetitive nature of such loading with the presence of vertical loads produces a gradual alteration in the head displacement and bearing capacity of the piles. This sometimes may produce catastrophic consequences. A cumulative displacement and bending moment lead to a problems in the pile foundations represented by serviceability problem due to the extra displacement of the piles and failure structurally when the bending moment value reach to the point of yield. In order to investigate the influence of combined loading on the pile-soil interaction performance, a cyclic loading system has been developed. Through this multi-purpose system, lateral sinusoidal loading could be applied on the head of an instrumented model pile with strain gauges at various amplitudes and frequencies under stress-controlled mode.

A series of 72 laboratory tests are performed to investigate the single pile response when subjected to combined loads, by illustrating the variation of horizontal and vertical displacements as well as bending moment along the pile depth. Moreover, numbers of parameters are studied, including: cross section shape of the pile

(circular and square), slenderness ratio L/D (25 and 40), magnitude and frequency (0.067, 0.1 and 0.2 Hz) of the cyclic load. All tests are achieved in dry sand with one relative density (R.D.) 70% (i.e. dense). One hundred cycles are used in each test to represent repetitive of environmental loading on offshore structures during the storm wave.

Results obtained from the experimental tests under the combined load confirm that the lateral displacement and bending moment along pile decrease with increasing the vertical load level, the rate of reduction reach to 73 % and 46 % for displacement and maximum bending moment after 100 cycles respectively. Exactly the contrary, but it may cause problem with respect to allowable settlement. For piles under the influence of combined loads regardless vertical load level, the displacements (vertical and lateral) and bending moment increase with increasing the magnitude of cyclic load ratio (CLR), the difference in the rate of increase reaches to 82%. Although the square and circular pile sections had nearly the same outside dimensions, the square pile provides lateral deflection that is 12 to 42 % lower than a circular pile for the same amount of cyclic load. Besides, there is an observable influence of slenderness ratio (L/D) and frequency on the values of displacements (lateral and vertical) and bending moment. Most of these values under the effect of the pure cyclic load are higher than those observed in combined loads for all frequencies (i.e. 0.067, 0.1 and 0.2 Hz). Furthermore, the increasing in the number of cycles under the influence of high cyclic lateral loads and frequency (i.e. 0.2 Hz.) has a greater influence on the behavour of the pile compared on low cyclic lateral loads and frequencies (i.e. 0.067 and 0.1 Hz).