Lateral Dynamic Response of a Single Pile Model

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Abstract

The dynamic response of a single pile with an attached mass giving a single degree of freedom (SDOF) system subjected to lateral pile-head loading is described. Two types of dynamic tests were performed, primarily free-vibration and dynamic forced-vibration tests. The main aims of this paper were to provide a basic understanding of the single pile head action and to evaluate the applicability of the elastic continuum method (ECM) in estimating the dynamic parameters of the pile-soil system. The single pile model was constructed using an instrumented steel pipe with an outside diameter of 50.65 mm and a wall thickness of 1.05 mm. The measured data from the frequency domain analysis were analysed to determine the natural frequencies f_n, damping ratios ζ, and lateral pile-mass connection displacement u_{Lat} of the pile-soil system. The experimental results obtained were then compared with those calculated from the analytical calculation based on the ECM. The analytical prediction was based on a perfect pile-soil bonding with the pile embedded in a homogeneous soil layer with a constant Young's modulus with depth. The natural frequency obtained from the free-vibration test was greater than that from forced-vibration test. This was found to be in general agreement with other related published works. The experimental and analytical results were shown to be reasonably matched, thus, the ECM demonstrates a good potential application in estimating the dynamic parameters and the lateral displacement.

Keywords: dynamic response, lateral pile head loading**,** single pile, single degree of freedom.