MODIFICATION OF THE HILEY FORMULA BY CONSIDERING PILE LENGTH

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A. ABSTRACT

Pile driving formulae are applicable in driven pile foundation; pile driving formulae predict pile capacity by the pile head movements during driving. Hiley Formula is one of the most well-known pile driving formulae which widely adopted in foundation engineering around the world. As reported by many previous studies, pile driving formulae are not adequate in providing satisfactory prediction of pile capacity. Discrepancies might be due to many factors, such as the driving disturbance to soil, the set-up effect of the soil after driving, the difference between the static capacity and the dynamic capacity, and the influence of pile length on the pile head movements during driving.

From the derivation of the existing formulae, it could be noticed that they have not considered the influence of pile length to ultimate pile capacity prediction. In this investigation, a parametric study by one-dimensional wave equation was carried out to study the pile performances for different pile lengths by using simplified pile/soil numerical models to study the pile length influences. The parametric study simulated and examined how the stress wave was generated in the pile shaft by the driving impact, propagating down from pile head to the tip, reflecting back from the toe and propagating up back to the head. During the stress wave propagation, the one dimensional wave equation computed the stress and strain behaviors for the pile sections interacting with the surrounding soils due to the relative movements. In addition to the wave equation, a semi-empirical formula was also utilized to compute

the pile capacity for the same pile/soil model for comparison to determine also the pile capacity.

This investigation found the pile length dominantly influenced the elastic and the plastic displacements at the pile head during driving. Two phenomena, namely as reflected tension wave effect and localized effect, were adopted to explain how the pile length is influencing the pile head movements. These phenomena influence the pile head movements during driving simultaneously but differently for various pile lengths.

Considering pile length influences to the pile head movements, a modified Hiley formula was derived by considering pile length and from the parametric study results. It is suggested to improve the Hiley formula prediction by a dimensionless improvement factor, called as Length Factor A. The A value was found varied from 0.5 to 3.5 for different pile lengths in the given ground condition assumption. The modified Hiley formula was found not only inherited the advantages of pile driving formulae being easily applicable but also significantly improved the accuracy in pile capacity prediction. The modified Hiley formula has been verified by static load tests and by pile dynamic load tests for several construction sites in Macau.

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