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The Capacity of Sheet Pile Foundation under Eccentric Loading

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ABSTRACT

This paper mainly presents the capacity of sheet pile foundation on sand under central and eccentric loadings. The sheet pile foundation is a shallow footing that is skirted by sheet piles around the periphery. The main motivations of developing this new foundation are to develop the novel foundation for railway structures and to enhance the performance of existing foundations. The results of 1g vertical loading test clearly demonstrate that circular and square sheet pile foundations can substantially increase the vertical capacity of conventional shallow foundation on sand. The vertical capacities of sheet pile foundation when the load acts on center and on eccentric location were compared and discussed. By using the zero vertical displacement concept of swipe test, the next series of tests were then carried out with the aims of investigating the horizontal capacities of this foundation under various loading conditions. The test results of the swipe test are useful to identify the maximum horizontal capacities and are useful to generate the simple equation for predicting the foundation capacity in V-H load space. The tests are also extended to observe the foundation behavior and capacity on different soil densities.

KEY WORDS: Sheet pile foundations; 1g test; vertical capacity; shallow foundation; V-H load space

INTRODUCTION

Caisson or skirted foundation is currently used more commonly as a foundation system for offshore structures (Watson and Randolph, 1998). Using the design concept of the caisson foundation, Tokyo Institute of Technology and the Railway Technical Research Institute of Japan proposed the first use of sheet pile foundation. The main motivations are to develop the novel foundation for railway structures and to enhance the performance of existing foundations when subjected to combined loading conditions. The sheet pile foundation is a shallow footing that is skirted by sheet pile around the periphery (Punrattanasin et al., 2002a and 2002b). Figure 1 shows the schematic drawing and the overview of the proposed sheet pile foundation. In construction, sheet piles are driven vertically with sufficient length and are connected to the shallow foundation by shear keys. The skirt of sheet pile foundation may lead to a higher vertical, horizontal and moment capacities than that of the conventional shallow foundation. The primary load is transferred to subsoil by the end bearing of shallow foundation and the sheet pile system is mainly auxiliary to reduce the tilting. Figure 2 shows the full scale loading test performing with shallow and sheet pile foundations. The results of horizontal loading test in Fig. 3 clearly indicated the higher horizontal capacity of sheet pile foundation over the shallow one. The incremental capacity is from the stronger foundation system. The aim of this study is to investigate the shape effect of footing and the loading location on the performance of the new foundation on sand when subjected to pure vertical and to the combination of vertical (V) and horizontal (H) loads. Understanding the new foundation behavior and capacity will make an engineer more confidence in design processes.

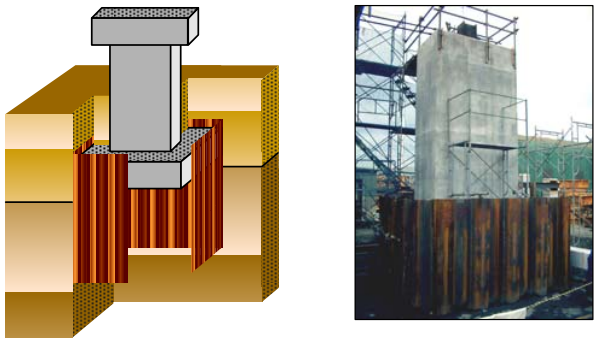

Fig.1 The schematic drawing and the overview of sheet pile foundation.

Fig. 2 Load test on sheet pile foundation (after Nishioka et al., 2007).