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Determination of The Critical Embedded Depth Of Cantilever Pile Retaining Wall Using Physical Modeling Technique

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Abstract

Excavation and supporting systems have been always of challenging issues in civil engineering practice. In this article, the behavior of one widely used excavation supporting system called Contiguous Bored Pile (CBP) retaining wall is studied using physical modeling technique. Embedded depth of pile is a fundamental design parameter attainable in design phase and it is known that the wall displacement decreases with increasing pile embedded depth. But what is remained unknown and is meant to be revealed in this article is that to what extent increasing wall embedded depth can be effective. Critical embedded depth of pile is the minimum embedding depth at which the maximum efficiency of pile arises. Based on observations, the critical embedded depth of cantilever wall in granular soil is 1.2 times of wall height. It is worthy to note that the results of this study is not only applicable to all types of cantilever retaining walls, but also to the piles under lateral loading.

Keywords: Contiguous Bored Pile Wall, Physical Modeling, Critical Embedded Depth, Horizontal Displacement.

1. INTRODUCTION

Excavation and supporting retaining walls have been always encountered as challenging issues in civil engineering practices. Nowadays, there are a wide range of excavation stabilization methods each of which has its own advantages and disadvantages. The choice of each method is influenced by numerous factors such as geotechnical conditions, water table, soil layering, maximum retained height, the surrounding structures and importance, sensitivity and economy of the project [1]. One of the widely used methods for stabilization of excavation is Contiguous Bored Pile Wall (CBP). This system provides both lateral and vertical bearing capacity and can avoid excessive bulk excavation, help to control ground movement, be installed in restricted working spaces and be cost effective when combined with capping beam in comparison with other similar methods. Execution of this system summarily consists of boring the shaft piles, putting the armatures, concreting the piles and excavating the soil in front of piles, respectively. Besides, a capping beam is performed in order to keep unity of piles as a unit wall and prevent bulking of piles [2].

In this study, the critical embedded depth of pile is found using physical modeling technique. Different cases of fixity condition such as free end (soft bed) and fixed end (hard bed), and different values of wall stiffness were tested by putting into practice different pile length to diameter ratios (L/D) and different pile spacing.

2. HISTORY OF PHYSICAL MODELING

Physical modeling has an old background in Geotechnical engineering. Wen was the first who reported using model piles to study batter and vertical piles [3]. Numerous researchers have used small scale physical modeling and reached valuable results. Matlock and Ripperger worked on lateral loading of piles in cohesive soil using this method [4]. Prakash in his PhD dissertation performed static and cyclic tests to one groups of model piles embedded in sand and concluded that group effect were negligible for spacing greater than 8d (pile diameter) [5]. Davisson and Sally performed lateral load tests on lateral and vertical model piles to develop design criterions for foundations for rocks and dams for U.S. Army Corps of Engineers [6]. Park published a comprehensive study of seismic performance of steel encased concrete piles with focus on the