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Determination of The Critical Embedded Depth of Cantilever Bored Pile Wall Using Numerical Analysis

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Abstract

In this article, the behavior of one widely used excavation supporting system called Contiguous Bored Pile (CBP) Retaining wall is studied using Finite Element software of PLAXSIS. The embedded depth of wall is a fundamental design parameter attainable in the design phase and it is known that the wall displacement decreases with increasing pile embedded depth. However, what is remained unknown and is meant to be revealed in this study 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 pile in granular soil and cohesive soil are 1.1 and 2.3 times of the wall height, respectively. Furthermore, the effect of soil type and its strength on the wall behavior and also the effect of changing the embedded depth on the wall bending moment was investigated.

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Keywords: Contiguous Bored Pile Wall, Numerical Modeling, Critical Embedded Depth, Total and 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].

The main purpose of this study is to investigate the effect of increasing the embedded depth (D) of the wall on its displacement using finite element software of PLAXIS in order to find the wall critical embedded depth. The critical embedded depth of wall ($D_{critical}$) is the minimum embedded depth of wall at which the maximum efficiency of wall arises. Also further analysis was made to investigate the effect of the soil type and its strength on the critical embedded depth. Besides the effect of increasing wall embedded depth on the maximum wall bending moment (M_{max}) was examined.

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.

2. NUMERICAL MODELING

In the recent century, Computers played a vital role in improvement of science and technology. Finite Element (FE) software of PLAXIS 2D was used in this study for numerical modeling. This software is able