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Expansion Characteristics of Ground by Pulse Power

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ABSTRACT

This paper introduces the PDT(Pulse Discharge Technology) piling method. The PDT piling method is to install in-situ a pile using electrical power so called Pulse power. Since this piling technique can make not only a bore hole to be expanded but also the ground to be improved by compaction, the pile installed by PDT appears to be able to develop shaft and end bearing capacity efficiently. In this study, we introduce a coefficient of expansion. In order for quantitative evaluation of the relation between pulse power and ground expansion a series of in-situ tests were conducted. In the tests, we divided soil conditions into several groups by constituents and the number of blows in the standard penetration test, N.

The tests were carried out on various numbers of pulse discharge. As a result, it was concluded that the coefficient of expansion appeared to increase with an increase of the number of discharge and with a decrease of the number of blows, N. In addition, the coefficient of expansion appeared to differ from one position to another even though having the same N value.

KEY WORDS: Pulse Power, Coefficient of Expansion, SPT N, Bored Pile

INTRODUCTION

Since 1990s the piling technique, in which a precast pile is installed in the ground after boring, has been widely used in Korea especially in urban area(Lee et al, 2003). Even though this technique induces much less vibration and noise than pile driving, it has several disadvantages as following. First, the ground disturbance is inevitable during boring and it gives rise to the reduction of shaft resistance. In general, it has been known that the bearing capacity of a bored pile is taken by shaft resistance up to 60%. Such a shaft resistance is, however, far smaller than that of a driven pile due to the ground disturbance and stress release (Van Weele, 1988; DeBeer, 1988). Second, when boring the hole, there always be some amount of slumped or loose soils at the bottom of it, and if it is not ensured that the base is clean and is free of any slumped or loose soils the piles may have a large settlement and less the end bearing capacity. Therefore, this technique requires the final blows to drive the piles into the ground so that the end bearing capacity becomes high enough. These final blows induce some degree of vibration, noise and pile head damage and so on (Lee et al, 2003; Hong et al, 1997; De Beer, 1988; Broms et al, 1988). For these reasons, a new piling method which can take advantages from both driven and bored piles is necessary to be developed. In order to overcome the disadvantages of such a bored piling method, several researches have been carried out focusing on enhancement of shaft and end bearing resistance. For example, Chai (2000), and Hong, et al (2005) proposed a new boring method, so called SDA(Seperated Doughunt Auger). In this method they made an attempt to minimize the ground disturbance and the hole collapse by means of a casing. However, this method has still difficulty in cleaning the slumped soil perfectly.

Meanwhile, Prakash et al(1990) mentioned that if the concrete at base of the piles is compacted with high energy, the disturbed soil may be re-compacted. In other word, if the loose soil is recompacted by one way another, the more enhanced the shaft resistance as well as the end bearing capacity could be expected. In this paper, a new piling technique, so called PDT (Pulse Discharge Technology) piling method, is presented. The PDT piling technique is to install in-situ piles using electrical power. In this technique, the disturbed hole can be recovered with such a high electrical power, so called pulsed power. Furthermore, a series of pilot field tests were conducted in order to investigate the characteristics of ground expansion.

PILING TECHNIQUE

Pulse Power

Pulse power is the physical value that indicates the energy change per unit time (dE/dt). The power depends on how fast the energy is released. In other words, if a unit of energy is discharged in 1 sec, a watt of power will be generated. However, if the same energy is discharged in 1 μs (10^{-6}sec), the power will be 1MW(10^{6}Watts) as shown in Fig. 1.