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Effect of Sheet Pile Driving on Geotechnical Behavior of Adjacent Building in Sand: Numerical Study

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Abstract

Construction vibration such as sheet pile driving can produce earthborn vibrations which may be leads to problems for the supporting soils and adjacent structures. Vibrations create the stress waves traveling outward from the source through the soil and cause structural damage due to dynamic vibration induced settlement. The main aim of the present research is to study the vibration effect through sheet pile driving technique on the surrounding soil and adjacent structure. A series of plain strain finite element analysis using Plaxis 8.2 dynamic module is run to simulate the installation technique of a sheet pile unit using driving technique (hammer type). The effect of construction stages with different embedded sheet pile depth, sand relative density, and foundation distance from the driving source is also studied. The influence of hammer driving amplitude on the foundation response and excess pore water pressure are presented. The results showed that the increase of both embedment sheet pile depth and hammer efficiency can significantly produce higher excess pore water pressure and foundation settlement. The increase of sand density can also has a great effect in increasing the foundation damage of adjacent structure compared with low sand relative density. The building damage can significantly take place when the driving is closed to foundation.

Keywords: Finite Element; Sheet Pile Driving; Plaxis; Pore Pressure; Dynamic Settlement.

1. Introduction

Building vibrations can generate soil vibration with variation in intensity, which mainly depends upon the source of vibration. Pile driving is mainly used in many applications for geotechnical engineering (i.e. foundation support and etc. Pile-driving is installed typically by use of impact or vibratory hammers.

Ground vibrations due to pile driving are part of a complex process. Vibration is generated from the pile driver to the pile. As the pile interacts with the surrounding soil, vibrations are transferred at the pile-soil interface. The vibration propagates through the ground and interacts with structures, both above ground and underground. The vibration continues into the structure where it may disturb occupants and/or damage the structure.

The vibration waves may cause potential damage of existing building induced by vibration source. More specifically, these vibrations can cause ground settlements and deformations that may lead to differential settlements of foundations. In case of vibratory sheet piling, generation and dissipation of excess pore pressure occurs simultaneously. It has been found that the interim drainage results in a significant decrease in pore pressure generation.

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