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Investigation of Settlement and Heave Induced by Pile Driving

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Abstract

Impact hammers and vibratory drivers are used for piles and sheet piles installation. Dynamic loads force piles to vibrate and penetrate into the ground that result in soil displacements and vibrations around a pile. The soil movements may produce settlements in sandy soils, heave and lateral displacement toward the existing nearby foundations in clay soils. The most common factor for assessment of ground vibrations during the pile driving is peak particle velocity, PPV. The aim of this research is presenting the relation between PPV resulted from pile driving and its effects, like settlement in sandy soils and heave in clays. For this purpose, a data bank by collection of case histories which are including the properties of pile driving system -soil, pile, hammer- and the effects of pile driving has been prepared. Then, the important factors influenced on heave and settlement have been investigated.

Keywords: Pile driving, Settlement, Heave, PPV

1. INTRODUCTION

Construction activities can affect on structures in different ways. Pile driving is an age-tested method of constructing foundations where adequate ground support is not directly available. Despite of all advantages of pile driving as the common method of pile installation, it is also a source of negative environmental effects. Noise and air pollution are the most commonly expressed concerns, but they are also relatively easily alleviated. In contrast, vibrations originating from the impact driven pile are both difficult to determine beforehand and costly to mitigate, while potentially having serious adverse effect on adjacent structures and their foundations, as well as on vibration-sensitive installations and occupants of buildings. These effects may include heave, settlement, and structural damages. When the pile driving hammer impacts the pile head, a stress (or strain) wave, i,e., vibration, is created that propagates at certain frequencies and amplitudes down the pile, into the soil, and in under and into adjacent structures. Three types of ground waves are considered when analyzing pile driving: spherical waves emitted from the pile toe, cylindrical waves propagating laterally from the pile shaft, and surface waves, which are generated by wave refraction at the ground surface at a critical distance from the pile, [1] as shown in Fig. 1.

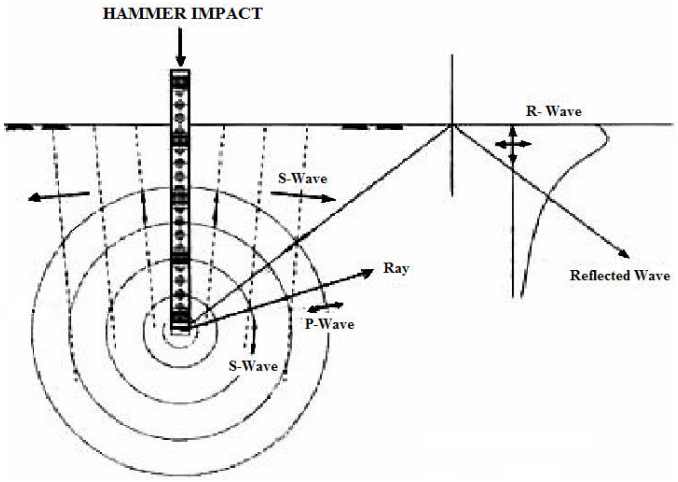

Figure 1. Ground vibrations induced by pile driving (Woods, R.D, 1997)