Proceedings of the Seventeenth (2007) International Offshore and Polar Engineering Conference
Lisbon, Portugal, July 1-6, 2007

ISBN 978-1-880653-68-5; ISBN 1-880653-68-0(Set); ISSN 1098-6189 (Set)

Evaluation of Quality Control Parameters of Driven Piles Using Digital Imaging

Hee Suk Yun,
Coastal and Harbor Engineering Research Laboratory, Korea Ocean Research and Development Institute
Ansan-Si, Gyonggi-Do, Korea

Jeong Woo Seok
Institute of Technology, Samsung Corporation
Seongnam-Si, Gyonggi-Do, Korea

Daejin Hwang
Institute of Technology, Samsung Corporation
Seongnam-Si, Gyonggi-Do, Korea

Myoung Mo Kim
Department of Civil Engineering, Seoul National University
Seoul, Korea

ABSTRACT

At most pile construction sites, the quality control parameters of pile installation and the pile bearing capacity are calculated by using velocity-time history and axial force-time history measured by the accelerometers and strain gauges, respectively, instrumented at the pile head during pile driving. This study used the newly developed Digital Pile Penetration and Rebound Monitoring system (DPRMs) to develop simple, convenient methods for evaluating the quality control parameters and the bearing capacity. To this aim, data were collected at two construction sites and one test site, which was prepared solely for this research, by DPRMs and Pile Driving Analyzer (PDA). Piles constructed at those sites were PHC (Pretensioned spun High strength Concrete) and steel piles. The maximum compressive stresses calculated from the DPRM measured data were 100±15% of those from the PDA measured data. The empirical relation between the pile drop height and the maximum initial velocity of pile head measured by DPRMs was obtained from a regression analysis whose coefficient of determination was 0.81. When the hammer drop heights predicted by the empirical relation were used in the dynamic formulas, the pile capacity estimation became more accurate by about 10%.

KEY WORDS: driven pile; DPRMs; quality control; driving stress; hammer drop height; dynamic formula; pile capacity

INTRODUCTION

Driven pile construction is controlled by various means to ensure sufficient pile capacity and to prevent pile damage. In-situ methods to determine the pile capacity can be classified into two types: static methods and dynamic methods. Static methods include the static pile load test and Osterberg cell test; dynamic methods include the dynamic load test and Statnamic test. The static load test, which is the most reliable but the most costly and time-consuming, cannot determine pile capacity during pile construction. The dynamic load test, although less reliable than the static load test in determining pile capacity, coupled with CAPWAP analysis is widely used for construction control in the field because it is reliable enough to determine pile capacity, and can offer information about construction conditions such as pile integrity and pile stresses during driving.

The ideal construction control of driven piles would consist of the dynamic pile load test performed on every pile under construction and the static pile load test performed on every pile after installation, but this combination would be unrealistic because of time and cost. Therefore, pilot tests on some representative piles to be constructed are performed, and driving resistance (blow counts) is measured to confirm the pile capacity at most construction sites.

In this paper, a new method is proposed to evaluate the pile capacity and pile integrity more easily. It uses the newly devised DPRMs (Digital Pile Penetration and Rebound Monitoring system), which measures pile head movement during pile driving.

DIGITAL PILE PENETRATIONS AND REBOUNDS MONITORING SYSTEM

Digital Pile Penetrations and Rebounds Monitoring system (DPRMs thereafter) was developed to measure the penetration and the rebound of a pile in the field. This system consists of special markings attached to the pile, a high-speed line-scan CCD camera, lens, and a portable PC, which is designed to withstand humidity, dirt, shock, and vibrations in