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Development of an Automated-Unmanned Seabed Type Marine CPT System

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ABSTRACT

In the design and construction of the coastal/offshore structures, it is very important to evaluate the geotechnical characteristics of marine soils, which support the structures. Although the offshore site investigation is much more difficult than onshore, safe and precise jobs have not been guaranteed because of the insufficiency of the test equipments especially for sites with deep water depth and high testing depth. Previously developed test equipments need to possess some massive structures to protect the successive conventional rods. The main objective of this study is to develop a new type of marine cone penetration testing (CPT) system, which can be utilized even for deep sea conditions and high depth (about 50m) of soil layer without any additional structural reinforcement device. The system is a seabed type and employs conventional cone, which shows more reliable results than a miniature cone. The most important parts of the marine CPT such as continuous rod system, cone penetration system with wheel drive, automatic cone rod assembly/disassembly system etc., were newly designed and manufactured. Some tests to verify the developed marine CPT system were performed at both onshore and offshore sites as well as mechanical tests in the laboratory. The test results show the consistent and promising performance of the new equipment, and thereafter the system would be applicable to various sites with practical/economical advantages.

KEY WORDS: marine soils, offshore site investigation, marine cone penetration testing (CPT), seabed type, continuous rod system

INTRODUCTION

Most coastal/offshore structures in Korea are scheduled to be located in the western and the southern coasts, which are composed of soft ground such as loose sandy soils or clayey soils. The precise evaluation of the thickness and/or the engineering properties of soft ground greatly affect the construction methods, costs and period. Therefore, it is necessary to obtain rigorously the geotechnical properties of soils for economical and efficient design of offshore structures.

Piezocone penetration test (CPTu) has been known as a very promising in situ test method because it can be used with more accuracy to obtain soil classification, the subsurface stratigraphy, deformation and consolidation characteristics as well as strength characteristics of clayey soils by providing continuous and consistent results with depth (Lunne et al, 1996). The CPT can be applied to offshore sites as well as onshore sites with high efficiency.

Since offshore site investigation is generally much more difficult than onshore jobs due to the external conditions such as wave action, tidal force, currents etc., safe and precise site investigations have not been guaranteed because of the insufficiency of the test equipment especially for the site with deep water depth and high testing depth. A lot of research for the development and practical application of offshore site investigation equipment have been accomplished by many researchers and companies. However, previously developed test equipments are usually very expensive due to the exclusive vessel, or need to possess some massive structures for safekeeping of the successive conventional rods.

The main objective of this study is to develop a new type of marine piezocone penetration testing (CPT) system, which can be utilized even for deep sea conditions and high depth (about 50m) of soil layer without any additional structural reinforcement device. In this paper, the background of the development and main features of the new seabed type of CPT system were introduced. Furthermore, the verification test results performed in the laboratory and offshore site were also presented.

PREVIOUS MARINE CPT SYSTEMS

Similar to other marine site investigations including conventional boring, sampling, field vane tests etc., the marine CPT can be performed with onshore equipment. In this case, a temporary working platform such as vessels or barges as shown in Fig. 1 is needed. Since temporary working barges are generally restricted to a shallow water depth because of the limited platform legs and tidal forces, wave