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Study on the Motion of Water in the Water Chambers for Wave Energy Converter

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ABSTRACT

Wave energy conversion technique is now actively being developed all over the world. In order to construct the system which is safe, durable in severe sea conditions and of high cost performance, it is necessary to guide the motion of water body near the converter to a preferable one. For this purpose this study is planned to experimentally investigate the motion of water introduced in the water chambers, which are made by partly submerged vertical walls, in array parallel to the direction of wave propagation. In the laboratory experiment, the amplitude of vertical motion of the water surface in the water chambers was measured and the amplification ratio has been investigated. It is shown that the ratio of horizontal length of each chamber to wave length should be smaller than one-tenth. In some conditions, amplification ratio increases with the increase of the draft/wave height ratio and wave period/natural period ratio of the U-shaped water oscillation.

KEY WORDS: Water chambers; water motion; amplification ratio, natural period.

INTRODUCTION

Controlling the direction of motion of the water due to water wave whose frequency and wave height are relatively high is a key point in the practical use of wave energy conversion. Indeed, all the systems of oscillating water column type control the motion of the water due to water wave in order to utilize the air flow as energy intake (Takahashi et al., 1989). On the other hand, several movable body types also use water chamber for the benefit of the operation of those systems. **Figure 1** shows the schematic diagram of the float counterweight type wave energy converter in which the float is located in such water chamber (Hadano et al., 2002; Hadano et al., 2006). Almost all of the systems with water chamber are located on the shore with their longitudinal direction almost perpendicular to the wave travelling direction so as to amplify the vertical motion of the water in the chamber for large energy gain. In this case, since the structure will receive severe wave force, it should be strong and this raises the cost (Koirala et al., 2009).Also, phase of the vertical motion of the water in the chambers located in array will be almost the same in individual chambers. In order to avoid this problem it is effective to set the water chambers in array such that

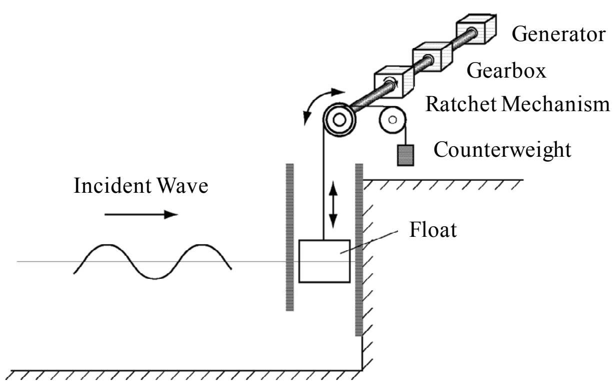

Fig. 1 Schematic diagram of the float-counterweight device

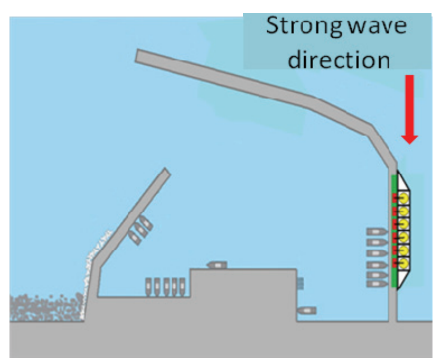

Fig. 2 Conceptual diagram of the location of the water chambers along breakwater

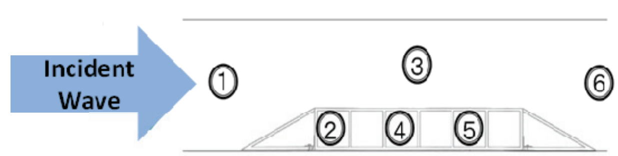

Fig. 3 Diagram showing the structure of the water chambers and the location of wave gauges