

Experimental Research on Primary Conversion of a Floating OWC “Backward Bent Duct Buoy”

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ABSTRACT

Backward Bent Duct Buoy (BBDB) which has a bent center-pipe opened to the lee side of the incident waves is a kind of moored floating OWC-type wave energy converter. In this paper, in order to make clear the fundamental characteristics of BBDB, three-dimensional experiments in waves for motions of five different BBDB models are carried out. Motions of 6 degrees of freedom of BBDB, pressure and water levels in the air chamber, etc. are measured. From the experiments, fundamental characteristics of BBDB such as the relationship between motions of BBDB and pressure in the air chamber according to the changes of the body shape of BBDB are obtained.

KEY WORDS: Backward Bent Duct Buoy, Primary Energy Conversion, Regular Waves, Experiment

INTRODUCTION

Many kinds of wave energy converters have been proposed in recent years. Backward Bent Duct Buoy (BBDB) is a wave energy converter of moored floating oscillating water column type which is composed of an air chamber, horizontal duct and buoyancy chamber and turbine as shown in Fig.1. The mouth of the horizontal duct in underwater is faced away from the waves. As BBDB has the advantage that the primary conversion performance is better than other floating type devices and mooring force is smaller than others because BBDB advances in the incident wave direction with slow-speed, BBDB is said to be one of the best type converter among proposed wave energy converters.

Some researchers are investigating about BBDB in Japan, China, Denmark, Ireland, Korea and India. Masuda (1986) proposed BBDB and carried out the tank test. He showed that BBDB has the advantage that the primary conversion performance is better than other floating type devices, and the primary conversion efficiency of BBDB with the backward facing duct for the wave direction is larger than that with front facing duct for the wave direction in waves. Masuda et al. (1993) performed tank test for the various BBDB hull configuration to investigate of primary conversion performance.

McCormick and Sheehan (1992) have experimentally shown the presence of reverse time-mean drift force that make the buoy drift into waves over specific frequency ranges. Liang Xiangguang et al. (2000) carried out experiments for the mooring of BBDB. Some theoretical researches on BBDB are also being done. Lewis et al. (2003) carried

out the comparison of physical and numerical models for BBDB in frequency domain. Hong, D.C. et al. (2004, 2005) and Kim, J.H. et al. (2006) carries out the calculations on motions of BBDB in regular waves and drift force acting on BBDB, and compared the numerical results with the experimental results.

However, many matters have not been fully understood, for example relation between the hull configuration of BBDB and motions of the BBDB in waves, and between motions of BBDB and primary conversion performance.

In this paper, a set of tank test for five BBDB models with different geometry is carried out and incident wave, motions of the BBDB, and air pressure and water surface elevations in the air chamber are measured. The effects of the hull configuration of BBDB on motions of BBDB and pressure in air chamber are discussed.

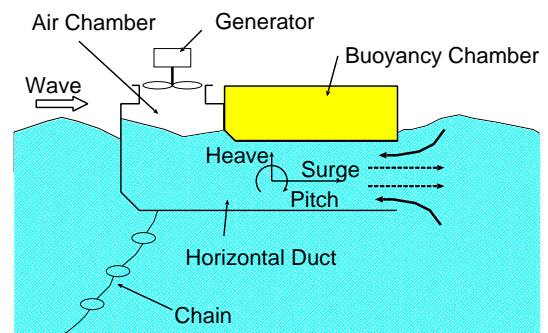


Fig. 1 Principle of BBDB

EXPERIMENTAL APPARATUS

Test models and Coordinates

The BBDB models which are used for experiments and a local coordinate system adopted here are shown in Fig.2. In this figure, the cylindrical object is a buoyancy chamber and the L shaped kind of object is an air chamber. The lower part of the air chamber from draft line is filled with water. The model is made of aluminum. The sizes and