

Development of Dual Face Serpent-Type Wave Generator

T. Hiraishi and K. Hirayama
Port and Harbour Research Institute
Yokosuka, Japan

N. Hosotani
Mitsui Engineering & Shipbuilding Co. Ltd.
Akishima, Japan

ABSTRACT

The dual-face directional random wave maker has been developed in order to reproduce double-peaked two-directional waves, long period waves and directional waves with oblique principal wave direction. Results from a series of wave generation tests demonstrate that the dual-face generator system is suitable to reproduce the target wave conditions with good accuracy.

KEY WORDS: Directional random waves, directional spectrum, dual-face wave generator, experimental wave measurement, long period wave

INTRODUCTION

Various types of directional random wave generators have been widely developed to reproduce experimentally the wave condition similar to real sea waves. Especially, the recent development of active absorption theories of multi-directional waves (Ito, K., et al., 1996) has made it possible to install a directional wave generator with three generator faces (multi-face directional wave generator) (Ito et al., 1996, Hiraishi et al., 1995). A wide area in the basin is possible to be employed as the effective test area (Funke et al., 1987) by the establishment of multi-face wave generators.

Meanwhile, recent systematic and large-scale field observation (Nagai et al., 1993) demonstrate that the directional spectrum observed offshore often has two peaks at different directions as shown in Figure 1. Each peak direction is usually apart more than 90° each other. Such double peaked directional waves are considered to be composed of 'wind wave' component with relatively short periods and 'swell' with long periods. Reproduction of double peaked directional waves is of great importance to carry out experimental study on the stability of offshore structures and navigating ships. A new type directional wave maker has been developed for the generation of double peaked directional waves as well as the multi-face wave generation with active absorption (Hirakuchi et al., 1992).

Moreover, long period waves with period longer than swell become important to estimate the stability and safety of floating structures and

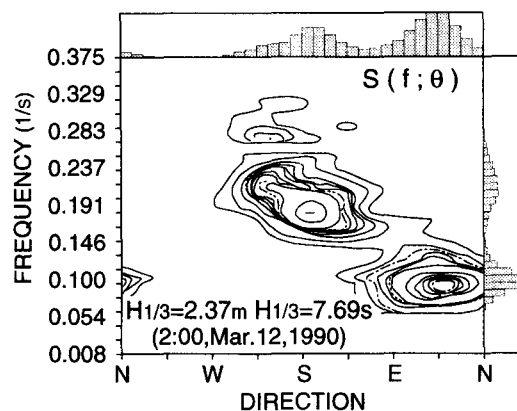


Figure 1 Observed directional spectrum with double peaks

large cargo vessels moored to berths. Because long waves' periods are near to natural periods of system composed of a ship and mooring ropes, their penetration into harbors may cause large surge motion and breakage of the ropes by resonance (Hiraishi, 1997a). Periods of long waves range usually from 50 to 100 s in prototype (Hiraishi, 1997b). The main energy of long period waves propagate as free waves from the offshore area. A standard spectrum of long period waves has been proposed to estimate influences of long period waves in harbor planning (Hiraishi, 1998).

Figure 2 shows the proposed profiles of a standard spectrum including the short period components (wind wave and swell) and long period wave components. The spectral density of long period wave components is constant and its level is determined by the parameter αl . The standard spectra with the parameter αl of 1.60, 1.65 and 1.70 are described in the figure. In order to reproduce the long period components evaluated in the standard spectrum, relatively large strokes are necessary. The newly developed directional wave maker should be also applicable to the generation of combination of short and long period waves. Tsunami is also reproduced by using the large stroke.