Physical Wave Flume

Introduction

A physical wave flume (Fig. 1) has been designed and constructed at the Department of Civil Engineering. Initial design started in 1998 and the flume is fully operational since February 1999. Its primary objective is to assist students when exploring wave dynamics, and to allow our researchers to get a better understanding of waves and wave/structure interaction using the wave flume. All components for the flume (steel construction, step motor, motor steering, software for wave generation, acquisition and analysis, ...) have been designed in-house.

Dimensions

The flume dimensions are 15.0 x 0.35 x 0.60 m (L x W x H). The flume is composed of 5 independent parts, and by adding more parts its length is expansible. Design water depth is 0.30 m. Maximum wave height inside the flume is about 0.20 m.

Wave paddle

A piston type wave paddle is installed for generation of waves (Fig. 2). The maximum stroke is 0.40 m. The paddle displacement is accomplished by using a step motor (i.e. an electric actuator). The step motor is connected with the paddle using a spindle.

Wave Generation using "GENESYS"

The Wave Generation System "GENESYS" is a PC-based application software package for generation of regular or random paddle displacement signals, and for simultaneous acquisition of data from wave height meters. Wave generation and DAQ procedures have been implemented using LabVIEW® software. The paddle displacements are controlled using a serial connection between PC and the steering board of the step motor.

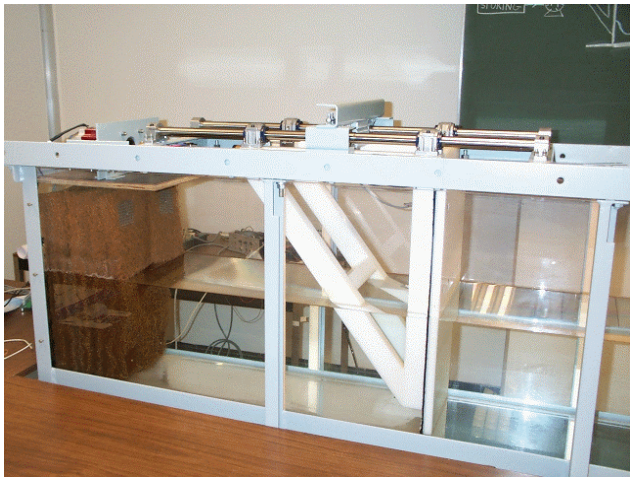

Fig. 2. *Detailed view of piston type wave paddle.*

Wave Analysis using "ANASYS"

A PC-based software package for analysis of wave signals is included in the flume software. Features include determination of wave characteristics in time and frequency domain, statistical analysis of wave heights, and options for plotting and output of detailed wave information.

Fig. 1. *Overview of physical wave flume at Dept. of Civil Engineering.*

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Wave Absorption using "AWASYS"

The wave flume is equipped with the AWASYS system. The AWASYS system is an active wave absorption system that allows the wave paddle to simultaneously generate the incident waves and absorb the spurious reflected waves. Surface elevations are measured at two locations inside the wave flume. The reflected wave train is separated from the measured wave field by means of digital filtering and subsequent superposition of the measured elevation signals. An additional incident wave train is determined in order to absorb the reflected wave train.

The AWASYS system has been designed and programmed in-house, and is based largely on the AWASYS system developed by Peter Frigaard of Aalborg University, Denmark.

Fig. 3 shows the performance of the AWASYS system for irregular waves (Hs = 0.04 m, Tp = 1.48 s, d = 0.30 m). Two types of tests have been performed: first a vertical wall (full reflection) is used, secondly a mild slope (1V:10H, no reflection) is used. For each type the AWASYS system has been switched off and on respectively. A comparison of the incident wave spectra is shown in Fig. 3, and clearly shows the performance of the AWASYS system for fully reflective structures and irregular waves.

Fig. 4 shows the paddle displacement signal X and the corrected paddle displacement signal X_{corr} for a fully reflecting structure (wall - top) and a low reflecting structure (slope - bottom).

Contact

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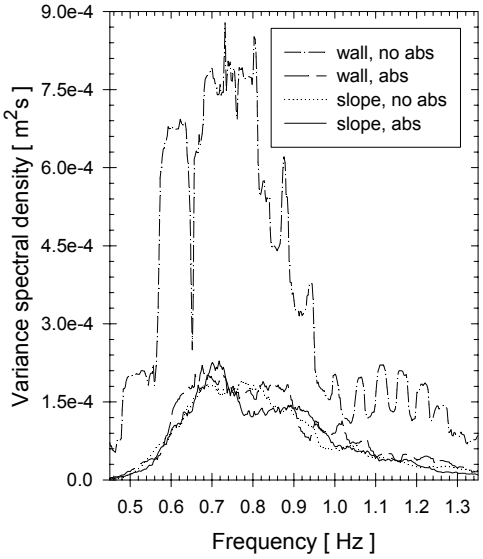

Fig. 3. *Performance of active wave absorption system for irregular waves for the cases "wall" (full reflective) and "slope" (no reflection).*

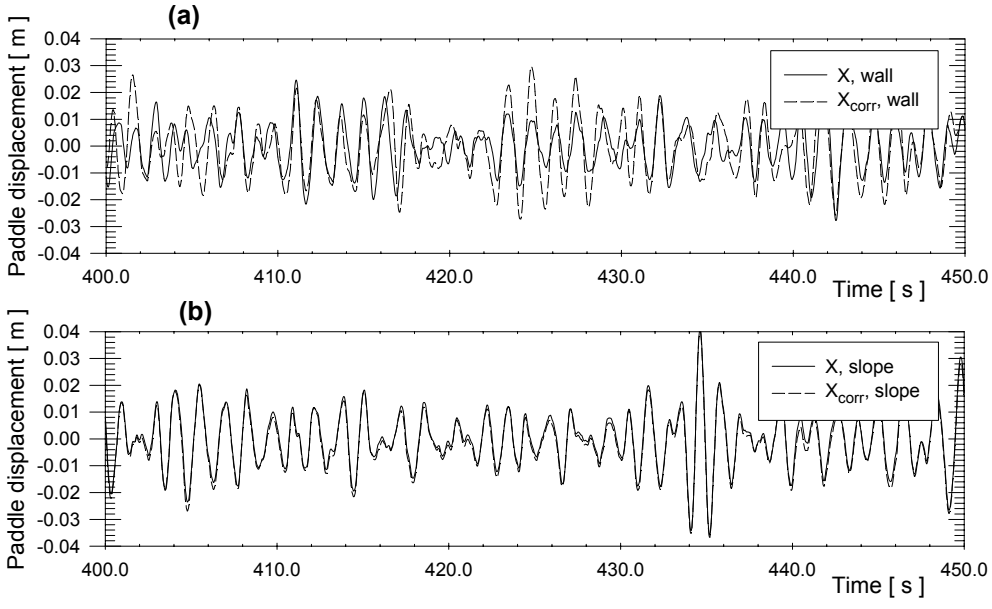

Fig. 4. *Paddle displacements (without and with absorption correction) for the cases "wall" and "slope" resp.*

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