Study on the Stability of Breakwater Structure in North-east Coast of Tianjin Port

Liancheng Sun, Chun Chen, Longzai Ge

Key Laboratory of Engineering Sediment of Ministry of Communications, Tianjin Research Institute of Water Transport Engineering, Ministry of Communications Tanggu, Tianjin, China

ABSTRACT

A 2-D experiment on the stability of structure segment, wave overtopping and wave forces on breakwater for reclamation engineering were carried out in a wave tank with hydraulic piston-type wave maker offered with reflection absorbing system. There are three options for the breakwater design, namely: caisson with curved perforated wall (Model 1), caisson with curved perforated wall and additionally a high crown wall (Model 2) and step-type caisson with low crest elevation in the front of sea side (Model 3). Three water levels are tested: extreme high water level (EHWL), design high water level (HWL) and the design low water level (LWL). Under the action of regular and irregular waves with 50 years return period, reflected wave by breakwater, second waves behind the breakwater caused by wave overtopping, wave overtopping discharge and the average thickness of water flow over the top of structure were measured, the stability of caissons, shoulder pad rubble and riprap mound as well were investigated.

KEY WORDS: breakwater; stability; wave overtopping; wave force.

INTRODUCTION

Dongjiang Port is located in the northeast coast of Tianjin Port oriented to the Bohai bay. It is a peninsula-style port which is a reclamation area on the coastal zone; its north-south length is about 10.7 kilometers, from east to west the width is 3 kilometers, and the area is about 31.9 square kilometers (Fig. 1). To effectively prevent the artificial harbor off the waves on the beach and yacht marina, a breakwater in the east of Dongjiang Port was constructed. In order to meet the needs of the design of breakwater, so as to understand the stability of the breakwater structure units as well as the wave overtopping discharge and the wave forces on structures, a wave cross-section model test for breakwater construction was carried out. Three kinds of structure cross-section options, at different water levels under the action of the corresponding design wave conditions were carried out (Sun, 2008; 2009).

EXPERIMENTAL WAVE CONDITIONS

Experiment of wave parameters of 50 years return period on E (ESE) direction of the wave are considered. Both regular waves and irregular waves are tested. For regular waves, the one percent cumulative probability wave height $H_{1\%}$ is taken, for irregular waves JONSWAP spectrum are used. Sea bed elevation before the seawall is -2.5m, Wave parameters are listed in Table 1. Three design options of breakwater are shown in Figs 2–4 below.

![Fig.1 Layout of the construction](image1)

![Fig.2 Cross section of Model 1](image2)