Experimental Study on Mechanical Characteristics of Wooden Plank Road under Wave Actions

Liancheng Sun, Shanshan Yao and 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

Wooden plank road is a sightseeing sidewalk made from wood and in this test a wooden plank road crossing over the semi-circular breakwater of Tianjin Port is simulated, the plank road uses high-pile bent structure with 7m bent space as its foundation, each bent structure is composed of two φ1000mm piles, longitudinal beams are poured in place on the top of the piles and then precast hollow beam are installed, after that, the longitudinal beam and hollow beam connect as a whole. As the project located at the concave corner between the east dike and north breakwater of Tianjin Port, the forces of wooden plank road in this paper is different from the former study, mainly in three aspects: (1) since the bottom of the wooden plank road cross over the semi-circular breakwater, the interaction between the breakwater will lead to complex bottom wave state; (2) the basal span of the hollow beam is as large as 20m each single width along the wave direction, thus the uplift pressure become the main factor affecting the structure design; (3) the wave energy will be concentrated at the concave corner where the wooden plank road lies.

KEY WORDS: Breakwater; wooden plank road; wave forces; physical model tests.

INTRODUCTION

As the wooden plank road located at the wave energy concentration area, the pile’s diameter is just 1.0m, considering the effects of the water level and waves. The scale of the experiment need to be small enough to carry out laboratory measurements through the pressure sensor arrangement of the corresponding points. However it is difficult to satisfy the above requirements in 1m wide wave flume. Therefore, the semi-integral physical model test is introduced in this paper, which is able to reflect the real wave conditions. The wooden plank road model is eventually placed in a flume which is 45-m long, 12-m wide and 1.5-m high. The ends of flume are equipped with wave-absorbing devices. The wave maker is an absorption wave machine driven by motor servo which is supported by the Key Laboratory and reach the international advanced level. The machine can produce both regular waves and irregular waves. This model will simulate the entire 90m long wooden plank road and part of the north breakwater of Tianjin Port. For the collection of wave force, it was used the SG2000 dynamic water level measurement system.

The model is designed by the gravity similar criteria (Ministry of Transport of China, 2001), geometric scale is 13.5, force scale is 2460.4 and time scale is 3.67, using JONSWAP spectrum as irregular wave spectra. Wave parameters of the experiment are shown in Table 1.

Table 1. Wave parameters

<table>
<thead>
<tr>
<th>Return Period</th>
<th>50a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wave Parameters</td>
<td>H1/3(m)</td>
</tr>
<tr>
<td>Extreme high water level</td>
<td>2.6*</td>
</tr>
</tbody>
</table>

Note: “*” means wave is breaking

The cross-section view of the wooden plank road is described as below (Ministry of Transport of China, 1998): the basis of the wooden plank road is the existing semi-circular breakwater whose crest elevation is +5.0 m. Mud surface elevation is +1.5 m, and crest elevation of the plank road is +7.50 m. Using high-pile bent structure with 7m bent space, each bent is composed of two φ1000mm piles. Longitudinal beams are poured in place on the top of the piles, and then precast hollow beam are installed, after that, the longitudinal beam and hollow beam connect as a whole (see Figure 1).