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LABORATORY STUDIES ON WAVE FORCE OF COASTAL STRUCTURES MADE OF FLAT GEOTUBES*

LIN Gang, SHU Yi-ming, LU Xin, DAI Lin-jun, YU Xin-zhou, ZHANG Xian-lei, YI Jing-rong
College of Water Conservancy and Hydropower Engineering, Hohai University, Nanjing 210098, China,
E-mail: lingang9804@163.com

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Abstract: Flat geotubes are widely used for coastal structures such as seawalls, breakwaters and sightseeing groins, etc.. However, the understanding of the stable mechanism involved in the wave-structure interactions should be deepened, and one of the important work is to clarify the stress state of the structure under the wave action. In this article, wave force acting on coastal structures made of flat geotube is experimentally investigated. The required drag, inertia and lift coefficients are especially analyzed from the results of hydraulic model experiments specially designed for geotube structure. Several types of structures made of flat geotubes under wave action have been tested in order to understand the stress state of the geotube fixed to force transducer within different structures. Experimental results show that the wave-induced forces on the instrumented geotube are markedly influenced by wave elements. Meanwhile, the magnitude of horizontal force of adjoining geotube is different at the same time.

Key words: flat geotube, wave force coefficients, inertial force, drag, lift, coastal structure, hydraulic model experiment

Introduction

There is a long coastline along the East and South of China, and potamic shoreline are also widely distributed inland. Many coastal structures such as seawalls, artificial reefs, speedway and even reservoir have been built around these lines. These structures are more and more used instead of hard coastal framework made of concrete or rubble materials[1]. And flat geotubes are widely adopted. In recently years, many coastal structures have been successful constructed made of flat geotube. However there is no ready-made theory or formulae available for the hydraulic stability of flat geotube structures, which is used to accounting for the process affecting the stability of structure. The most important of studying the stability of structure is to analyze wave forces acting on flat geotubes.

Based on the previous investigations, a new experiment has been designed, in order to study the characteristics of wave-structure interaction[2-4]. A geotube fixed to force transducer, which is placed in several types of geotube configurations, is used to gain the drag, inertia and lift wave force in the wave action and study the stress state of different geotube structures in combination wave elements. By using the least square method, the drag, inertia and lift coefficients C_D, C_I and C_L are derived in this article.

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Biography: LIN Gang (1978-), Male, Ph. D. Candidate
Corresponding author: SHU Yi-ming,
E-mail: shym@hhu.edu.cn

1. Theoretical formulae

1.1 *Wave force and coefficient formulae*

According to the Morison equation, the wave-induced horizontal force on the geotube structure is given by

$$F_H = 0.5\rho C_D A_s u(z,t)\left|u(z,t)\right| + \rho C_I V \frac{\partial u(z,t)}{\partial t} \tag{1}$$

where ρ is the density of water, C_D the drag force coefficient which reflects on the shape and material of the flat geotube, C_I the inertia force coefficient, A_s the cross-section area of geotube normal to the water current, V the volume of the geotube, and $u(z,t)$ the horizontal particle water current velocity in the vicinity of the geotube structure.