Parametric Study and Design Method of Compressed Steel-Rubber Composite Anti-Collision Device

Ruigen Zhou, Ziheng Xin, Haiying Ma, Junjie Wang
Tongji University, Shanghai, China

J.A. Lozano-Galant
University of Castilla-La Mancha, Spain

Contact:ZRG@tongji.edu.cn

Abstract

The compressed steel-rubber composite anti-collision device is a new type of self-floating device protect bridges from ship collision, which can significantly reduce the structural damage caused by ship collision. The use of compressed tires recycles the old tires and increases the elasticity of the device. Based on experimental analysis, the paper continued to develop detailed finite element model to investigate the behavior of the anti-collision device. Besides the comparison with the test results, parametrical study was developed including the thickness, position, number of the diaphragms to evaluate the sensitive parameters, so as to determine the design parameters for different collision conditions. Finally, a simplified design method including the key parameters was proposed to simplify the design process of anti-collision design.

Keywords: anti-collision device; parametrical study; ultimate load capacity; simplified formula

1 Introduction

The compressed steel-rubber composite anti-collision device is a kind of self-floating bridge anti-collision device with the advantages of high anti-collision efficiency, good durability and low consumption (environmental protection and low cost). Previous and current research mainly focus on the ability to protect bridge abutment structures. Chen et al.[1] investigated the effects of material strength, number of roll-slip components and yield strength of energy-consuming steel cylinders on the anti-collision performance of self-floating collision avoidance devices. The results showed that self-floating anti-collision devices could prolong the impact time and significantly reduce the peak impact force. Fan et al.[2] carried out numerical simulations of a new steel-concrete combination anti-collision device, and the numerical analysis results showed that the protection performance of the device was better than that of the traditional steel fenders. Luo et al.[3] investigated the protective capability of a steel-composite anti-collision device and showed that it could effectively mitigate the severity of ship-bridge collisions and significantly reduce the structural response of bridge columns. Zhou et al.[4] proposed a new type of assembled ultra-high performance concrete (UHPC) anti-collision device, and found that the collision prevention device had a very strong energy absorption capacity. Pan et al.[5] studied the collision process between a ship

https://doi.org/10.2749/nanjing.2022.0845
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