Experimental and Numerical Investigation of Slamming on Wedges with Different Stiffened Panels

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ABSTRACT
This paper studies the slamming responses of a wedge structure for the water entry problem. One steel wedge with stiffened panels with a deadrise angle of 45 degrees and a series of free-drop model tests were carried out. An explicit finite element code is applied to simulate this slamming problem. The peak pressure, duration time and stress responses on wedge structure are obtained. Comparisons of the numerical and experimental results are carried out. Good agreement is achieved. The influence of structural stiffness on slamming responses is also discussed.

KEY WORDS: slamming; wedge; peak pressure; stress responses; structural stiffness; test; duration time.

INTRODUCTION
Slamming occurs on the ship and ocean structure in a harsh working environment. Slamming is a transient process, and the impact pressure is quite short and large, which will cause local structural deformation or hull structure fatigue, and even the hull structure collapse after failure. The problem of slamming has attracted more and more attention. Since slamming is a complex hydrodynamic phenomenon of interaction between ship and wave, which has the characteristics of locality, instantaneity and rapid mobility, it is quite difficult to study the slamming phenomenon. The research methods on slamming include theoretical analysis, numerical calculation and experimental research.

In recent years, numerical methods based on Explicit Finite Element Method (FEM) have been applied to study slamming problems. Chen (2005) studied the water entry problems of a flat-bottom structure by using Msc.Dytran. Stenius (2006) used the explicit FEM of LS-DYNA to investigated the 2D rigid wedge water entry problems. 2D elastic panel-water impact problem was also discussed by Stenius (2007). The influence of the penalty factor on the damping effect was discovered by Aquelet (2006). Luo (2011) carried out a study of the hydroelastic impact problem on wedges by using The Arbitrary Lagrangian-Eulerian (ALE) algorithm, and excellent comparisons with experimental ones were obtained. Xu (2014) carried out a prediction for water entry of 2D wedge body with explicit FEM.

In this paper, a wedge model with small stiffness is designed and used in experiments to study the impact. The predicted slamming responses by using FEM code Msc.Dytran is compared with the results from the experiment to validate the simulations. Then the influence of structural stiffness on slamming responses is analyzed based on the validated simulation model.

MODEL TEST
One steel wedge model with a dead rise angle 45° is designed and built for the experimental program, which is illustrated in Fig. 1.

![Fig. 1 Middle cross-section of the model](image)

The bottom of the model is made up of two stiffened panels with 2 longitudinal stiffeners and 3 transverse frames on each side. The