Proceedings of the Eighteenth (2008) International Offshore and Polar Engineering Conference
Vancouver, BC, Canada, July 6-11, 2008

ISBN 978-1-880653-70-8 (Set); ISBN 1-880653-68-0 (Set)

Numerical Simulation of Hydrodynamic Behaviors of Single Grid Mooring Net Cage under Waves

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ABSTRACT

In this paper, based on lumped mass method and linear wave theory, a numerical model of the grid mooring net cage under waves has been developed by setting up the motion equations of floating system, net system, mooring system and floaters. In order to validate the numerical model, physical model tests have been carried out. According to our comparisons, the simulated results agree well with the experimental data. For single grid mooring system, there are three types of mooring lines, including bridle ropes, grid ropes and main ropes. According to our simulated results, forces in the three types of mooring line were calculated and analyzed. At the end of the paper, the hydrodynamic behaviors of net cage with the grid mooring system and four-point mooring system were simulated respectively, and the effects of mooring system types on the mooring line forces, the motions of floating collar and the net deformations of net cage were compared.

KEY WORDS: Single grid Mooring Net Cage; Four-point mooring; Numerical Simulation; Gravity cage

INTRODUCTION

For the near-shore fishing farms may result in serious problems such as pollutions and diseases, more fishing farms are being located offshore at present. This calls for new technological challenges, as fish farms are being installed at location more exposed to waves and current. Therefore, researches on hydrodynamic characteristics of the deep water gravity cage become a priority of the further development of offshore cage aquaculture. An easy-to-use computer-simulation system for designing fishing nets is required to reduce costs, save time, and avoid the labor of flume tank tests. In the recent decades, some scientists have attempted to simulate the dynamic behavior of fishing net shape and put forward many useful methods, for example,Tsukrov (2003), Fredheim (2001) and Lader (2001). In our previous researches, a numerical model(four-point mooring system), which can simulate the hydrodynamic behavior of gravity cage in current and waves, has been developed and validated. In this paper, the hydrodynamic behavior of gravity cage with the single grid mooring system in waves are simulated, using the numerical model. According to our simulated results, the forces in the three types of mooring line (including bridle ropes, grid ropes and mooring ropes) are analyzed. Then, the hydrodynamic behaviors of net cage with the grid mooring system and four-point mooring system are simulated respectively, and the effects of mooring system types on the mooring line forces, the motions of floating collar and the net deformations of net cage are compared.

NUMERICAL METHODS

Generally, the single grid mooring net cage consists of netting system, mooring system and floating collar system, as shown in Fig. 1 In this section, the numerical model of systems are introduced, respectively.

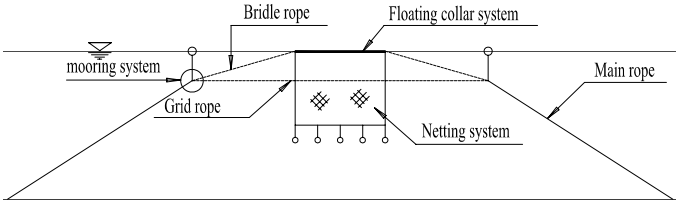

Fig.1. Sketch of grid mooring net cage structure

Model of floating collar system

The floating collar system includes floating pipes, handrails, stanchions and joint members. In general, the floating collar system of the gravity cage is usually at the water's surface. The double floating pipes are the main parts to withstand the wave–current-induced loads. For simplicity, the floating collar system is regarded as a double-column pipe system, as shown in Fig. 2. It is assumed that the floating collar system will

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