Basic Research on Advanced Safety for Offshore Sea Berth in Open Sea and Berth Operation Support System

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ABSTRACT

The suspension of cargo handling caused by moored ship motions is one of the most serious problem at sea berths facing to open sea area. In this paper, we focus on a tanker sea berth facing to the Pacific Ocean. Firstly we research about the berth operation of the sea berth. Secondly, we observe and analyze the wind waves and the swell at the sea berth. Next, we simulate moored ship motions under these waves and winds, then we compare the hearing results from the berth master with the simulation results. Finally, we propose a berth operation support system for a safe berth operation.

KEY WORDS: Sea berth, Long period wave, Mooring ship motion, Berth operating support system

1. INTRODUCTION

Nowadays, most of sea berths in Japan are located in an inland sea area where weather conditions are calm. So, they are operated without any serious accidents while ships are moored. However, in recent decades, the sea berths start to be built in an open sea area, then the suspension of cargo handling or the emergency ship evacuation become serious problems. In recent years, it is reported that there are many cases of impossibility of cargo handling or breaking accidents of mooring ropes due to large moored ship motions in harbors which is located to open sea(Hiraishi at el, 1997)(Nagai at el, 1994). The improvement of the safety of moored ship and the berth efficiency are requested by berth operators. The large ship motions are caused by long period waves of 1-3 min. or the asymmetric mooring force between mooring ropes and fenders. It is important for the safety ship mooring to consider the moored ship motions in the berth planning stage. However, as far as berth operations concerned, wave heights are still used as parameters as the operation limit, therefore the investigation on large and long period moored ship motions due to the long period waves and etc. aren't reflected to actual berth operations correctly.

In this paper, we focus on a tanker sea berth located in the Pacific Ocean, and carry out the hearing research about berth operations such as cargo handling and mooring. And we observe the wind wave in winter season and the swell when a typhoon pass east sea of Japan. Moreover we carry out the simulation of the moored ship motions for moored Very Large Crude Carrier(VLCC) using observed data of waves and winds. Then we verify the validity in accordance with comparisons of hearing results with simulation results. And we propose a berth operation support system according to our study.

2. PROCEDURE FOR THE STUDY

The sea berth considered in this study is shown in Fig.2.1. It is a tanker sea berth which is located offshore 4km from the coast facing to the Pacific Ocean, and is effected by high waves or swells. The sea berth has been operated for more than 20 years, and 250,000DWT class tanker(VLCC) is the standard type of the berth, sometimes 100,000DWT class tanker is berthing. In a harbor near the sea berth, breaking accidents of mooring ropes due to long period waves are sometimes observed(Hiraishi at el, 1997). We mainly focus on the existence of long period waves at the tanker sea berth.