

New Evaluation Method of Port Planning and Ship Operation From Viewpoint of Ship Motions Using New Observation System

Kenji Sasa*

Hiroshima National College of Maritime and Technology, Toyota-gun, Hiroshima, Japan

Masayoshi Kubo

Kobe University of Mercantile Marine, Kobe, Hyogo, Japan

Satoru Shiraishi and Toshihiko Nagai

Port and Airport Research Institute, Independent Administrative Institution, Yokosuka, Kanagawa, Japan

ABSTRACT

In recent years, the maritime transportation world has changed a great deal. Maritime transportation lends itself well to environmental protection. On the other hand, transportation requires speed more than ever, and although ship motions in oceans or in harbours have already been studied, it is necessary to evaluate these ship motions in their totality. Also, ship motions are the important factor when evaluating the difficulty of ship handling when ships enter or depart harbours. This study discusses a new type of measurement unit of ship motions. Ship motions are observed for two ships in various sea areas or situations. Then, some relations between observed ship motions and port operation are evaluated with the new simulation method for harbours.

INTRODUCTION

In recent years, environmental problems such as global warming have become very serious for future society. The main reason for global warming is the discharge of CO₂ from vehicles during transportation. Hence, it is important that transportation systems discharge less CO₂ in order to construct the Recycling Society. Maritime transportation should be used more and more as a stage of domestic transportation from the point of view of environmental protection. However, the speed and safety of maritime transportation tend to be more influenced by weather conditions than other transportation systems, such as cars. Maritime transportation consists of various situations such as navigation in the ocean, ship handling at harbour entrances, cargo handling and mooring in harbours. If harbours are facing open seas, speed and safety are strongly influenced by waves or winds when weather conditions worsen. Ship motions seem to be a more obvious parameter in the evaluation of speed and safety than wave heights or wind speeds. In previous studies, ship motions were researched from the point of view of seaworthiness and shipbuilding during navigation. Also, while the motions of a moored ship were researched from the point of view of harbour operation and construction, they need to be considered at the same time as the whole system of maritime transportation. Ship motions are one of the most important factors when evaluating the difficulty of ship handling near a harbour entrance, but ship motions are not observed or studied as much near a harbour entrance. Hence, it is necessary to research ship motions in each situation for the total evaluation of maritime transportation including harbour operation. While an

accelerator system or a video camera system is customarily used for the observation of ship motions, these systems cannot observe ship motions continuously, outside and inside the harbour, when a ship enters or departs.

First, we introduce the new type of measurement unit for ship motions, which is composed of GPS (Global Positioning System), optical fiber gyro and gyro compass. This unit was developed so as to be able to observe ship motions in each situation. Then, field observations of ship motions are carried out in all situations when ships navigate in open seas and bay areas in Japan. Finally, we consider some points about maritime transportation and port planning from various aspects using observed data of ship motions. And the new evaluation method can be proposed for future use in port planning and harbours facing the open sea.

PROBLEMS OF SHIP MOTIONS DURING MARITIME TRANSPORTATION AND HARBOUR PLANNING

In a stage of harbour planning, harbour tranquility used to be defined as the way to decrease wave heights inside harbours. Thus, long breakwaters are often constructed in harbours facing the open sea in Japan. This causes wave heights to become lower and keeps the water area in harbours calm. However, there are some problems with harbour oscillation and moored ship motions due to long period waves (Hiraishi et al., 1997). On the other hand, the issue of weather routing is researched when ships can avoid rougher sea areas during navigation. Fig. 1 shows the flowchart for ship motions that have to be considered in the total situation of maritime transportation.

Many studies are being carried out regarding moored ship motions in harbours (Shiraishi et al., 1996). On the other hand, the difficulty of ship handling is mainly examined by the ship handling simulator near the harbour entrance, although this considers only the influence of winds or currents. Waves are the most important factor for ships near a harbour entrance, especially in the open

*ISOPE Member.

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