

# NAVIGATION IN RESTRICTED AND CONGESTED AREAS

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## <sup>1</sup>ABSTRACT

An area of water where due to presence of many vessels in the vicinity, a repeated risk of collision exists and it may be difficult for own vessel to maintain her course is a congested area.

Restrictions can be of many types which can arise due to environment conditions or due to man made factors. Some of them may also be restricted due to the areas special recognition by IMO and various other regulations such as MARPOL such as areas protected by various annexes for control of pollution of marine environment.

### KEYWORDS

Risk of collision, IMO (International maritime organization), MARPOL (Marine environment Pollution)

## INTRODUCTION

An area of water where the situation repeatedly arises in which a vessel is likely to collide with another vessel and an action to avoid a collision is limited by the existence of a third vessel or fixed structure or due to the prevailing circumstances and conditions, or where such situation is expected to arise.

There are many notable areas of congested waters for e.g. East Coast of China, Gibraltar Strait, Istanbul strait etc.

Due to restrictions such as shallow water, high density of traffic, smelting ground, stranding, grounding. The ship maneuvering becomes very difficult in congestion and restrictions caused both due to authorities and nature.

The Officer of the watch (OOW) must always be aware of the possibility of navigation in congested waters, and if the vessel is expected to navigate such areas, he must take the following action:

Early evacuation from the congested area, if possible.

Arrangement of Lookout(s).

Report to the Master.

Test of manual steering or changeover to manual steering.

Contact with Engineers, if necessary.

Reduction to a safe speed, if required.

Running in Parallel of Power units of Steering gears.

The Master, when the vessel is in congested waters or upon receiving the report from the OOW above, must confirm the situation and increase officers or ratings for lookout as required. He shall take over the command of the vessel.

The OOW should also be aware of the ship handling characteristics so that he can take proper and effective action to avoid collision in compliance with the collision regulation.

Proper planning and routing measures are necessary if the vessel is operating in higher latitudes as presence of ice and fog are yet another danger which effect the shipping immensely. At no times the vessel is allowed to breach the annexes of the MARPOL regulations.

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## **<sup>2</sup> An Assessment of Ship Impact on the Ground during Maneuvering in a Port Water Area**

### **ABSTRACT**

The building of new ports is restricted by natural conditions of sea water area and the required great financial effort. The main restriction in serving these ships is the depth of port waters which directly affects the safety of a maneuvering ship. The undesired impact against the ground can damage the ship hull and block the port. Therefore, there is a need to develop scientific method of specifying the safe under-keel clearance such that the safety of a ship will be maintained for different conditions.

### **KEYWORDS**

Navigational risk, Ship impact, Port water areas

### **INTRODUCTION**

The rapid increase in seaborne transport observed since the 1970s has resulted in an intensive growth of the merchant fleet. Port areas are a particular type of navigable waters because maneuvering is limited by a number of factors. An analysis of marine accidents shows that a large number of such accidents occur within port waters. At present, the minimum keel clearance in the port of Świnoujście has been set to be approximately 0.1 of the ship's draft, which allows accepting ships drawing not more than 12.8 m. Those values of safe keel clearance result from scientifically proved method of predicting safe keel clearance. Naturally, the appropriate method has to be used assuring the determination the safety level which can be defined by navigational risk. The risk can be presented as a combination of the probability of ship's impact against the bottom and the consequent hull damage.

Let us consider this example. About 60 ships calling yearly at Swinoujście have their actual capacity limited by the maximum permitted draft that cannot exceed 12.80 m (according to the Port Regulations in force), even if in many cases the draft could be deeper. The losses due to that restriction are as follows:

- Limited quantities of cargo loaded and unloaded, which means lower earnings for the harbor and stevedoring companies.
- Lower ship owners' profits as the ship's capacity is not used to the full or longer turnaround Time due to necessary lighterage at the roads, before the ship's entrance. It should be noted that the Ship's operating costs are the same no matter whether the ship is fully laden or its capacity is Unused by, say, 15%;
- Port charges are smaller as they depend on the ship's tonnage (berthing, towage etc.);

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## ABSTRACT

An appropriate method for predicting the under keel-clearance should be available. The echosounder should be made use of frequently when navigating in restricted areas. It is also important to note what kind of restriction exists and what kind of seabed is available. The presence of various factors may lead the navigator to undermine the small echosounder. Draft settings to known at all times while navigating in restricted areas.

Keywords-echosounder, under keel-clearance

### <sup>3</sup> SHIP'S KEEL CLEARANCE

Safe movement of a ship in a certain area can be described as a state in which its hull will not touch the sea bottom.

The overall error in depth determination is connected with errors done in:

- inaccurate soundings,
- determining the navigational reserve,
- determining water level; and
- an error due to muddy bottom.

The error of ship draft determination is affected by errors done in:

- determining the change of draft in fresh water,
- estimated ship's list,
- draft determination due to waves,
- assessment of proceeding ship's squatting.

One of the most important factors affecting the keel clearance is the water level and associated error. The water level changes due to a variety of factors. In non-tidal waters, such as Polish ports, the chart datum refers to the mean sea level. From ship's safety point of view, decreased water level is critical. Therefore, it is recommended that the allowance be made for low water level while determining the keel clearance.

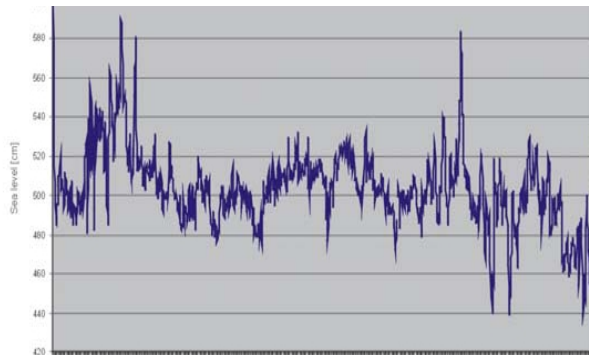


Fig. 1 Fluctuations of the sea water level in the port of Swinoujście in 2002

The chart shows clearly that the maximum drop of water level equals 60 cm and lasts over a relatively short period of time. Thus we can state that the water level reserve for low states assumed so far can be reduced. This will enable the port to accept ships of deeper draft, enhancing its effectiveness and competitiveness.

## **ABSTRACT**

A simplified approach as the quantity of absorbed energy depends on a lot of factors, but mainly on the structure of the ship's hull bottom, material properties and the type of damage. So safety of ship is affected the evaluation of ships movement is important and it should allow the impact against the ground

Keywords-ships hull damage, energy absorbed

## **<sup>4</sup>SAFETY OF A SHIP MOVING IN PORT WATERS**

Only incidents in which the ship's hull is damaged are regarded as accidents.

The damage may be of various kinds like tearing of bottom plating, crushing of deck, folding of web frames, stretching of shell plating.

That is why the evaluation of ship's movement safety should allow for its impact against the bottom, on condition that the effects of the impact (losses) do not exceed the accepted level (hull damage). The level of losses sustained from the impact against the ground depends on many factors, the most important of which is the type of bottom (ground). If the bottom is soft, penetration to a certain depth does not cause any hull damage. In the Rotterdam approach channel penetrations were observed to be as deep as 40 cm where no serious damage to the ship hull occurred.

Impacts against the ground are obviously caused by wrong determination of the keel clearance, i.e., its assumed value has been too small. On the other hand, if too large keel clearance value is assumed, the probability of impact will be decreased, but the admissible ship's draft will also be smaller.

Therefore, there is a need to develop a scientific method of forecasting the proper keel clearance for the acceptable safety level. The method should be based on the evaluation of the ship movement safety using the proper criteria. The risk of ship's hull impact against the ground resulting in hull damage may be used for the purpose.

The level of damage caused by hull impact against the bottom depends on a number of factors, the most important of which is the type of bottom (ground).

## **ASSESSMENT OF SHIP'S HULL DAMAGE DEGREE**

The kind and degree of hull damage depends mainly on the energy absorbed by the hull when hitting the bottom. The measure of hull damage used for the assessment of the impact is the volume of damaged hull material. The relationship combining the absorbed energy and the degree of damage has been empirically worked out by Minorsky [5]:

$$E = 47.2 \cdot RT - 37.2 \quad (9)$$

Where:

$E$  – Energy absorbed by the hull during impact [MNm],

$RT$  – degree of damage of hull material [m<sup>3</sup>]

The relation shows that the degree of damage increases in direct proportion with the energy absorbed by the ship's hull during the impact against an obstruction.

## **<sup>5</sup>ABSTRACT**

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Any subsequent action to ensure safety can be made only when the current safety level is shown quantitatively, and safety cannot be attained if there is any discrepancy in safety recognition between the controlling party and the controlled party. That is, the significance of Assessment Technology, which is an important technology for safety management, cannot be overlooked.

The target is to develop assessment technology that is capable of quantitatively assessing safety in various ship operating modes required for assisting safe ship operation from the shore side. And, the ultimate goal of this study is to promote research and development on safety management technology to assist the safe operation of ships from shore, by incorporating assessment technology into the prototype experiment system for the ship-shore communication network.

Keywords- safety management system, assessment technology.

## **6 DEVELOPMENT OF QUANTITATIVE ASSESSMENT TECHNOLOGY OF SHIP HANDLING RISK, WHICH IS HIDDEN BEHIND VARIOUS SHIP-HANDLING MODES:**

### **MONITORING SHIP OPERATING INFORMATION**

In parallel with work to complete the ship-shore two-way communication Network, safety studies were conducted on various modes of ship-handling Related to information that is required to be monitored, how such information is Processed and how such safety-assisting information should be transmitted from Shore to ships.

Concerning monitoring, ship operating information on position, course, speed, and ship motions of the FUKAE MARU, natural environmental information on wind direction, wind speed, wave heights, wave direction, and period, and, in addition, traffic environmental information by Radar PPI image, engine operating information represented by all information displayed on the engine console comprise the basic monitoring information, and these items of Information are made available in real-time at the base station on shore.

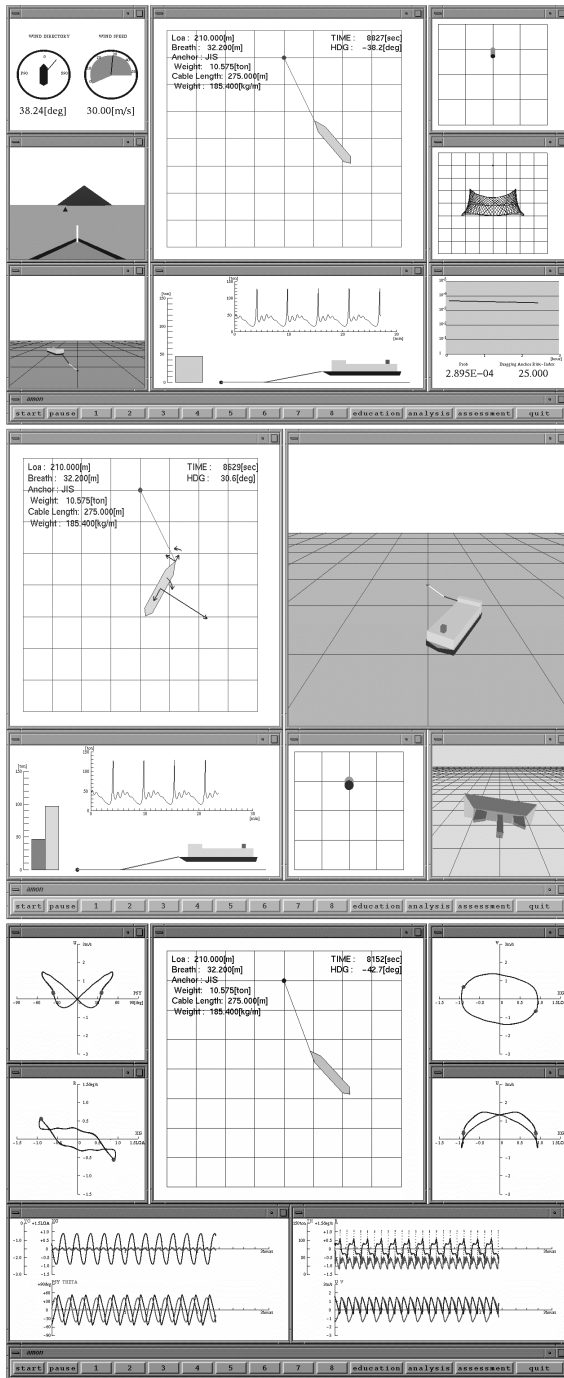
Besides the above, all data and information collected and imported into the shipboard LAN through ship-borne equipment and various sensors are made available for monitoring by requesting from shore as necessary.

### **ASSESSMENT TECHNOLOGY FOR SAFETY EVALUATION**

On the assessment technology that quantitatively assesses safety in various ship handling modes, which are required for assisting the safe operation of ships from shore, our Research Laboratory has successfully developed models for Quantitatively assessing risk levels in terms of objective numerical indexes for a variety of risks such as dragging anchor, breaking failure of mooring rope, destruction of a pier, overrun, collision with shore installations, ship-to-ship collision, grounding, and capsizing, which are associated with anchoring, berthing/unberthing operations, in-harbour ship-handling, navigation in narrow channel, ocean navigation under heavy weather, and accumulated technical Expertise.

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For ship-handling when berthing to a quay, a model capable of assessing latent risk of overrun and latent risk of destruction of a quay was proposed by introducing the concept of safety allowance [4, 5]. Furthermore, for ship-handling difficulties in harbour and in a narrow channel, where water area is restricted, and in waters where traffic is congested, Environmental Stress model (ES model) were proposed, while for grounding risk and collision risk, Unsafe Ship-handling model (US model) were proposed that

reflected the risk-assessment technique from the viewpoint of probabilities of Accident occurrence [7,8].

In waters with heavy traffic congestion, in particular, judging collision risks and selecting measures for collision avoidance constitute a major point of Consideration. Concepts of Collision Danger Line (CDL) and Cone-shaped Collision Danger Line (CDL triangle) have been developed and proposed as practical methods for navigators to readily assess risk under a specific safety Standard [7,9].

The significance of quantitatively assessing latent risks in all ship-handling Situations is to obtain basic information that enables the navigator to take the next step with confidence on the basis of the current verified safety level. When Viewed from the standpoint of managing safe ship operation, these constitute indispensable factors for developing an alert system and a safety advice system for a variety of ship-handling nodes. Figs. 4 and 5 show examples of assessment information images at the shore base station.

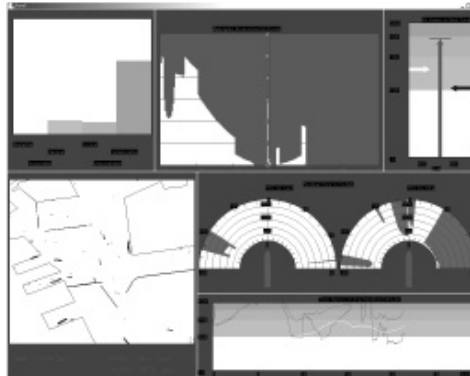


Figure 4: Assessment information images of ship-handling difficulties at the shore base station

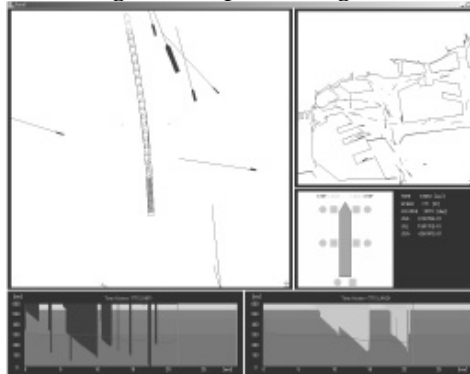
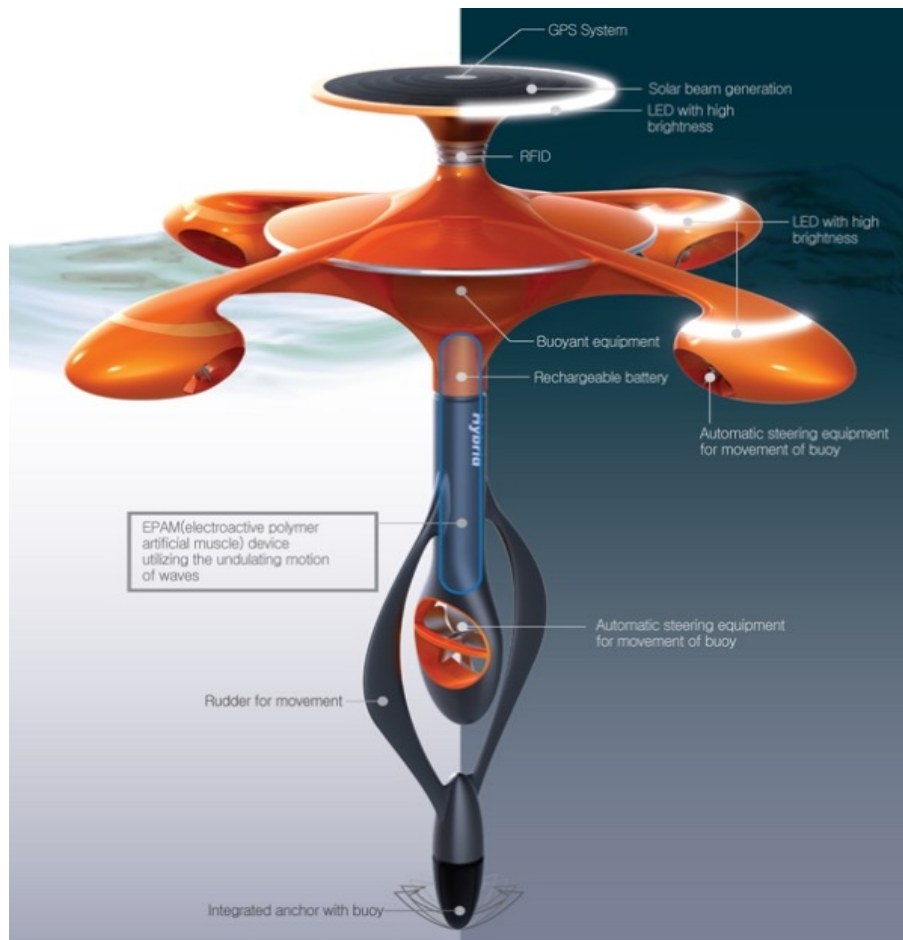


Figure 5: Assessment information images of collision and grounding risks at the shore base station

## LATEST TECHNOLOGY

## <sup>7</sup>Hybrid energy buoys

Introducing the concept that in the near future be able to manage shipping traffic. This new type of buoy is designed to be not only self-sufficient, but managed remotely. Are in constant motion (due to waves and ocean currents), the buoy produces energy for the use of electronic devices. Bui is able to prevent a shipwreck, giving a bright light signal to courts, and using the GPS can monitor this process. These buoys are easily tracked and managed using RFID.



# 8 THE CONCEPT AND WORKING OF BUOY IN A GLANCE

## Production of hybrid energy



### Concept



### The undulating energy of waves (EPAM)

The EPAM is shrinked or extended by the undulating force of the wave and such distortion of EPAM creates the electricity by induction of current drift.

5w of current per second is produced continuously

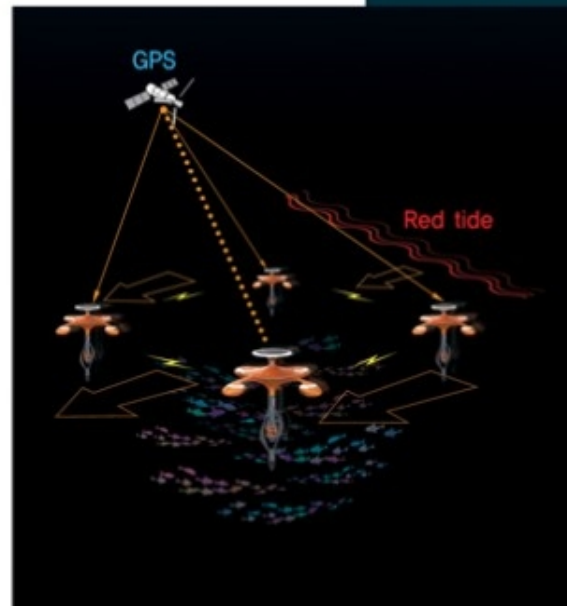


### Solar cell energy

Direct generation of electricity utilizing the photoelectric effect (The effect of electricity creation at the surface of material when the light is incident on the material.)

## Utilization of hybrid energy

- Prevention of colliding of ships in the night using the **LED** of high brightness
- Make the optimal environment by moving automatically using the **GPS** in case of problems such as red tide etc.
- Easy for the location tracing and control of buoy utilizing the **RFID**



## Conclusion

1. A ship can touch the bottom of a navigable area due to the reduction of its keel clearance.
2. One of the reasons of the decrease in keel clearance is a decrease in the water level.
3. Phenomena such as ship's pressure on the bottom ground and its reaction (passive earth pressure) are essential in the assessment of the impact effects.
4. The kind and degree of hull damage mainly depend on the energy absorbed by the hull During its impact against the sea bottom.
5. The results of the research permits to assess of navigational risk and thus to improve the safety of ship maneuvering in restricted and congested areas.
6. Research and development on the safety management technology for shore based assistance of safe ship operations has been steadily promoted by operating the prototype system of the ship-shore communication network between the FUKAE MARU (450 GT) owned by Kobe University, Faculty of Maritime Sciences and the base station within the premises of the FUKAE campus, using satellite communication.

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