Load Lines and Intact Stability of OTC Ships in Restricted Service

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Summary

This paper introduces the requirements of load lines and intact stability of Open-Top container ships in restricted service by Maritime Safety Administration of China. These requirements are developed on the fact that the sea conditions of restricted sea areas (coastal seas) is better than those of unrestricted seas, and permit no model test be carried out for Open-Top container ships in restricted service, provided that with all open holds filled with water to the determined level, the stability of the fully laden ship in the intact condition meet the survival criteria, and the hold bilge dewatering system have the required capacity, and the freeboard has the minimum height related to the ship length.

1 Background

In 1994 International Maritime Organization (IMO) issued the Circular MSC/Circ.608/Rev.1, Interim Guidelines for Open-Top Containerships (OTC-ships). This document gives an alternative of load lines by 1966 ICLL for Open-Top Containerships in unrestricted service, in which the maximum hourly rate of ingress of green water in any one open holds determined from model test is required, and stability of the fully laden ship in the intact condition with all open holds completely filled with water to the top of the hatch is required to meet the survival criteria, and the bilge pumping system is required to have a determined capacity related to the maximum hourly rate of green water shipped in seagoing conditions as established by the comprehensive model test specified and rainfall etc.

Now the Open-Top container ships in restricted service are developed for short domestic voyage in China. It is obvious that the requirements for OTC-ships in unrestricted service are unsuitable for those in restricted service because the sea conditions of the ships is better than those in unrestricted service.

However, the philosophy of the Circular MSC/Circ.608/Rev.1 should be acceptable in developing the regulation for OTC-ships in restricted service.

Through investigating some OTC-ships in river-sea and coastal area service of China, it is found that the amount of shipped green water of the ships is limited, therefore, some requirements, for example, the model test required by the Circular MSC/Circ.608/Rev.1 may be unnecessary for OTC-ships in restricted service under certain equivalent conditions. Secondly, for the requirement for stability of the fully laden ship in the intact condition with all open holds completely filled with water to the top of the hatch, the level of the water filled in open holds may be also modified for above reason.

According to the Circular MSC/Circ.608/Rev.1, the significant wave height may be regarded as the key factor for requirements of load lines stability and hold bilge dewatering system. In this consideration, based on the wave statistics of sea navigation areas and analysis of stability and freeboard for some actual OTC-ships in coastal areas in China, a study has been made for developing load lines requirements which are equivalent to those obtained by model tests as required in the Circular MSC/Circ.608/Rev.1. As the results of the study exempting model tests, the requirements for OTC-ships in restricted service are developed for Maritime Safety Administration (MSA) of China as follows.

2 Calculating significant wave height for restricted sea areas in China

From the paper[1], the values of calculating significant wave height for restricted sea areas in China are given in Table 2.1:

Table 2.1 Calculating significant wave height (m)

Sea area	CSR*	GCSR*	Unrestricted
Bohai sea	3.5	4.5	—
Yellow sea	4.0	5.0	—
East China sea	4.5	6.0	—
Taiwan straits	5.0	6.0	—
Eastern and south coast of Taiwan	5.0	6.0	—
South China sea	5.0	6.0	6.5
North sea	3.0	4.0	—

* CSR—Coastal service restriction GCSR—Greater coastal service restriction

Based on this result, the significant wave height of model tests for load lines of ships are determined as shown in Table 2.2 as follows:

Table 2.2 Significant wave height for model test

Sea navigation areas	Significant wave height* (m)
Greater coastal service restriction (GCSR)	7.5
Coastal service restriction (CSR)	5.5
Sheltered water service restriction (SWSR)	3.5

* The significant wave height of model test is increased on account of safety margin.

However the Chinese maritime community expects simplified requirements, especially that without to model tests as required by the Circular MSC/Circ.608/Rev.1 for OTC ships in restricted service. Therefore, a series items concerning the requirements of load lines and stability are studied for this type of ships.

3 Basic requirements of load lines without model test

(1) The freeboard of ships shall not be less than the minimum form freeboard as listed in Table 3.1:

(2) A dash plate or deck house or forecastle with at least a standard height shall be fitted in front of the No.1 hold.

Table 3.1 Minimum form freeboard

Sea navigation areas	Minimum form freeboard
Greater coastal service restriction (GCSR)	0.035L
Coastal service restriction (CSR)	0.030L
Sheltered water service restriction (SWSR)	0.0275L

4 Hold bilge dewatering system

It is considered that the hourly rate of ingress of green water in open hold could be determined by the wave height at seas. According to the Circular MSC/Circ.608/Rev.1, the maximum hourly rate of ingress of green water in any one open hold determined from model test should not exceed the hatch opening area multiplied by 400 mm/hour. This requirement is corresponding to unrestricted service of 8.5 m significant wave height.

Based on the results of model tests of some ships in restricted service, the minimum hourly rate of ingress of green water in open holds are determined as shown in Table 4.1:

Table 4.1 Minimum hourly rate of ingress of green water in open holds

Sea navigation areas	Minimum hourly rate of ingress of green water
GCSR	No.1 hold: 150mm/h, others: 100mm/h
CSR	No.1 hold: 130mm/h, others: 100mm/h
SWSR	100mm/h

And the bilge pumping system should have a required capacity to pump:

(1) The amount of shipped green water equal to those listed in Table 4.1, multiplied by the hatch opening area;

(2) Four-thirds of the amount of water required for fire-fighting in the largest hold;

(3) An amount equal to the capacity required for ships with closed cargo holds, whichever is the greater.

5 Intact survival stability

A study has been made for the stability of the fully laden ship in the intact condition with the assumed amount of water in holds in restricted service, in which the water level is lower the level of the top of the hatch side or hatch coaming [2].

The following figures show the righting arms curves of different amount of water corresponding to the percentage of depth of holds(u) for two ships in restricted service:

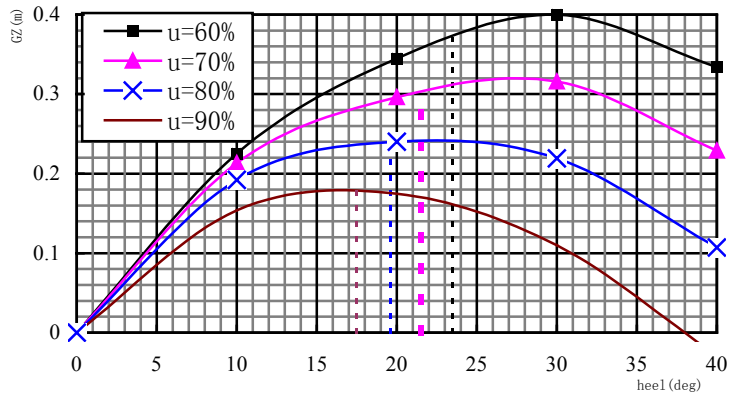

Fig. 5.1 Survival righting arms of 102TEU OTC ship

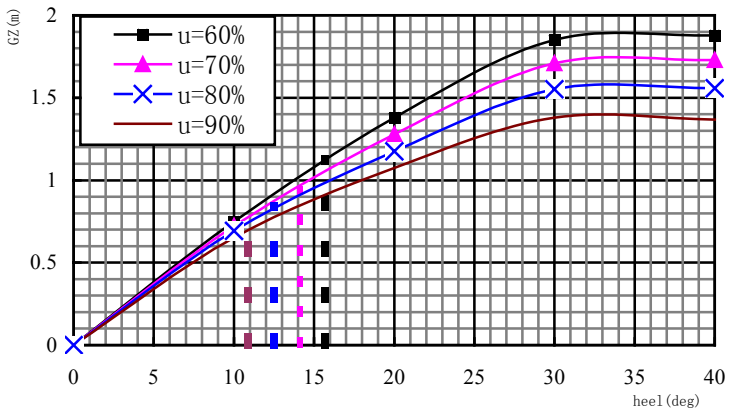

Fig. 5.2 Survival righting arms of 200TEU OTC ship

From the results of paper [2], the assumed amount of water in open holds of the fully laden ship in the intact condition are determined as shown in Table 5.1 as follows:

Table 5.1 Assumed amount of water in open holds

Sea navigation areas	Percentage of depth of holds*
GCSR	85 %
CSR	70 %
SWSR	55 %

* permeability of 0.7 is assumed for container holds

Under the above-mentioned loading condition, the intact stability of ships should meet the survival criteria (with factor s = 1) of Chapter II-1 Part B-1 of SOLAS 1974, as amended.

6 Conclusions

(1) With considering the basic factor of OTC ships, significant wave height in service, the requirements of load lines and stability have been developed for OTC ships in restricted service;

(2) Main requirements of load lines and stability exempting model test for OTC ships in restricted service, include:

— minimum form freeboard;

— required capacity to pump from three factors, including required minimum hourly rate of ingress of green water;

— Intact survival stability criteria under the fully laden ship in the intact condition with the assumed amount of water in open holds

(3) The developed requirement could meet the demand for the market of design and construction for OTC ships in restricted service.

Reference

[1] Assignment of calculating significant wave height for coastal sea areas of China

[2] Study on Stability criteria of fully laden ship filled with water in holds in intact condition