INTERNATIONAL MARITIME ORGANIZATION

IMO

E

SUB-COMMITTEE ON STABILITY AND LOAD LINES AND ON FISHING VESSELS SAFETY
51st session
Agenda item 4

SLF 51/INF.6
23 May 2008
ENGLISH ONLY

REVISION OF THE INTACT STABILITY CODE

Research outcomes for new generation intact stability criteria

Submitted by the Royal Institution of Naval Architects (RINA)

SUMMARY

Executive summary:	This document provides the information on latest research outcomes for new generation intact stability criteria for the Sub-Committee's consideration to the revision of the Intact Stability Code
Strategic direction:	5.2
High-level action:	5.2.1
Planned output:	5.2.1.2
Action to be taken:	Paragraph 6
Related documents:	SLF 50/4/4; SLF 50/WP.2 and SLF 51/4

Introduction

1 This document is submitted in accordance with paragraph 4.10.5 of the Guidelines on the Organization and Method of Work of the Maritime Safety Committee and the Marine Environment Protection Committee (MSC-MEPC.1/Circ.1), and provides comments on the report of the Working Group on Intact Stability (SLF 51/4).

2 The Sub-Committee, at its fiftieth session, agreed its action plan for developing new generation intact stability criteria by 2010 as an extension of the 2008 Intact Stability Code (2008 IS Code). This is because Part A of the 2008 IS Code requests the Organization to develop physics-oriented criteria for three major phenomena, which are difficult to be dealt with the current prescriptive requirements in the 2008 IS Code. These are restoring variation problems such as parametric rolling, stability under dead ship condition and manoeuvring-related problems such as broaching-to. The new criteria will allow us to directly apply first-principle tools, such as numerical simulations, analytical solutions and model experiments.

Research executed for this purpose

3 Since these phenomena have highly dynamic natures, the Royal Institution of Naval Architects (RINA) believes that new physics-oriented criteria can be developed only if latest research progress in naval architecture is fully reflected in the consideration at the Organization. For this purpose, it is essential for the Organization to obtain the outcomes of such latest ship stability researches. Many research outcomes in the ship stability field have been already published in the international journals and conferences through several learned societies in the world and are available in the libraries and in the INTERNET.

4 Among them the Japan Society of Naval Architects and Ocean Engineers (JASNAOE) established a research committee for the IMO physics-oriented intact stability criteria from 2005 to 2008 and executed a systematic research programme covering all three capsizing modes. On 27 March of 2008, the final report was read at the international conference named "the 6th Osaka Colloquium on Seakeeping and Stability of Ships" in Osaka and many experts in the field of ship stability from all over the world attended this colloquium and discussed the final report. Further, the JASNAOE published its final report on its website. The final report consists of six parts: the summary, the part on parametric rolling with forward velocity, the part of parametric rolling under drifting condition, the part on stability under dead ship condition, the part on application of reliability analysis and the part on broaching.

5 The RINA is of the opinion that these research outcomes could directly or indirectly contribute towards the development of the new generation intact stability criteria at the IMO. Therefore the RINA herewith provides the information of these research outcomes with the cooperation of the JASANAOE. The website reporting the JASNAOE's purpose-designed research is as follows:

[http://www.jasnaoe.or.jp/en/society/table.html]

Its summary is set out as the annex.

Action requested of the Sub-Committee

6 The Sub-Committee is invited to take into account the above information for its consideration on the revision of the Intact Stability Code.

***

ANNEX

SUMMARY OF THE REPORT OF JASNAOE'S PURPOSE-DESIGNED RESEARCH PROJECT

Part 1: Current problems in ship intact stability and activity from JASNAOE SCAPE Committee

This part reviews current problems in intact stability criteria, including the development of new generation intact stability criteria at the IMO (International Maritime Organization), the activities of the IITC (International Towing Tank Conference)'s Specialist Committee on Stability in Waves (SiW) and relevant international researches as the backgrounds of the SCAPE Committee (Strategic Research Committee on Estimation Methods of Capsizing Risk for the IMO New Generation Stability Criteria) in the JASNAOE (Japan Society of Naval Architects and Ocean Engineers). Then the achievements of the SCAPE committee are overviewed.

Part 2: Prediction methods for parametric rolling with forward velocity and their validation

Regarding parametric rolling of ships with forward velocity, this part reports experimental, numerical and analytical studies conducted by the SCAPE committee, together with critical review of theoretical progress on this phenomenon. Here experimental results of a containership in regular, long-crested and short-crested irregular head waves, and those of a PCTC (pure car and truck carriers) are also shown. They are compared with several numerical predictions to realise quantitative prediction of parametric rolling. The restoring variation, which is main cause of parametric rolling, is investigated with model experiments and potential theories. Application of time-varying coefficient vector autoregressive model is also attempted. Furthermore, the effect of devices preventing parametric rolling is investigated.

Part 3: Prediction methods for parametric rolling under drifting condition and their validation

In this part, experimental and theoretical research works on heavy parametric rolling in beam waves which have been done for these three years by the SCAPE committee are reviewed.

Part 4: Prediction methods for capsizing under dead ship condition and obtained safety level

Regarding capsizing of ships under dead ship condition, this part reports experimental, numerical and analytical studies conducted by the SCAPE committee, together with critical review of theoretical progress on this phenomenon. Here capsizing probability under dead ship condition is calculated with a piece-wise linear approach. Effects of statistical correlation between wind and waves are examined. This approach is extended to the cases of water on deck and cargo shift. Further, experimental and theoretical techniques for relevant coefficients are examined.

Part 5: Application of first order reliability method to ship stability

This part investigates the application of the first order reliability method (FORM) to the capsizing probability problem under dead ship condition subject to beam wind and waves with stochastic variation. The dynamically excited moment is modelled as Gaussian process and described by random vector with standardised normal distribution through frequency discretisation of the power spectra. Then, the most probable set of wave and wind components that will induce prescribed roll angle as well as the capsizing probability is evaluated.

Through numerical calculation for a large passenger ship problem, the obtained result is compared with that from the Monte Carlo simulation and then the shape of the limit state surface is investigated.

Part 6: Prediction methods for broaching and their validation

Regarding broaching associated with surf-riding, this part reports experimental, numerical and analytical studies conducted by the SCAPE committee, together with historical review of theoretical progress on this phenomenon. Here effect of higher-order terms in numerical modelling, extension to novel propulsion systems and application of global bifurcation theory, optimal control theory and random process theories are discussed. Experimental techniques are also investigated.

_____