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GOAL-BASED NEW SHIP CONSTRUCTION STANDARDS

Comments on the report of the Correspondence Group on GBS

Submitted by Japan

SUMMARY

Executive summary:	This document comments on the report of the Correspondence Group on GBS, namely work plan for the generic GBS framework focusing on the gap between the top-level goals and functional requirements
Strategic direction:	10
High-level action:	10.1.1
Planned output:	10.1.1.2
Action to be taken:	Paragraph 13
Related documents:	MSC 84/5/3, MSC 83/5/5, MSC 82/5/5, MSC 82/5/8, SLF 50/4/4 and SLF 49/5/5

1 This document is submitted in accordance with the provisions of paragraph 4.10.5 of the Guidelines on the organization and method of work of the MSC and MEPC and their subsidiary bodies (MSC-MEPC.1/Circ.1) and comments on the report of the Correspondence Group on GBS (MSC 84/5/3).

Proposal of the work plan by a correspondence group

2 For the development of the generic GBS framework, work plans were condensed through the extensive discussion in the correspondence group. In particular, the following prioritization was proposed, although discussion time was limited:

.1 definition of a generic framework for GBS as the basic structure/elements/basics of the work plan;

.2 development of general guidelines for GBS;

.3 a process of monitoring of the current safety level, the determination of the current safety level of rules from first principles, based on a developed risk model and the risk model itself;

.4 whether all new or revised IMO regulations, class rules and other mandatory standards should be followed by a commentary in an agreed format, explicitly stating which functional requirements are addressed, and the substantial basis for the regulation; and

.5 formulation of step-by-step functional requirements for all new areas of regulation and for every considered revision of existing regulations. It was mentioned that it might be inefficient to develop functional requirements in one go. The structure and format should be defined in the guidelines.

Definition of a generic framework for GBS as the basic structure/elements/basics of the work plan and the work to be done to develop a generic GBS framework

3 The correspondence group discussed the items of the generic GBS framework as proposed in previous submissions (e.g., MSC 82/5/8 and MSC 80/6/4):

.1 top-level goal of the IMO regulations, rules and class rules;

.2 sub-goals of the IMO regulations, rules and class rules;

.3 functional requirements that have to be fulfilled to meet the sub-goals and consequently the top-level goal;

.4 verification/validation process for class rules and other standards; and

.5 class rules and other standards.

4 Japan has the same view as the majority of the GBS Working Group, i.e., that the generic framework should contain: top-level goal of IMO regulations, rules and class rules; sub-goals of IMO regulations, rules and class rules; and functional requirements that have to be fulfilled to meet the sub-goals and consequently the top-level goal.

Determination of the current safety level of rules from first principles based on a developed risk model and the risk model itself and step-by-step formulation of functional requirements

5 Two examples, in terms of intact stability and structural safety, are introduced for the further consideration of the methodology for compensating the gaps between top-level goals and the functional requirements.

6 Regarding intact stability, three major capsizing scenarios in terms of performance-based criteria are requested to be developed for the revision of the IS Code by 2010 by the SLF Sub-Committee. Those major capsizing scenarios are associated with the righting lever variation, i.e., the parametric rolling, the pure loss of stability and so forth, the dead ship condition and the broaching, including consideration of matters related to manoeuvrability. In the GBS framework, those three kinds of stability failures correspond to functional requirements. The introduction of a probabilistic stability assessment, based on physical models, into performance-based criteria is being examined in the development of the performance-based criteria. This is owing to the possibility that the probabilistic approach can be linked with a risk analysis and the dynamic-based approach enables us to deal with new ship types without experience.

7 It is also being examined whether the performance-based criteria would be minimum requirements for ship design, applicable to unconventional types of ships and major dynamic modes of stability failures. In this concept, a ship is firstly distinguished conventional from unconventional applying vulnerability criteria, which are easily used and are based on simplified physical models, simple mathematical formulations or analytical solutions. Only if she fails to comply with it, is she categorized as unconventional and then direct stability assessment utilizing numerical simulation or the equivalent means should be applied.

8 Through extensive studies in recent years one of the feasible methodologies for a probabilistic assessment of stability at dead ship condition was constructed and verified by means of a piece-wise linear method. Fig. 1 shows an example of the long-term and short-term capsizing probabilities of a Ro-PAX ferry under intact condition within one year as a function of wind speed. Here the short-term probability means the probability that the ship capsizes within one year, assuming a stationary sea state continues during one year and the long-term one indicates the probability that the ship capsizes within one year with the statistics of wind and waves assuming one stationary sea state continues during 3,600 seconds. It is found that the short-term capsizing probability increases in accordance with the increase of wind speed and the long-term probability is not larger than the short-term probability for extreme sea states.

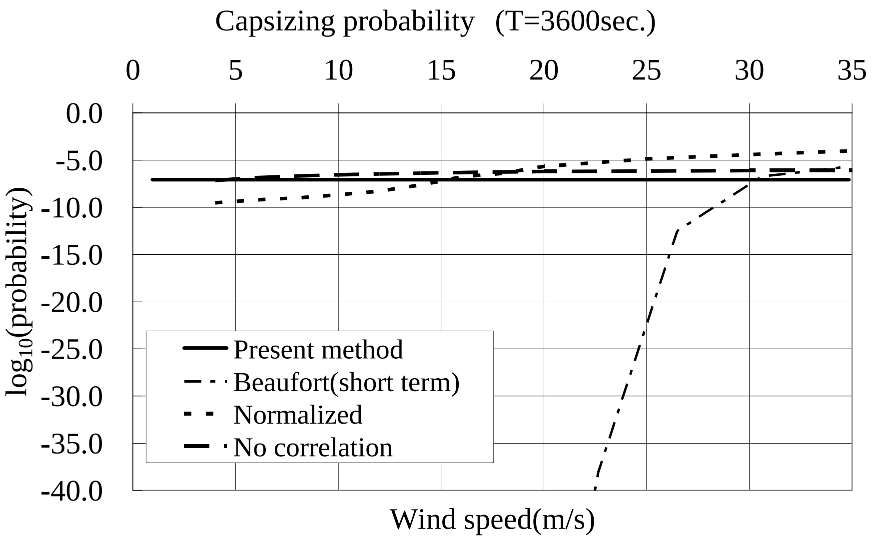

Fig. 1. Example of the computation of the capsizing probability in one year of a Ro-PAX ferry at dead ship condition

9 Together with the construction of the methodology for the performance-based criteria of the intact stability based on the physical consideration, gaps between the top-level goals and functional requirements could exist. In the case of unconventional vessels, such as huge passenger ships, it is difficult to compensate those gaps because it is considered that the accidents associated with the intact stability failure have rarely been reported so far. Therefore, gaps between the top-level goals and functional requirements may be different in ship types. In addition, the effect of the operation on those gaps was not necessarily clarified. One possible way here is to estimate the safety level for conventional vessels complying with current criteria with the first-principle tools and to apply it also to unconventional vessels. Further, operational guidelines for each vessel could be developed with the first-principle tools used for developing the design criteria.

10 With regard to structural safety, it is preferable to further the construction of the generic GBS framework by means of structural reliability analysis. It has progressed well, but considerable work remains to be done. In spite of many reliability studies, the present rules for trading ships and some rules for FPSOs do not reach the level of analysis that is required to be considered a risk-based design. The present rules for trading ships can roughly be divided into two types: Type 1 is characterized by means of scantling formulae that depend on some global geometrical parameters (with no clear distinction between load and strength); Type 2 rules are based on allowable stress checks, where a single safety coefficient is imposed between actual stresses and limiting stresses (a typical case is the reduction of the yield stress from 235 to 175 MPa). Rules for FPSOs, like other offshore structures, have been calibrated based on a reliability methodology. The advanced design approaches, which include using direct analyses of load effects, have been applied in case of advanced ships, notably LNG and container vessels as well as FPSOs and large high-speed vessels.

11 In the present situation, only the methodology for structural reliability analysis for the ultimate limit state is established. However, further verification work of that methodology should be carried out by examining uncertainties of loads (both still-water loads and wave-induced loads), strength of materials and so forth. In addition, it is difficult to compensate gaps because the real structural accident occurs owing to a combination of many factors, such as fatigue, corrosion and so forth.

12 It is preferable, to ensure proactive safety, not to develop empirical criteria but to develop rational criteria such as physical based criteria. However, many gaps between top-level goals and functional requirements certainly remain. Further examination should be carried out to compensate those gaps in addition to developing risk models for functional requirements.

Action requested of the Committee

13 The Committee is invited to consider these examples and take action as appropriate.

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