INTERNATIONAL MARITIME ORGANIZATION

IMO

E

SUB-COMMITTEE ON SHIP DESIGN AND EQUIPMENT
50th session
Agenda item 18

DE 50/18
29 December 2006
Original: ENGLISH

GUIDELINES FOR UNIFORM OPERATING LIMITATIONS OF HIGH-SPEED CRAFT

Proposal on speed limitations of high-speed craft

Submitted by China

SUMMARY

Executive summary:	This document contains a specific proposal on speed limitations of high-speed craft.
Action to be taken:	Paragraph 8
Related document:	DE 49/20, paragraph 5.16

Background

1 The Sub-Committee, having discussed the issue of operating limitations of high-speed craft under the agenda item on "Review of the 2000 HSC Code and amendments to the DSC Code and the 1994 HSC Code" at its forty-ninth session, agreed that an MSC circular should be prepared to guide Administrations in determining operational limitations in a consistent manner. The Sub-Committee also proposed to include, in its work programme and the provisional agenda for DE 50, a high priority item on "Guidelines for uniform operating limitations of high-speed craft", which was endorsed by the Maritime Safety Committee at its eighty-first session.

2 As from 1996, China has required that high-speed craft be provided with, in addition to relevant technical manual(s) such as "operating manual" and "route operational manual", a permanent board showing the relation curve of "significant wave height – speed limitations" on the bridge, which directs the crew to control the speed of operation based on actual wave height at sea for safe navigation. Based upon the operational and managerial experience of high-speed craft, China deems it necessary to develop "Guidelines for uniform operating limitations of high-speed craft".

Analysis

3 The design load of hull structure for a high-speed craft depends mainly on the slamming pressure of wave acting on the hull structure while the craft is navigating at high speed in heavy sea. The hull structure might be damaged as a result of unreasonable speed when the craft navigates in heavy seas.

4 The design load of hull structure for a high-speed craft is closely related to the vertical resultant acceleration at centre of gravity of craft. In designing a high-speed craft, the ship owners or designers will determine the maximum value of the vertical resultant acceleration at centre of gravity as allowed by structural design (normally the average value of 1/100 maximum at craft's gravity centre is to be taken), taking into account of such factors as the purpose, navigation areas and voyages of the craft, and consequently, the relation curve of "significant wave height – speed limitations" is determined by using the formula as set out in paragraph 6 below. The relation curve of "significant wave height – speed limitations" may also be determined by model test in wave conditions.

5 While a high-speed craft is under severe wind wave at sea, care shall be exercised in its operation for stability purpose, and speed limitation be determined by the visual wave height (similar to significant wave height) and the relation curve of "significant wave height – speed limitations", as appropriate, so that the loads to the hull structure will not exceed the design value and the structural safety therefore ensured.

6 The formulae to determine the relation curve of "significant wave height – speed limitations" are as follows.

6.1 For high-speed monohull, normal catamaran, SES, SWATH, wave piercer craft and hydrofoil craft:

$$V_{HK} = 75.54\sqrt{L}\left[\frac{a_{cg}\Delta}{K_T(H_{1/3}+0.07B_{WL})(L-2B_{WL})(50-\beta)B_{WL}}\right]^{0.715} \quad \text{kn}$$

where:

a_{cg} – the vertical resultant acceleration at centre of gravity of craft, in *g*, 1.0 in maximum;

K_T – hull type factor:
for monohull craft, normal catamaran, wave piercer craft, $K_T = 1.0$;
for SES, SWATH, $K_T = 0.8$;
for hydrofoil craft, $K_T = 0.7$

L – length of craft, in *m*, to be taken as the length of design waterline;

B_{WL} – design waterline breadth, in m, for multihull craft, the sum of maximum moulded breadths of each hull at the design waterline;

β – dead-rise angle at LCG , in "°";

Δ – full load displacement, in *t*;

$H_{1/3}$ – significant wave height, in *m*;

V_{HK} – speed of the craft at sea with significant wave height $H_{1/3}$, in *kn*;

g – acceleration of gravity, in m/s^2, $g = 9.81\ m/s^2$.

6.2 For ACV:

$$V_{HK} = \frac{a_{cg}\sqrt[3]{\Delta}}{0.044\sqrt{H_{1/3}}+0.022} \quad \text{kn}$$

7 As an example, the relation curve of "significant wave height – speed limitations" for a high-speed wave piercer craft is given in the annex, together with the comparison between the model test value for the vertical resultant acceleration a_{cg} at centre of gravity of two craft and the value calculated by the formula in 6.1 above.

Action requested of the Sub-Committee

8 The Sub-Committee is invited to consider the operating measures of a permanent board showing the relation curve of "significant wave height – speed limitations" to be equipped in the bridge of high-speed craft as mentioned in this proposal when drafting "Guidelines for uniform operating limitations of high-speed craft", and to adopt the formula as set out in paragraph 6 for determining the relation curve of "significant wave height – speed limitations".

***

ANNEX

EXAMPLE OF THE RELATION CURVE OF "SIGNIFICANT WAVE HEIGHT – SPEED LIMITATIONS"

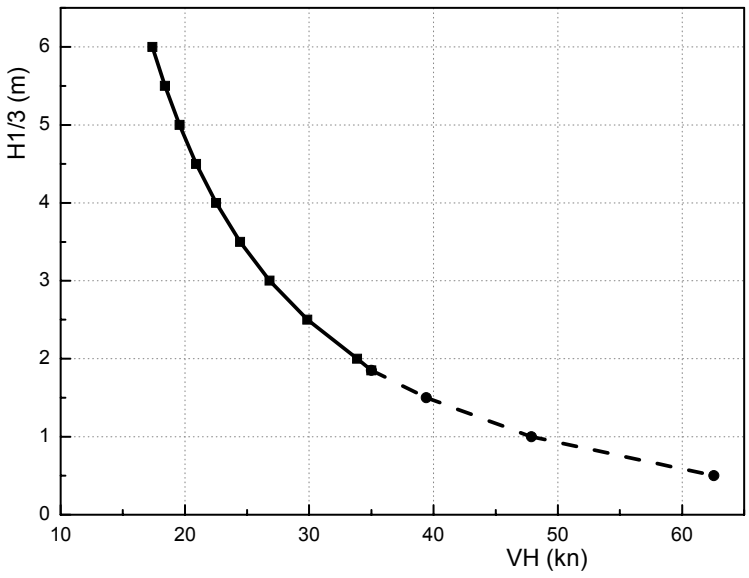
1 Data of full scale.

Type of craft	wave piercer ro-ro passenger craft
Length overall (Loa)	72.00 m
Length of design waterline (Lwl)	66.00 m
Moulded breadth (B)	22.00 m
Design waterline breadth (B_{WL})	2×4.3 m
Moulded depth (D)	6.10 m
Design draught (d)	3.10 m
Full load displacement (Δ)	970.00 t
Maximum design speed (V)	35 kn
Design navigation service	China Greater Coastal Service
Maximum significant wave height corresponding to design navigation service	6.00 m
Dead-rise angle at LCG (β)	29.4°

2 The maximum allowable value of the determined vertical resultant acceleration at centre of gravity: a_{cg} = 0.403 g.

3 Determination of the relation curve of "significant wave height – speed limitations".

The relation curve of "significant wave height – speed limitations" shown as follows may be obtained by applying the formula in 6.1 of this proposal in accordance with the value of a_{cg} as determined above:



4 Comparison between the relationship of "speed – wave height – acceleration" and model test result.

4.1 Example A – high-speed wave piercer ro-ro passenger craft (see example of this Appendix):

Model seakeeping characteristics test value: when: $H_{1/3}$ = 3.0 m, V_{HK} = 35 kn,

a_{cg} = 0.59 g

Value calculated by applying the formula as recommended: a_{cg} = 0.55 g.

4.2 Example B – high-speed small waterplane area twin hull traffic craft (L = 33.62 m):

Model seakeeping characteristics test value: when: $H_{1/3}$ = 3.5 m, V_{HK} = 20 kn,

a_{cg} = 0.12 g

Value calculated by applying the formula as recommended: a_{cg} = 0.184 g.