ANNEX 7

STABILITY OF MULTIHULL CRAFT

1 Stability criteria in the intact condition

A multihull craft, in the intact condition, should have sufficient stability when rolling in a seaway to successfully withstand the effect of either passenger crowding or high speed turning as described in paragraph 1.4. The craft's stability should be considered to be sufficient provided compliance with this paragraph is achieved.

1.1 Area under the GZ curve

The area (A1) under the GZ curve up to an angle θ should be at least:

$$A1 = 0.055 \times 30/\theta \text{ (m.rad)}$$

where θ is the least of the following angles:

.1 the downflooding angle;
.2 the angle at which the maximum GZ occurs; and
.3 30^{o}

1.2 Maximum GZ

The maximum GZ value should occur at an angle of at least 10^{o}.

1.3 Heeling due to wind

The wind heeling lever should be assumed constant at all angles of inclination and should be calculated as follows:

$$HL_1 = \frac{P_i . A . Z}{9800\Delta} \text{ (m)} \qquad \text{(See figure 1)}$$

$$HL_2 = 1.5\ HL1 \text{ (m)} \qquad \text{(See figure 1)}$$

where P_i = 500 (Pa)*
A = projected lateral area of the portion of the ship above the lightest service waterline (m^2)
Z = vertical distance from the centre of A to a point one half the lightest service draught (m)
Δ = displacement (t)

*The value for P_i for ships in restricted service may be reduced, subject to the approval of the Administration.

1.4 Heeling due to passenger crowding or high speed turning

Heeling due to the crowding of passenger on one side of the craft or to high speed turning, whichever is the greater should be applied in combination with the heeling lever due to wind (HL_2).

1.4.1 Heeling due to passenger crowding

When calculating the magnitude of the heel due to passenger crowding a passenger crowding lever should be developed using the assumptions stipulated in 2.10 of this Code.

1.4.2 Heeling due to high speed turning

When calculating the magnitude of the heel due to the effects of high speed turning a high speed turning lever should be developed using the following formula:

$$TL = \frac{1}{g}\frac{V_o^{\;2}}{R}\left(KG - \frac{d}{2}\right) \qquad \text{(m)}$$

where	TL	=	turning lever (m)
	V_o	=	speed of craft in the turn (m/s)
	R	=	turning radius (m)
	KG	=	height of vertical centre of gravity above keel (m)
	d	=	mean draught (m)
	g	=	acceleration due to gravity

1.5 Rolling in waves *(figure 1)*

The effect of rolling in a seaway upon the craft's stability should be demonstrated mathematically. In doing so the residual area under the GZ curve (A_2), i.e. beyond the angle of heel (θh), should be at the least equal to 0.028 m-rad up to the angle of roll θr. In the absence of model test or other data θr should be taken as 15^o or an angle of (θd - θh) whichever is less.

2 Criteria for residual stability after damage

2.1 The method of application of criteria to the residual stability curve is similar to that for intact stability except that the craft in the final condition after damage should be considered to have an adequate standard of residual stability provided:

.1 the required area A_2 should be not less than 0.028 m-rad (figure 2 refers); and

.2 there is no requirement regarding the angle at which the max GZ value should occur

2.2 The wind heeling lever for application on the residual stability curve should be assumed constant at all angles of inclination and should be calculated as follows:

$$HL3 = \frac{P_d.A.Z}{9800\Delta}$$

where P_d = 120 (Pa)
A = projected lateral area of the portion of the ship above the lightest service waterline (m^2)
Z = vertical distance from the centre of A to a point one half of the lightest service draught (m)
Δ = displacement (t)

2.3 The same values of roll angle should be used as for the intact stability.

2.4 The downflooding point is important and is regarded as terminating the residual stability curve, the area A_2 should therefore be truncated at the downflooding angle.

2.5 The stability of the craft in the final condition after damage should be examined and shown to satisfy the criteria, when damaged as stipulated in paragraph 2.6 of this Code.

2.6 In the intermediate stages of flooding, the maximum righting lever should be at least 0.05 m and the range of positive righting lever should be at least 7^o. In all cases, only one breach in the hull and only one free surface need to be assumed.

3 Application of heeling levers

3.1 In applying the heeling levers to the intact and damaged curves the following should be considered:

3.1.1 for intact condition:

.1 wind heeling lever - steady wind (HL_1)
.2 wind heeling lever (including gusting effect) plus either the passenger crowding or speed turning levers whichever is the greater (HTL).

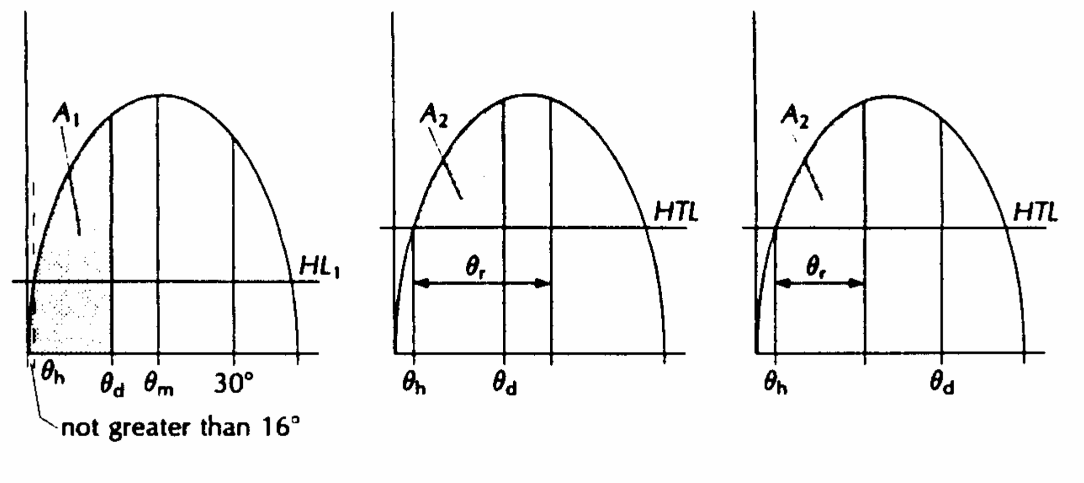
3.2.2 for damage condition:

.1 wind heeling lever - steady wind (HL_3); and
.2 wind heeling lever plus heeling lever due to passenger crowding (HL_4).

3.2 Angles of heel due to steady wind

3.2.1 The angles of heel due to steady wind when the heeling lever HL_1, obtained as in paragraph 1.3, is applied to the intact stability curve, should not exceed 16^o; and
3.2.2 The angle of heel due to steady wind when heeling HL_3, obtained as in paragraph 2.2, is applied to the residual stability curve, after damage, should not exceed 20^o.

Multihull craft criteria



HL_1 = Heeling lever due to wind
HTL = Heeling lever due to wind + gusting + (passenger crowding or turning)

Figure 1 - Intact stability

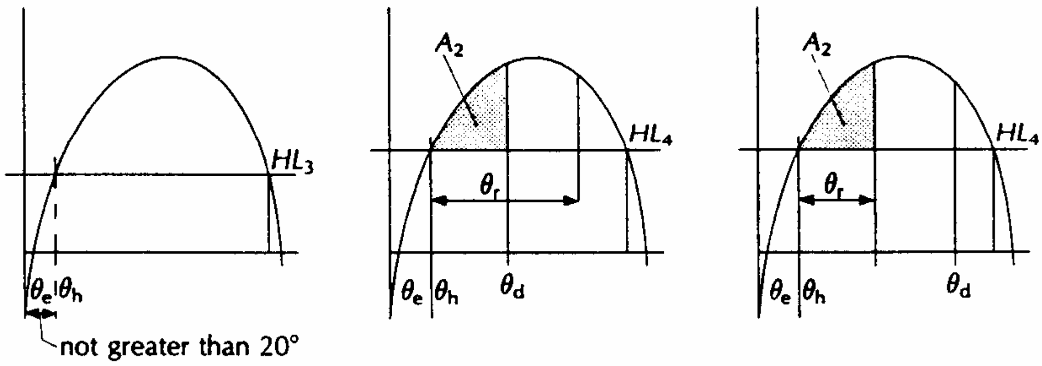


Figure 2 - Damage stability

HL_1	= Heeling lever due to wind
HTL	= Keeling lever due to wind + gusting + (passenger crowding or turning)
HL_3	= Heeling lever due to wind
HL_4	= Heeling lever due to wind + passenger crowding
θ_m	= Angle of maximum GZ
θ_d	= Angle of downflooding
θ_r	= Angle of roll
θ_e	= Angle of equilibrium, assuming no wind, passenger crowding or turning effects
θ_h	= Angle of heel due to heeling lever HL_1, HTL, HL_3 or HL_4
A_1	$\geq$ Area required by 1.1
A_2	$\leq$ 0.028 m.rad