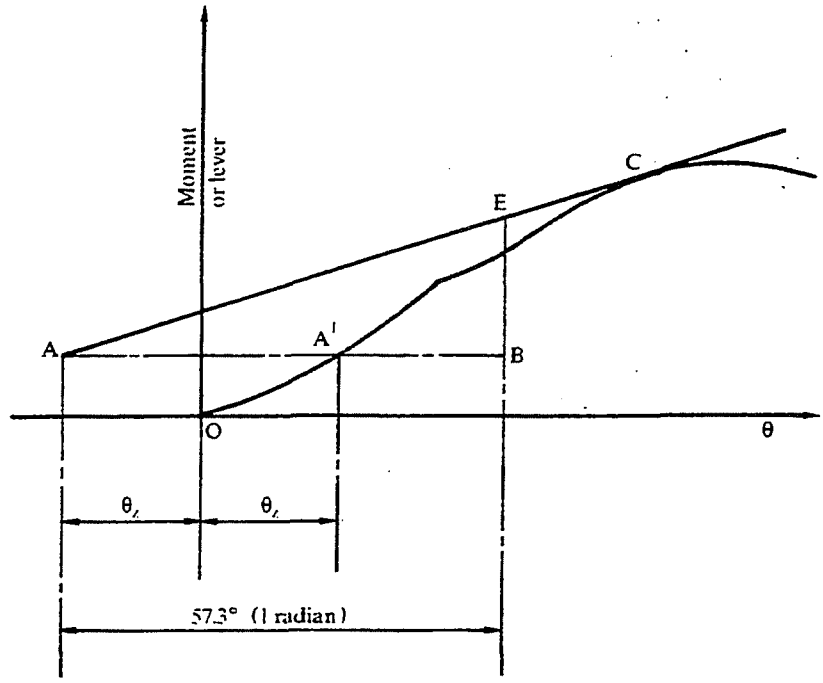


Figure 12 DYNAMIC STABILITY CURVE

The distance BE is equal to the capsizing moment if measured along the ordinate axis of the dynamic stability curve. If, however, the dynamic stability levers are plotted along this axis, BE is then the capsizing lever, and in this case the capsizing moment Mc is determined by multiplication of ordinate BE in metres by the corresponding displacement in tonnes.

$M_c = \Delta$ x BE (tonne metres)

(iii) The amplitude of rolling θ_z is determined by means of model and full-scale tests in irregular seas as a maximum amplitude of rolling of 50 oscillations of a craft travelling at 90° to the wave direction in sea state for the worst design condition. If such data are lacking the amplitude is assumed to be equal to 15°.

(iv) The effectiveness of the stability curves should be limited to the angle of flooding.

C.8.4.2.2 Stability in the Transient and Foil-borne Modes

C.8.4.2.2.(a) The stability should satisfy C.8.6 of this Section.

C.8.4.2.2.(b):

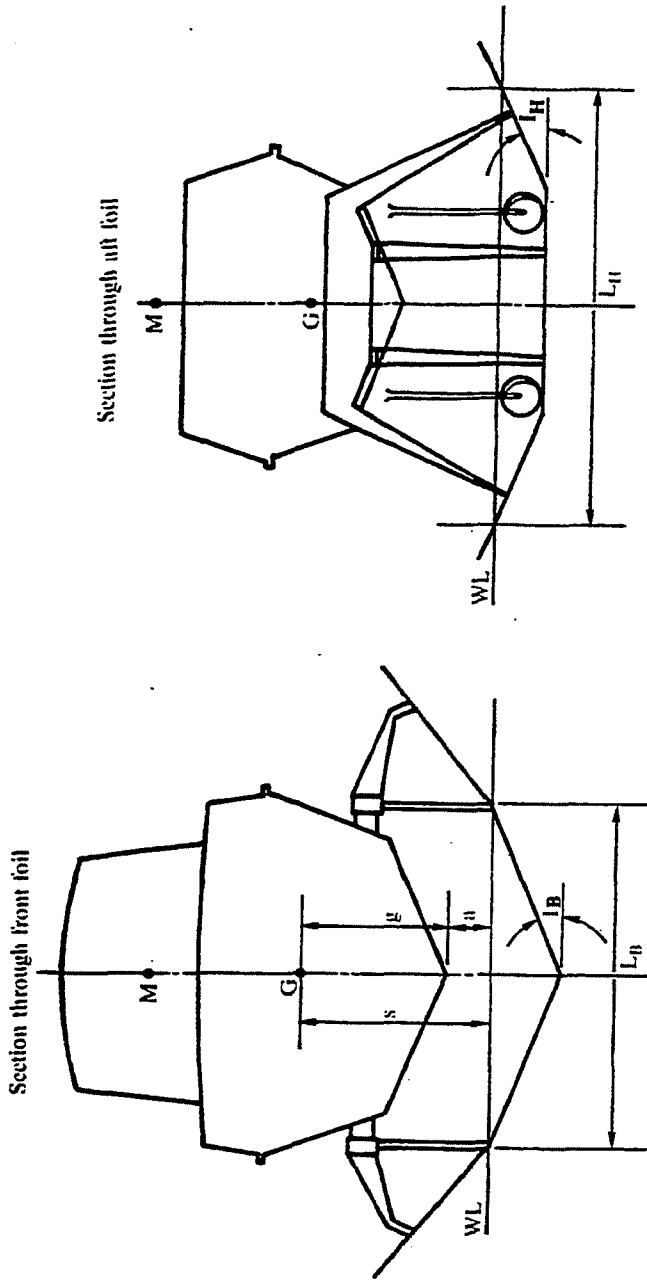
(i) The stability in the transient and foil-borne modes should be checked for all cases of loading for the intended service of the craft.

(ii) The stability in the transient and foil-borne modes may be determined either by calculation or on the basis of data obtained from model experiments and should be verified by full-scale tests by the imposition of a series of known heeling moments by off-centre ballast weights, and recording the heeling angles produced by these moments. When taken in the hull-borne, take-off, steady foil-borne, and settling to hull-borne modes, these results will provide an indication of the values of the stability in the various situations of the craft during the transient condition.

(iii) The time to pass from the hull-borne mode to foil-borne mode and vice versa should be established. This period of time should not exceed two minutes.

(iv) The angle of heel in the foil-borne mode caused by the concentration of passengers on one side should not exceed 8°. During the transient mode the angle of heel due to the concentration of passengers on one side should not exceed 12°. The concentration of passengers should be that taken from paragraph C.1.1.1.

C.8.4.2.2.(c) One of the possible methods of assessing foil-borne metacentric height (GM) in the design stage for a particular foil configuration is given in Figure 13.



$$GM = n_B\left(\frac{L_B}{2\tan l_B} - S\right) + n_H\left(\frac{L_H}{2\tan l_H} - S\right)$$

where n_B = percentage of hydrofoil load borne by front foil
n_H = percentage of hydrofoil load borne by aft foil
L_B = clearance width of front foil
L_H = clearance width of aft foil
a = clearance between bottom of keel and water
g = height of centre of gravity above bottom of keel
l_B = angle at which front foil is inclined to horizontal
l_H = angle at which aft foil is inclined to horizontal

STABILITY OF HYDROFOIL WHEN FOIL-BORNE

Figure 13

C.8.4.3 **Fully Submerged Hydrofoils**

C.8.4.3.1 **Hull-borne Mode**

C.8.4.3.1.(a) The stability in the hull-borne mode should be sufficient to satisfy C.8.4.3 and C.8.4.5 of this Section.

C.8.4.3.1.(b) The provisions of C.8.4.2.1.(b) to C.8.4.2.1.(e) are appropriate to this type of craft in the hull-borne mode.

C.8.4.3.2. Transient Mode

(a) The stability should be examined by the use of verified computer simulations to evaluate the craft's motions, behaviour and responses under the normal conditions and limits of operation, and under the influence of any malfunction.

(b) The stability conditions resulting from any potential failures in the systems or operational procedures during the transient stage which could prove hazardous to the craft's watertight integrity and stability should be examined.

C.8.4.3.3 Foil-borne Mode

The stability of the craft in the foil-borne mode should be in compliance with C.8.4.6 of this Section. The provisions of C.8.4.3.2 of this Section also apply.

C.8.4.3.4 Stability Checks

The provisions of C.8.4.2.2.(b) should be applied to this type of craft as appropriate and any computer simulations or design calculations should be verified by full-scale tests.

C.8.5 Buoyancy and Stability Following Damage

C.8.5.1 Following any of the postulated damages detailed in C.8.5.4 and C.8.5.5, the craft in still water should have sufficient bouyancy and positive stability to ensure that in the displacement mode simultaneously:

(a) the final waterline is at least 76 mm below the level of any opening where progressive flooding could take place;

(b) the angle of inclination of the craft from the horizontal does not exceed 8° in any direction for all permitted cases of loading and for such uncontrolled passenger movements as are likely in emergency conditions. The Authority may permit angles of inclination up to 16° immediately after damage but quickly reducing to 12° provided that:

(i) suitable hand holds and efficient non-slip deck surfaces are provided; and

(ii) it is impracticable to restrict the angle of heel to 8°.

In exceptional cases the Authority may permit larger inclinations after damage provided the angle is quickly reduced to 12° and the provisions of (b) (i) and (b) (ii) above are satisfied;

(c) flooding of passenger compartments or escape routes will not significantly impede the evacuation of passengers; and

(d) the Authority should be satisfied that the range of residual stability after damage is adequate.

C.8.5.2 Following any of the postulated damage outlined in C.8.5.4 and C.8.5.5, the Authority should be satisfied that all reasonable and practicable steps have been taken to ensure that the craft, in the worst intended conditions, will have sufficient buoyancy and positive stability to remain afloat for at least 30 minutes or three times the demonstrated evacuation time plus 7 minutes whilst simultaneously ensuring that in the displacement mode:

(a) any flooding of passenger compartments or escape routes will not signicantly impede the evacuation of passengers; and

(b) essential emergency equipment, emergency radios, power supplies and public address systems needed for organising the evacuation remain accessible and operational.

C.8.5.3 Any damage of a lesser extent than that postulated in C.8.5.4 and C.8.5.5 which would result in a more severe condition should also be investigated. The shape of the damage should be assumed to be parallelepiped.

C.8.5.4 The following side damages are to be assumed anywhere on the periphery of the craft:

(a) the length of damage should be 0.1L, or 3 metres + 0.03L, or 11 metres, whichever is the least;

(b) the depth of penetration into the craft should be:

0.2B or 5 metres whichever is less.

However, where the craft is fitted with inflated skirts or with non-buoyant side structures, the depth of penetration should be at least 0.12 of the width of the main buoyancy hull or tank structure; and

(c) the vertical extent of damage should be taken for the full depth of the craft.

C.8.5.5 Bottom damages are to be assumed anywhere on the bottom of the craft as follows:

(a) the length of damage in the fore and aft directions should be 0.1 L, or (3 + 0.03L), or 11 metres, whichever is the least;

(b) the width of the damage should be:

0.2B or 5 metres, whichever is less; and

(c) the depth of penetration into the craft should be:

0.02B or 0.5 metres, whichever is less.

C.8.6 Stability of the Craft in the Non-Displacement Mode

C.8.6.1 The Authority should be satisfied, that when operating in the non-displacement and transient modes within approved operational limitations, the craft will, after a disturbance causing roll, pitch, heave or a combination thereof, return to the original attitude.

C.8.6.2 The roll and pitch stability of each craft in the non-displacement mode, should be determined experimentally prior to entering commercial service and be recorded.

C.8.6.3. Where craft are fitted with surface piercing structure or appendages, precautions should be taken against dangerous attitudes or inclinations and loss of stability subsequent to a collision with a submerged or floating object.

C.8.6.4 The Authority should be satisfied that the structures and components provided to sustain operation in the non-displacement mode should in the event of agreed damage or failure provide adequate residual stability in order that the craft may continue safe operation to the nearest place where the passengers and crew could be placed in safety, provided caution is exercised in handling.

C.9 Off-Shore Supply Vessels

C.9.1 Off-shore supply vessels should meet at least the criteria laid down in C.2.

C.9.2 Where a supply vessel's characteristics render compliance with C.9.1 impossible, the following criteria may be used:

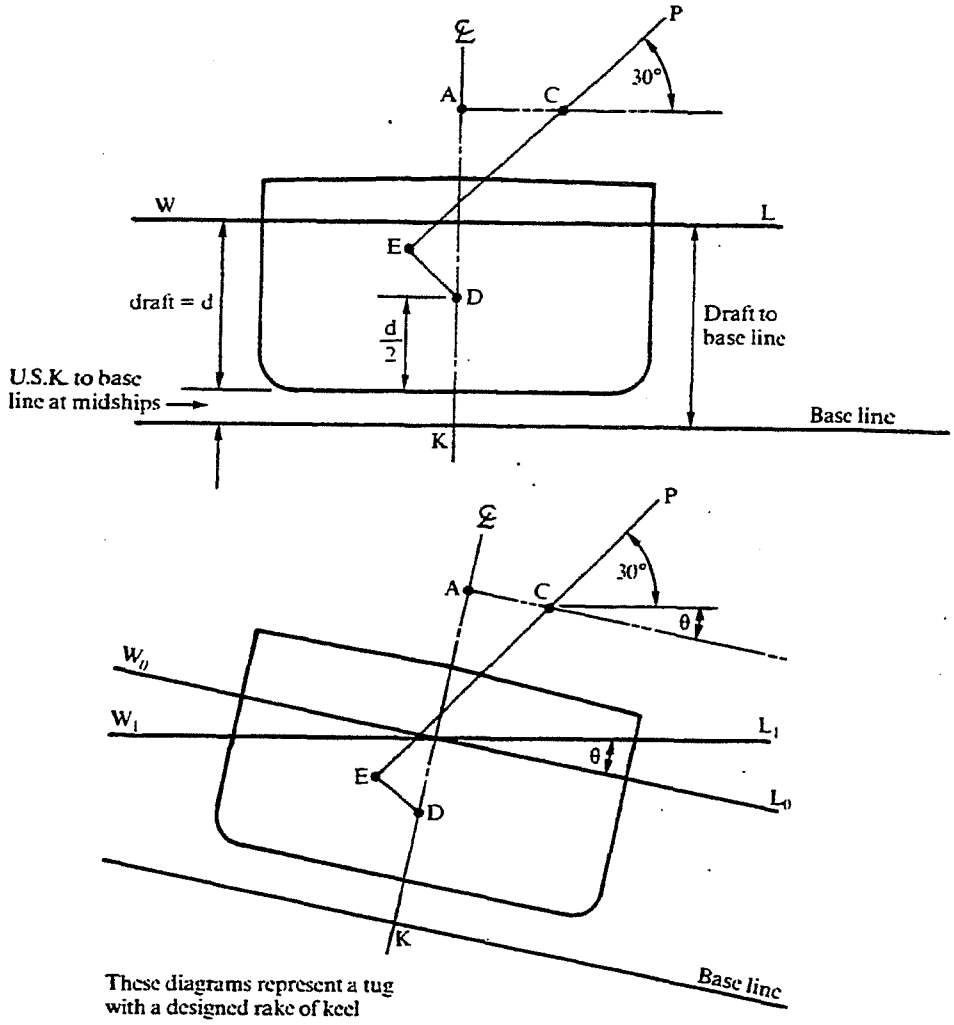
(a) The area under the curve of righting levers (GZ curve) should not be less than 4.011 metre-degrees up to an angle of 15° when the maximum righting lever (GZ) occurs at 15° and 3.151 metre-degrees up to an angle of 30° when the maximum righting lever (GZ) occurs at 30° or above. Where the maximum righting lever (GZ) occurs at angles between 15° and 30°, the corresponding requisite area under the righting lever curve should be determined by use of the formula:

$$\text{Area} = 3.151 + 0.0573\,(30° - \theta_{max})$$

where θ_{max} is the angle of heel at which righting lever curve reaches its maximum.

(b) The area under the righting lever curve (GZ curve) between the angles of heel of 30° and 40° or between 30° and the angle of flooding 0_f if this angle is less than 40°, should be not less than 1.719 metre-degrees.

Note: The angle of flooding 0_f is the least angle of heel at which openings in the hull, superstructures or deckhouses which cannot be closed weathertight immerse. In applying this criterion, small openings through which progressive flooding cannot take place need not be considered as open.



These diagrams represent a tug with a designed rake of keel

Figure 14

The diagrams above show a section of the vessel in way of the towing hook. On these diagrams:

P	is the bollard pull of the vessel
C	is the position of the towing hook in its guide quadrant
EC	is the line of action of the tow rope pull through C acting at right angles to the vessel's centre line, and at an angle of elevation of 30° to the horizontal.
KA	is the height of A above the baseline
D	is the centre of lateral resistance. It is taken to be at half the draft to the underside of the keel at midships i.e. at d/2 above U.S.K. at midships
KD	is d/2 + the distance from U.S.K. to the baseline at midships
ED	is the shortest distance between D and the line EC
A	is the centre of the towing hook guide quadrant
AC	is the radius of the towing quadrant