

# **PART V**

## **STABILITY, SURVIVABILITY AND SHIPSIDE MARKINGS**

### **5.1 Submission of Plans and Particulars**

#### **5.1.1 Stability**

Calculations are to be submitted at the design stage to show that for all anticipated conditions of loading, the intact and damage stability criteria required by Regulations 30, 32 and 33, and Schedules 1 and 3 to Merchant Shipping Notice MSN 1699(M) respectively, will be met. To help interpret a damage stability submission, a clearly labelled plan should be produced indicating, by means of cross hatching or numbers, those compartments which are assumed flooded or counter-flooded for each case of damage investigated. A report of the inclining experiment and the final stability information book are to be submitted to the MCA for approval in accordance with Regulation 31 of the Regulations and paragraph 5.3 of these Instructions.

#### **5.1.2 Damage control plan**

When watertight closures or cross flooding arrangements are approved for subdivided ships a Damage Control Plan and Booklet is to be provided in accordance with Regulation 38 of the Regulations, and paragraph 5.13 of these Instructions.

#### **5.1.3 Ballast**

If the ship is to carry permanent ballast, the type (solid or liquid), quantity and distribution should be indicated in the stability information book.

### **5.2 Intact Stability Standard (Regulation 30)**

#### **5.2.1 General**

5.2.1.1 The design and construction of every subdivided ship should be such as to ensure that the ship, in all probable loading conditions and after due correction has been made for the effect of free surface of liquids in tanks, will meet the intact stability criteria set out in Schedule 1 of Merchant Shipping Notice MSN 1699(M).

5.2.1.2 The intact stability criteria set out in the Regulations are a minimum and may not be sufficient for a ship to withstand damage to the extent described in Regulation 33. (See also paragraph 5.5 of these Instructions).

5.2.1.3 In any cases where the intact stability criteria cannot be met by a particular ship on account of its unique design and operating conditions, the MCA may consider the application of alternative criteria which will be at least as effective.

5.2.1.4 The MCA should be consulted as early as practicable if there is likely to be difficulty in achieving the required stability.

5.2.1.5 Where it is found necessary to include the volumes of enclosed superstructures in the calculations to derive cross curves of stability, all openings in such spaces must be provided with weathertight closing arrangements.

The enclosed superstructures which may be permitted to be used in the calculations are:

- a) superstructures located above the superstructure deck;
- b) deckhouses on or above the freeboard deck; and
- c) hatchway structures on or above the freeboard deck.

In the case of Ro-Ro ships the surveyor should ensure that any door leading into a deckhouse or sidehouse the volume of which is included in the derivation of the cross curves of stability, is listed in the written instructions provided for the guidance of the master. A copy of these instructions must be retained in the Stability Information Book.

5.2.1.6 The effectiveness of enclosed spaces used in the derivation of cross curves of stability can only be maintained if before departure and during a voyage there is adopted a procedure to ensure that weathertight doors and hatches are effectively closed and remain so.

5.2.1.7 The surveyor should ensure that any door leading into a deckhouse or side house the volume of which is included in the derivation of the cross curves of stability, is listed in the written Instructions provided for the guidance of the Master. A copy of these Instructions must be retained in the Stability Information Book.

5.2.1.8 The surveyor should also ensure that in the notes for the guidance of the Master in the Stability Information Book, reference is made to Merchant Shipping Notice No. M.1361 "Dangers of Flooding" which offers a check list of items to be inspected to help maintain the weathertight and watertight integrity of the ship.

5.2.1.9 In the development of hydrostatic particulars, vertical centres of gravity of tank or compartment capacities, and maximum allowable vertical centre of gravity information, a standard base line or datum must be used. This base line must be clearly stated in the stability book. In the case of a ship having a designed rake of keel, hydrostatic particulars

should be developed for waterlines parallel to the datum line and not parallel to the rake of the keel. Particular attention must be paid to the marking of draught marks on a ship with a raked keel.

### **5.3 Inclining, Lightweight Survey and Stability Information (Regulation 31) [as amended by CN 22/99]**

#### *5.3.1 Inclining test and lightweight survey for subdivided ships*

5.3.1.1 At or near completion, every subdivided passenger ship is to be inclined, and the inclining test is to be prepared and conducted in the manner set out in Appendix A to these Instructions.

5.3.1.2 The test is to be witnessed by a MCA surveyor who should be satisfied that it is carried out in such a manner and under such conditions as will give reliable results from which to derive the lightship particulars upon which the worst service condition and subsequent damage stability investigation will be based.

5.3.1.3 Every subdivided ship is to be provided with approved information relating to the stability of the ship for the guidance of the Master. Such information is to be contained in the form of a book, the 'Stability Information Book', and should include the particulars appropriate to the ship as required in Appendix D of these Instructions together with the sample conditions of loading based upon the accepted results of the inclining test.

5.3.1.4 In order to ascertain that the stability information carried by the ship remains valid, every subdivided ship is to undergo a lightweight survey every 5 years to establish whether there has been any change in the lightship displacement and lightship longitudinal centre of gravity. If it is found or anticipated that the results of the lightweight survey when compared with the ship's approved stability information derived from the previous inclining test, show a change in the lightship displacement greater than 2% or a deviation from the lightship longitudinal centre of gravity greater than .1 % of the previous LCG, the ship is to be re-inclined. The lightweight survey is to be witnessed by a nominated surveyor who should be satisfied that the survey is conducted in a satisfactory manner. If the revised lightship weight would result in the freeboard mark being submerged in the 100% Load Departure Condition this condition should be clearly marked in the book - 'Non Seagoing Condition - See Deepest Load Departure Condition'. An additional Deepest Load Departure Condition should then be placed in the book in which the ship is loaded to the freeboard mark with either a reduced number of passengers or a reduced quantity of stores, water and oil fuel, subject to sufficient fuel being carried to permit a complete round trip with an adequate margin to cater for emergencies. The new condition should satisfy the Maximum KG envelope curve. If it is found impossible to sufficiently reduce the total weight of fuel, water and stores in this departure condition to compensate for the increase in lightship weight then the number of passengers shown

on the Passenger Certificate must be reduced accordingly, and the Passenger Certificate reissued for the revised number of passengers.. Where the use of the new lightship weight and centre of gravity would result in the ship continuing to comply with the limiting KG in the Maximum KG envelope curve it will not be necessary to prepare a new Stability Information Book provided that the new lightship particulars are noted on each loading condition shown in the book, stating the date on which the lightship check was carried Out. Where, however, the use of the new lightship particulars would result in the ship failing to comply with the limiting KG in the Maximum KG envelope curve a new Stability Information Book should be prepared and submitted for approval after first being examined by the surveyor.

5.3.1.5 In the case where the change in lightship weight is not greater than 2% and the deviation from the original lightship longitudinal centre of gravity is no greater than 1 % of the previous LCG it will not be necessary to re-incline the ship. If the change in the lightship weight would result in the freeboard mark being submerged in the 100% Load Departure Condition then the procedure outlined in Paragraph 5.3.1.4 should be adopted. Where the change in lightship weight would not result in the freeboard mark being submerged in the 100% Load Departure Condition it will be sufficient that the revised lightship weight and LCG are noted on each loading condition in the book, stating the date on which the lightship check was carried out.

5.3.1.6 In all cases the Lightship History Page in the Stability Information Book is to be suitably endorsed at every Lightweight Survey following the initial approval of the book, and a copy of the inclining or lightweight survey is to be placed on board the ship for the guidance of the master.

5.3.1.7 At the discretion of the MCA, and after consideration 'of any relevant information submitted about the ship, the interval between lightweight surveys may be extended for a period of not more than one year.

5.3.1.8 It is the owner's responsibility to inform the MCA of any proposed alterations to the ship's hull, equipment or machinery affecting the seaworthiness of the ship. Where such alterations may affect the stability information supplied to the ship, this will need to be amended whether the surveyor considers it necessary or not to re-incline the ship.

## 5.3.2 Stability information

5.3.2.1 When examining the Stability Information Book the surveyor should ensure that the Master is provided with simplified information from which to ensure that the ship complies with the prescribed intact and damage stability criteria in any proposed loading condition. The Stability Information Book should also provide the Master with information relating to the stability of the ship during loading and unloading. Such information

should state the maximum ahead or astern trim, maximum forward and after draught, and maximum angle of heel permitted during such operations. The surveyor should confirm and record on file that these restrictions are compatible with shore facilities e.g. ramps, linkspans etc.

5.3.2.2 The rapid and simple process of determining that the ship's stability shall meet the requirements of Regulation 30 required by paragraph 1 of Schedule 1 to Merchant Shipping Notice MSN 1699(M) which makes use of the tabulated or graphical presentation of permissible vertical centres of gravity (KG fluid) values or required metacentric height (GM) values. Such information is to be developed with the ship on even keel and at trims by the bow and stern equivalent to 0.4% and 0.8% of the ship's subdivision length over a range of displacement or mean draughts which are likely to occur in service. As these standard trims will become the limiting trims when approving the stability information, the surveyor should confirm with the owner that the ship will not operate with a trim greater than standard otherwise additional information will be required. If its form and loading characteristics result in a particular ship operating at trims different from the standard, the MCA may permit alternative trims to be substituted in the derivation of the limiting envelope curves of required metacentric height or permissible vertical centre of gravity. These curves or tables should be determined taking into account the change of trim due to heel, and where a datum other than the top of the keel has been used the assumed axis should be clearly defined, particularly in the case of ships with a raked keel. Only enclosed superstructures may be taken into account when deriving such curves or tables.

5.3.2.3 Stability information placed on board for the guidance of the Master should contain only calculations and instructions relevant for the determination of the ship's stability. As the derivation of the KG (fluid) envelope curves takes account the required intact and damage stability criteria, there is no longer the need to produce for each sample loading condition presented in the Stability Information Book, the corresponding curve of righting levers (GZ). One sample condition should however be presented showing the use of free surface moments, derivation of curve of righting levers (GZ) and the use of the permissible KG (fluid) envelope curve.

5.3.2.4 In the case of Class IV Ro-Ro passenger ships, additional information should be provided identifying the method by which the stability calculations are to be undertaken during loading operations and also prior to departure as outlined in Appendix 5 to Merchant Shipping Notice No. M.1413.

5.3.2.5 Surveyors should ensure that approved "Instructions" relating to the closing of weathertight openings in bulkheads above the bulkhead deck and approved "Instructions" for the control of watertight doors are included in the Damage Control Plan.

5.3.2.6 It is not the MCA's intention that stability information should normally be carried on board open boats, partially decked ships of Classes V and VI, decked ships of Class VI carrying less than 101 passengers, or Ships of Class VI(A).

5.3.2.7 For every ship of Classes III and IV, every decked ship of Class V, and every decked ship of Class VI carrying more than 100 passengers, a calculation should be submitted showing the angle of heel which would occur with two thirds of the passengers distributed on one side of the ship and one third on the other side. For the purpose of this calculation the ship should be assumed to be in the worst anticipated service condition. The passengers should each be represented by a weight of 75 kg and should be assumed to be congregated at 0.30 m<sup>2</sup> per person on the uppermost deck or decks to which they have access, and at an assumed centre of gravity of 760mm above the deck. The resulting angle of heel should not exceed 7°.

5.3.2.8 For every ship of Classes III and IV, every decked ship of Class V, and every decked ship of Class VI carrying more than 100 passengers, of less than 100 m in length, a calculation should be submitted by the shipbuilder to show the angle of heel due to turning with the ship assumed to be in the worst anticipated service condition using the following formula. The resulting angle of heel should not exceed 10°.

$$MR = 0.233x \frac{\Delta}{g} x \frac{Vo^2}{L} (KG - \frac{d}{2})$$

WHERE	MR =	HEELING MOMENT IN TONNES M
	$\Delta$ =	DISPLACEMENT IN TONES
	g =	ACCELERATION DUE TO GRAVITY (9.81m/sec/sec)
	Vo =	SERVICE SPEED IN M/SEC
	L =	LENGTH OF SHIP IN M
	KG =	HEIGHT OF CENTRE OF GRAVITY ABOVE KEEL IN M
	d =	MEAN DRAUGHT IN M

5.3.2.9 In no case should the surveyor certify for any number of passengers unless the ship has sufficient stability and freeboard to carry that number safely.

5.3.2.10 Approval of the Stability Information Book should undertake the following procedure which is based upon the Q.A. procedure outlined in Q.A. document number MCA 415.

- (i) Three copies of the proposed Stability Information Book should in the first place be issued to the Surveyor in Charge at the earliest opportunity for his examination and any comments required to bring the book in line with the stability information quoted in Appendix D of the Instructions to Surveyors.
- (ii) The three copies are to be marked "PROVISIONAL".
- (iii) If the stability aspects of the book satisfy the surveyor a copy of the book signed and dated by the surveyor, together with comments regarding any amendments required to the detailed information/format in the book, is to be placed on board the vessel in the custody of the master.
- (iv) The remaining two provisional copies (together with the surveyor's comments) are to be forwarded to Headquarters for any further comments which may be required for final approval.
- (v) Where however the stability aspects in the provisional book are unsatisfactory according to the Surveyor in Charge a provisional stability book will not be issued and all copies with relevant comments from the surveyor and all necessary information will be forwarded to Headquarters for further discussion and final approval.
- (vi) The final approved copies together with the comments from Headquarters are to be returned to the Surveyor in Charge where one copy is to be forwarded for amending to the person for preparing the book.

(vii) The time scale on receiving the books and returning the book to the person responsible for preparing the book shall be in accordance with the MCA Code of Practice.

5.3.2.11 Four copies of the revised or amended book are then to be submitted to MCA Headquarters by the person responsible for preparing the book for final approval and signing. The four copies will be returned to the Surveyor in Charge where one copy will be retained by the MCA for records purposes and two copies returned to the owners instructing them to place an approved and stamped copy on board the ship for the use of the master. The final copy is to be issued to the person who prepared the book.

5.3.2.12 Acknowledgement that the provisional book (when submitted) has been removed from the ship and one stamped and one approved copy has been placed on board the ship should be obtained by the Surveyor in Charge from the owners and a copy of the letter placed on the CM 18/01 file.

### 5.3.3 Buoyancy calculation and information document for non subdivided ships

5.3.3.1 Non-subdivided ships of Classes V to VI(A) required to meet the Buoyancy Test survivability standard are to have buoyancy calculations prepared and submitted in accordance with Schedule 2, Section 4 to Merchant Shipping Notice MSN 1699(M) and Appendix C to these Instructions.

5.3.3.2 Non-subdivided ships of Classes V to VI(A) are to be provided with a "Buoyancy Test Information Document" indicating the results of the buoyancy calculation. The document should include general particulars and a small scale general arrangement of the ship together with a sample of the full loaded condition, indicating the volume of displacement, freeboard, loaded draught and both the required and actual volume of buoyancy below the lowest downflooding point, based upon the results of the buoyancy calculation.

5.3.3.3 Vessels required to satisfy the buoyancy calculation must also satisfy the heeling test requirements set out below.

### 5.3.4 Heeling test and information document

5.3.4.1 Non-subdivided ships of Classes V to VI(A) required to meet the heeling test criteria are to have a heeling test carried out in accordance with Schedule 2, Section 3 to Merchant Shipping Notice MSN 1699(M) and Appendix B to these Instructions.

5.3.4.2 Non-subdivided ships of Classes V to VI(A) which have no stability information i.e. lines plan, hydrostatics and cross curves etc. shall be provided with a "Heeling Test Information Document" indicating the



general particulars, a small scale general arrangement, the assigned “lightweight” freeboard, the results of the heeling test and a lightweight/heeling test history page.

5.3.4.3 Non-subdivided ships of Classes V to VI(A) which have stability information i.e. lines plan, hydrostatics and cross curves etc. shall be provided with a “Heeling Test Information Document” indicating the general particulars, a small scale general arrangement, the full load condition and stability particulars, the results of the Heeling Test and a “lightship” history page.

### 5.3.5 Lightweight and freeboard surveys for non-subdivided ships

5.3.5.1 In order to ascertain that the survivability information carried by the ship remains valid, every non-subdivided ship of Classes V to VI(A) which does not have stability information is to undergo a lightweight freeboard check every five years, a copy of which is to be retained in the lightship history page.

5.3.5.2 Every non-subdivided ship of Classes V to VI(A) which contains stability information (i.e. lines plan, hydrostatics etc.), freeboard and draught marks, is to undergo a lightweight survey every 5 years to verify any change in the lightship weight and centres together with a lightship freeboard check. A copy of the lightweight survey and freeboard check is to be included in the lightship history page.

5.3.5.3 If it is found or anticipated that the results from the lightweight survey and lightship freeboard check when compared with the vessel’s previous heeling test calculation/lightweight freeboard check indicate an increase in the lightship displacement and centres or if there is a reduction in the previous freeboard measurement, the surveyor, after consultation with Headquarters, may require the vessel to be re-heelled where the previous heeling test attained an angle of heel exceeding 6° or the previous freeboard when heeled was minimal.

5.3.5.4 At the discretion of the MCA, and after consideration of any relevant information about the ship submitted by the owner, the interval between the lightweight/freeboard surveys may be extended for a period of not more than one year.

5.3.5.5 If a vessel’s heeling angle/lightweight or freeboard has to be amended and the vessel re-heelled a revised heeling/buoyancy document is to be approved by the surveyor and an approved amended copy placed on board the vessel.

### 5.3.6 Stabilising tanks

5.3.6.1 The free surface effect of stabilising tanks must be taken into account in the conditions shown in the Stability Information Book and in the damage stability calculations.

5.3.6.2 In the event of damage, the MCA will permit a stabilising tank to be either pressed up or emptied into a lower tank after the final stage of flooding has been reached, in order to improve the stability or further reduce angles of heel, providing that the ship has sufficient residual stability to withstand the effect of either operation.

5.3.6.3 The MCA may permit such operations during flooding, to reduce angles of heel, providing that it can be shown that they do not have a detrimental effect on the ship. The use of these operations to provide the ship with positive stability during and after flooding, or the fitting of valves in the ship's side for direct flooding of compartments from the sea will not be permitted.

### 5.3.7 Permanent ballast

5.3.7.1 The nature, amount and distribution of any permanent ballast is to be shown in the Stability Information Book.

5.3.7.2 If such ballast consists of either oil or water, means shall be provided to prevent its removal or transfer. This may be achieved by fitting a spectacle blank in the suction line to each tank containing the ballast.

5.3.7.3 Solid ballast should be effectively stowed, and fixed against movement, and should not be fitted in the double bottom tanks or any other confined space, because of the difficulties in surveying the structure. When it is proposed to fit solid ballast in such spaces, the surveyor should warn the owners that it may be necessary to remove some or all of the ballast in the future, in order that surveyors may examine the structure to their satisfaction.

## 5.4 **Standard of Survivability (Regulation 32)**

### 5.4.1 Requirements for ships to be decked

5.4.1.1 Ships of Classes III and IV must be subdivided and fully decked in order to comply with the requirements for watertight subdivision.

5.4.1.2 Fully decked ships of Classes V, VI and VI(A) may be subdivided or non subdivided depending on the requirements of the Tables in Section 1 of Schedule 2 to Merchant Shipping Notice MSN 1699(M) according to the number of passengers carried, the operating area, and the scale of life saving appliances carried on board.

### 5.4.2 Subdivision of fully decked ships

5.4.2.1 Fully decked ships of Classes III and IV, are to be subdivided to a factor of subdivision of either 0.5 or 1.0 and fully decked ships of

Classes VI and VI(A) are to be subdivided to a factor of subdivision of 1.0 according to the requirements of the Tables in Section 1 of Schedule 2 to Merchant Shipping Notice MSN 1699(M).

5.4.2.2 Fully decked ships of Classes V to VI(A) which do not attain such factors of subdivision may be accepted as satisfying the buoyancy test standard of schedule 2, section 4 to Merchant Shipping Notice MSN 1699(M) and should include the associated increase in the requirements for life saving appliances and the specified reduction in operational area requirements similar to "open" vessels.

#### 5.4.3 Non subdivided or partially decked ships

Where non subdivided or partially decked ships of Classes V, VI and VI(A) are to satisfy the requirements of the Buoyancy Test set out in Section 4 of Schedule 2 to Merchant Shipping Notice MSN 1699(M). As required by the Tables 1 and 2 in Section 1 of Schedule 2 to Merchant Shipping Notice MSN 1699(M) they shall also satisfy the requirements of the Heeling Test in Section 3 of Schedule 2 to Merchant Shipping Notice MSN 1699(M) and should include the associated increase in the requirements for life saving appliances and the specified reduction in operational area requirements where necessary.

#### 5.4.4 Freeboard for non subdivided or partially decked ships.

5.4.4.1 All ships, other than those which are subdivided to a factor of subdivision in accordance with the Table in Section 1 of Schedule 2, shall satisfy the requirements for freeboard in paragraph 2 in Section 3 of Schedule 2 to Merchant Shipping Notice MSN 1699(M).

5.4.4.2 The freeboard should be determined in the following manner:-

(i) When the vessel is loaded with weights representing the full number of passengers and crew at 75 kg for each person, and when all fuel and fresh water tanks are 95% full, the clear height of side above water, at the lowest point, is not to be less than 380mm for vessels 6.0m in length, or less than 760mm for vessels 18.3m and over.

(ii) For lengths between 6.0m and 18.3m, the height should be determined by linear interpolation. The length should be measured from the forward side of the stem to the after side of the stern post and the clear side should be measured to the top of the covering board, or to the top of the wash strake, if one is fitted above the covering board. If, however, a side deck is fitted, the clear height of side should be measured to the top of the deck at side, or to the top of the gunwale, whichever measurement gives the smaller freeboard.

(iii) The above requirement regarding minimum freeboard also applies where cargo is carried in addition to passengers.

5.4.4.3 In the case of existing ships of Class V operating in Category A and B waters a reduction in the required minimum freeboard as described in paragraph 2 of section 3 of Schedule 2 to Merchant Shipping Notice MSN 1699(M) may be accepted subject to a commensurate reduction in the maximum angle of heel of 7° being recorded at the heeling test such that the residual minimum freeboard after heeling is not less than the ship would have had, had the prescribed criteria been complied with.

5.4.4.4 Before considering lesser freeboards than those prescribed, it should be ensured that the stability characteristics of the ship considered have not been altered to a significant degree over the years (due to alterations or other reasons such as increase in passenger numbers). This can only be ascertained by conducting a heeling test and by comparing the original angle of heel with the new one. If, for example, the original angle of heel was 3.5° and the new angle is say 5° it would not be appropriate to allow a freeboard reduction. In such cases the number of passengers should be reduced to a figure satisfactory to the surveyor. If on the other hand the angle of heel increased purely by the additional life-saving appliances provided in order to comply with the amended Regulations a freeboard reduction may be justifiable. Each case will be treated on its merits.

## **5.5 Damaged Stability Standards (Regulation 33)**

### **5.5.1 General**

5.5.1.1 Damaged stability calculations are to be submitted showing the draught, trim, angle of heel and residual stability for the ship initially in the worst anticipated service condition which is likely to be experienced in service or over the operational range of draughts and trims. The results are to be summarised as curves of required metacentric height (GM) or maximum permissible vertical centre of gravity (KG).

5.5.1.2 The calculations should be carried out for the final stage of flooding plus five equally spaced intermediate stages of flooding and assuming the ship free to trim at each stage of flooding. The damaged stability cases which the MCA requires to be calculated, and the extent of damage and permeability's assumed in such cases, are normally decided when the subdivision arrangements are being considered.

5.5.1.3 Cases of damage may be submitted at an earlier stage, but the agreement of the surveyor should be obtained as to the extent of flooding and permeabilities to be used, before the cases are calculated.

5.5.1.4 The MCA may ask for additional cases of damage which may arise from the checking of the initial submission.

5.5.1.5 Where the calculations are carried out for the worst anticipated service condition the surveyor should obtain from the owners a letter verifying this condition.

5.5.1.6 The MCA may require calculations to be carried out with the ship assumed to be damaged in other service conditions if the trim and draught in those conditions indicate that the margin line may become submerged.

5.5.1.7 Preferably, the curve of righting levers derived over the whole range of flooding should indicate positive stability within the range specified in the criteria, however, the MCA will consider cases where the curves of righting levers do not meet the criteria, providing it can be shown that this is not critical of survival. At no stage should the margin line become submerged unless the provision of partial subdivision above the bulkhead deck, in accordance with Regulation 11, limits sufficiently the spread of water along the bulkhead deck and does not result in an unacceptable angle of heel. Such an angle of heel would not normally exceed 20° before cross flooding. (See paragraph 2.8 of these Instructions for instructions on partial subdivision above the bulkhead deck). There must be no progressive flooding as a result of margin line submergence.

5.5.1.8 In the case of ships carrying vehicles on the bulkhead deck submergence of the margin line at any stage of flooding will not be permitted.

5.5.1.9 The MCA will not require a calculation for a case of damage above any watertight flat or deck, where the flat or deck is situated less than 610mm below the waterline.

5.5.1.10 Where a calculation results in unacceptable residual stability and recourse is made to depositing floodwater to a lower level by means of automatic down-flooding ducts or similar devices, full details of the process will be required.

5.5.1.11 In general, no allowance shall be made for superstructures affected by side damage, except that portion or those portions of the erection which can be shown to remain intact and provide positive buoyancy after the submersion of the margin line.

5.5.1.12 In the case of multi-hulled ships, side damage calculations should assume only one hull has been involved in the damage but, additionally, the MCA may require calculations for damage to each hull at the same time, so that the effect of collisions involving end compartments or of grounding may be considered.

5.5.1.13 It should be noted that damage stability calculations may require a permeability of 60% or 95% to be used for cargo spaces, depending on whether or not the spaces are substantially filled, even though paragraph

3 of Section 2 of Schedule 1 to Merchant Shipping Notice MSN 1699(M) only provides for the use of a permeability of 95% for cargo spaces in ships the subdivision arrangements of which are considered under Schedule 1, Section 2.

5.5.1.14 Full details of proposed cross flooding fittings and calculations, showing that they will expeditiously reduce the list to an angle not exceeding  $7^{\circ}$ , should be submitted.

5.5.1.15 The fittings should be self-acting, except that, when it can be shown that this is not practicable, the MCA may permit them to be controlled by valves, providing the controls are operable from accessible positions above the bulkhead deck. The heel resulting from the flooding of the damaged compartment, before cross-flooding takes place, in association with or without additional assumed damage, shall not endanger the ship. The cross-flooding fittings should be arranged so that liquids cannot be transferred accidentally from side to side if the ship is being held over by a beam wind.

5.5.1.16 In cases of asymmetrical flooding the angle of heel and the condition of the ship should be calculated initially on the assumption that no cross-flooding has taken place

5.5.1.17 Information about cross-flooding fittings, and other information about stability in the damaged condition referred to in Regulation 33, should be incorporated in the damage control booklets available on board for the use of the master.

## **5.6 Verification of Damage Stability Calculations**

### **5.6.1 General**

5.6.1.1 When the cases of damage referred to in paragraph 5.5 are submitted, the surveyor is to be satisfied that:

- (i) the cases are as required by the MCA, i.e. that the correct spaces have been assumed damaged, and the correct permeabilities have been used;
- (ii) the measurements which make up the computer data correspond to the ship as building, or built and adequately define the volumes, levers, etc. used in the calculations; and
- (iii) the results comply with the requirements of Schedule 3 to Merchant Shipping Notice MSN 1699 (M).

5.6.1.2 When the results do not comply with the above requirements the surveyor should discuss with the builders means by which compliance may be obtained.

5.6.1.3 It may be helpful for the surveyor to be present from time to time during the period when the computer input data is being compiled by the designer.

5.6.1.4 It should be impressed on designers that it is in their interest to be satisfied with the method of calculation adopted and the accuracy of measurements which make up the input data, because of the delay which may arise from cases having to be re-examined.

## **5.7 Loading and Stability Assessment of Ro-Ro Passenger Ships Classes III, IV and V (Regulation 34)**

### **5.7.1 General**

5.7.1.1 The calculations made to ensure that the process of loading and unloading is performed safely may be carried out using either on-board or shore-based computer systems approved by the MCA, or by any other method which will enable an accurate result to be obtained. Details of the standards to be met by the computers and the method and procedure by which the calculation is to be made is described in Merchant Shipping Notice No. M.1413. The surveyor should confirm at its commissioning that the simple check procedure incorporated in the computer system is operating satisfactorily.

5.7.1.2 To ensure that the information used in the calculation of the ship's vertical centre of gravity is as accurate as possible all items of cargo and goods vehicles over 7.5 tonnes gross weight and referred to in the Merchant Shipping (Weighing of goods Vehicles and other cargo) Regulations 1988, as qualifying cargo items, are to be weighed before being taken on board.

5.7.1.3 For items not required to be weighed, any declared weight should be increased by 7% before being used in the calculation and where no weight is given, a weight estimated as accurately as possible is to be used.

5.7.1.4 The weights of coaches (which are not covered by the Weighing of Goods Vehicles and other Cargo Regulations) are to be taken as:-

- (i) for 2 axle coaches 14 tonnes
- (ii) for 3 axle coaches 19 tonnes

5.7.1.5 The weight of a private motor car is to be taken as 1.25 tonnes, and the weight of a passenger is to be taken as 75kg.

5.7.1.6 Appendix 5 to Merchant Shipping Notice No M.1413 sets out an acceptable method whereby the ship's loading master may determine the vertical moments of vehicular cargo on Ro-Ro passenger ships using the following individual vertical centres of gravity for various categories of vehicles, namely:-

Category 1	VCG above deck
Laden freight (lorries, road tankers, articulated lorries, drops, vans of 750kg payload and above)	1.9 m
Category 2	
Unladen freight (as above)	1.1 m
Category 3	
Motor cars (saloons, pickups, caravans, dormobiles, minibuses and vans below 750kg payload)	0.7 m
Category 4	
Coaches of all types	1.5 m
Category 5	
Special freight (i.e. low loaders carrying machinery, steel carriers, cattle carriers)	"X" m

5.7.1.7 The vertical centre of gravity of such units is to be determined by the loading master and, in cases where:

- (i) no loading information is available, the vertical centre of gravity should be taken at half the maximum height of the unit carried; and
- (ii) where units carry cargoes suspended from the ceiling i.e. meat etc., the VCG is to be increased accordingly;
- (iii) the vertical centre of gravity of passengers is to be taken at 760mm above the deck.

5.7.1.8 If the displacement of the ship determined from the observed draughts differs significantly from the displacement determined by the summation of the known weight of the ship, its cargo and other items of deadweight, the master should accept the displacement determined from the observed draughts as paramount. Where the displacement obtained from the observed draughts is greater than the calculated displacement the discrepancy should be treated as an additional increment of cargo weight, and this additional weight should be assumed to be acting at the mean vertical centre of gravity position for the total cargo weight being carried before the addition of this increment.



5.7.1.9 Where the displacement obtained from the observed draughts is less than the calculated displacement then the KG of the ship should be that obtained from the calculations of the loading condition but the displacement should be taken as that obtained from the observed draughts. Significant difference in displacement is to be taken as that representing more than 2cm in mean draught as calculated.

5.7.1.10 The ship will be considered as meeting all intact stability and damage stability criteria only if the calculated vertical centre of gravity KG (fluid) is less than the maximum permissible vertical centre of gravity or if the calculated metacentric height GM (fluid) is greater than the minimum permissible GM.

5.7.1.11 Where the calculated vertical centre of gravity is found to be higher than the maximum permissible vertical centre of gravity, or the calculated metacentric height found to be lower than the minimum permissible GM, the ship should not be permitted to leave until adjustments to the pattern of loading result in the lowering of the actual vertical centre of gravity sufficiently to ensure compliance with the curves of maximum permissible KG or minimum permissible GM as appropriate.

5.7.1.12 When examining the Stability Information Book to ensure that it contains sufficient sample conditions of loading to cover the expected range of actual loading conditions, the surveyor should be satisfied that the sample conditions of loading are practical conditions based on the ship's pattern of loading, refuelling, taking of fresh water and ballasting, and not merely a combination of the components of deadweight taken over a range of small increments of draught up to the maximum subdivision draught.

## **5.8 Hydrofoils**

Hydrofoils should be considered in the waterborne condition for subdivision, intact stability and damage stability and in addition, the stability should be investigated in the foil-borne condition.

## **5.9 Increase in Draught or Structural Alterations**

When an increase in draught is required, the owner should submit, after revision, any information outlined in paragraph 2.2 of these Instructions which is affected by such an increase, together with a modified worst service condition. The MCA will then examine the subdivision arrangements and determine which of the damage stability cases, if any, are required to be recalculated before such an increase can be granted. Depending on the circumstances of the case, the MCA may require an inclining experiment to be carried out on the ship, but in all cases the Stability Information Books are required to be modified. The above may also apply when structural alterations are to be undertaken and details of such alterations should be submitted for consideration.

## 5.10 Draught Marks (Regulation 35)

On every subdivided ship a scale of draught marks in accordance with paragraph 6 of Schedule 3 to the Merchant Shipping Registration of Ships Regulations 1993 shall be marked clearly at the bow and stern of the ship.

## 5.11 Subdivision Load Lines (Regulation 36)

### 5.11.1 C marks

For ships of Classes III to VI(A), the notation C should be used when only one subdivision load line is assigned and marked on the ship. When more than one subdivision load line is assigned to the ship, the notation C<sub>A</sub> should be used for marking the deepest subdivision load line, and the notations C<sub>B</sub>, C<sub>C</sub>, etc. for the alternative conditions of service.

### 5.11.2 Load line marks

5.11.2.1 Ships which are assigned freeboards and are required to be marked with load lines under the Merchant Shipping (Load Lines) Regulations 1998 are to be marked as follows:-

- (i) Where the lowest of the ordinary load lines is higher on the ship's side than the deepest subdivision load line, the latter shall form part of the same marking, the vertical line of the grid being extended downwards as necessary to reach the lowest subdivision load line. The subdivision load line or lines shall appear on the after side of the vertical line or grid.
- (ii) Where the deepest subdivision load line coincides or nearly coincides with the Fresh Water line, the subdivision marking C or C<sub>A</sub> may be indicated on the forward side of the grid.
- (iii) Where an "all seasons" freeboard is assigned and the deepest subdivision load line coincides with the horizontal line intersecting the load line mark a vertical line shall be marked extending downwards from the Fresh Water load line to reach the subdivision load line C or C<sub>A</sub> on the after side of the vertical line.

(See figures 5.1.1 to 5.1.5 inclusive).

### 5.11.3 Position of subdivision load line

5.11.3.1 The freeboard corresponding to each approved subdivision load line should be measured at the same position, and from the same deck line, as the freeboard determined by the Load Line Regulations.

5.11.3.2 In no case may any subdivision load line be assigned and marked on the ship's sides above the deepest load line in salt water determined by Load Line Rules.

5.11.3.3 In no case may a ship be so loaded that, when in salt water, the subdivision load line mark appropriate to the condition of service is submerged.

5.11.3.4 Whatever may be the position of the subdivision load line marks, the ship must in no case be loaded so as to submerge the load line mark, appropriate to the season and area of operation, determined by the Load Line Rules.

#### 5.11.4 Inspection

5.11.4.1 Before issuing the declaration, the surveyor should inspect the subdivision load line marks on the ship's sides, and be satisfied that they comply with the requirements of the Regulations and the foregoing instructions, and that the positions of the marks to which the ship may load, when carrying passengers, correspond with the approved subdivision draughts.

5.11.4.2 Where the surveyor finds that the moulded depth of the ship is greater than the figure shown on the approved plans, the subdivision load line is to be marked corresponding to the approved subdivision draught. Where the moulded depth is less than the figure on the approved plans, the subdivision load line is to be marked corresponding to the approved subdivision draught, less the amount by which the figures differ. Where the moulded depth is different on opposite sides of the ship, the deck line should be lowered on the higher side to correspond with the deck line on the lower side.

5.11.4.3 In no case should the subdivision load lines be marked in different positions on opposite sides of the ship, or at a higher position than that corresponding to the approved subdivision draught.

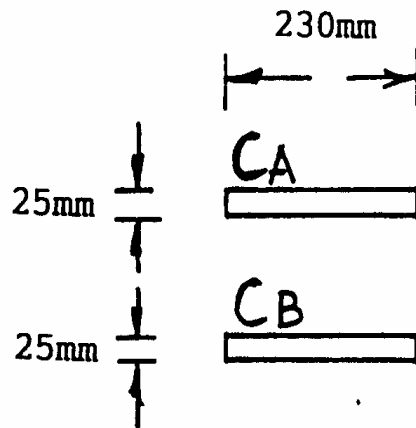


Figure 5.1.1 To illustrate paragraph 5.11.1

Ships which are subdivided but not required to be assigned a freeboard under the Merchant Shipping (Load Lines) Regulations 1998

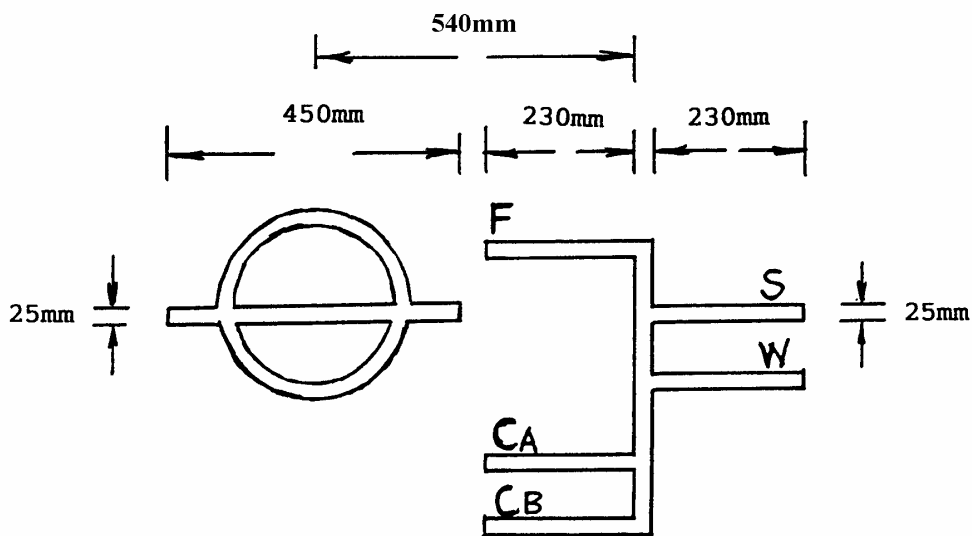
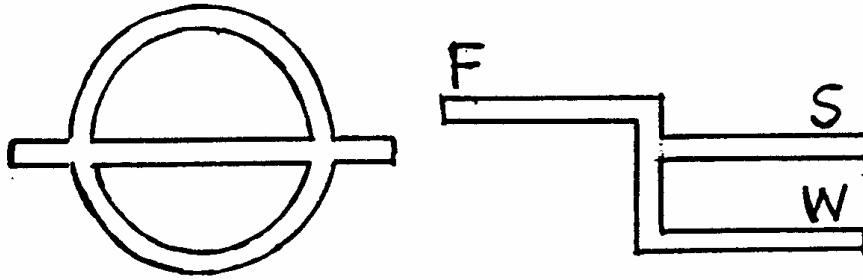


Figure 5.1.2 To illustrate Paragraph 5.11.2.1 (I)

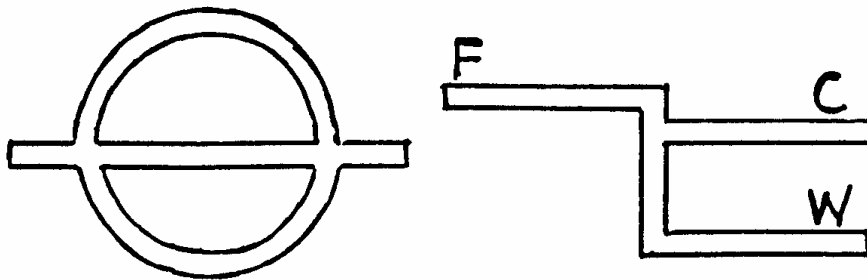
Ships assigned freeboards under the Merchant Shipping (Load Lines) Regulations 1998 where the lowest of the ordinary load lines is higher than the deepest subdivision load line

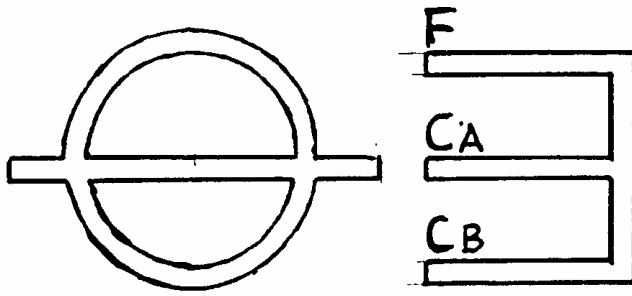


**Figure 5.1.3 To illustrate paragraph 5.11.2.1 (ii)**

Ships assigned freeboards under the Merchant Shipping (Load Lines) Regulations 1998 where the deepest subdivision load line nearly coincides with the Fresh Water line making the subdivision load line too close to the Fresh Water line to insert the C mark.

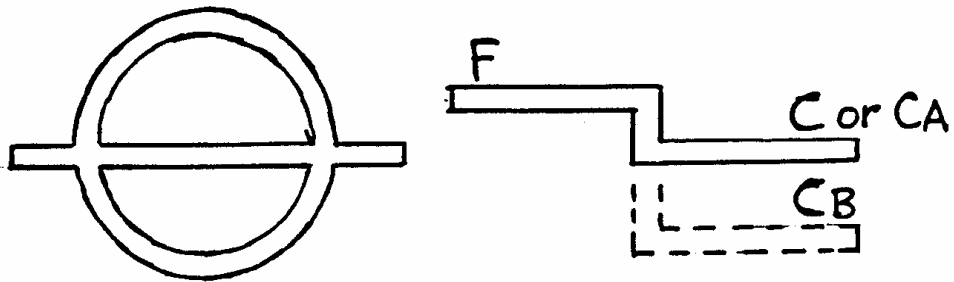
In such a case the Summer line may be omitted and the subdivision load line marked on the forward side of the grid as shown below





**Figure 5.1.4 To illustrate paragraph 5.11.2.1 (iii)**

Ships assigned an “all seasons” freeboard under the Merchant Shipping (Load Lines) Regulations 1998 where the deepest subdivision load line coincides with a horizontal line intersecting the load line mark



**Figure 5.1.5 To illustrate paragraphs 5.11.2.1 (ii) and 5.11.2.1 (iii)**

Ships assigned as “all seasons” freeboard and where the subdivision load line nearly coincides with the Fresh Water line

## 5.12 Freeboard Markings (Regulation 37)

Ships which are not required to be subdivided are to be marked on each side at amidships with a horizontal line as shown in figure 5.2.

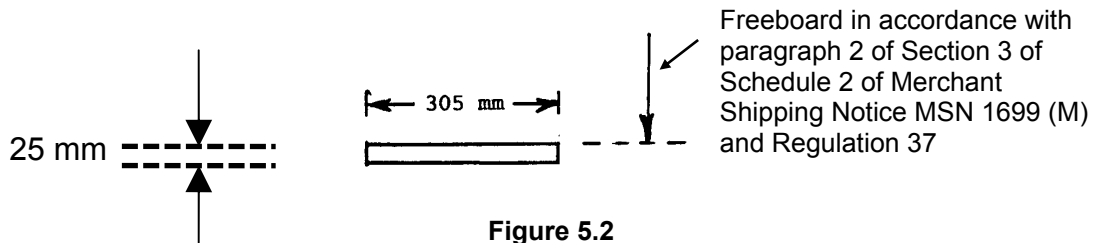


Figure 5.2

## 5.13 Damage Control Plans and Booklets (Regulation 38)

5.13.1.1 The damage control plan should be simple and free from unnecessary detail and lettering. It should show an elevation of the ship and plan views of the double bottom, decks and flats below, and including the bulkhead deck and any other deck from which fittings affecting the integrity of the subdivision arrangements may be operated. The watertight subdivision bulkheads and decks should be clearly indicated and the plan should also show the position of any opening or fitting which may affect the integrity of the subdivision arrangements, and the position from which they may be closed. The location of any cross-flooding fittings should also be shown. Wherever possible clear symbols to the surveyor's satisfaction should be used and details of the openings or fittings, the means of closing them and the position of operating such means given in tabular form.

5.13.1.2 The MCA may permit the plan to be dispensed with if the information is limited.

5.13.1.3 The damage control booklet should contain similar information and, in addition, the extent of damage assumed in the damage stability calculations, details of the worst anticipated service conditions upon which the calculations have been based, a summary of the final conditions of the cases of damage covered or curves of minimum GM or maximum KG permitted over the range of operating draughts and trims, and instructions to the Master on any action to be taken in the event of the ship sustaining damage. It is not considered necessary to supply any other details of the damage stability calculations.

5.13.1.4 The booklet may be dispensed with if the information is limited, and can be readily incorporated in the stability information booklet.